Scheme & Syllabus

Of

B.Tech. in Civil Engineering

CREDIT BASED CURRICULUM
(2018 - 2022)

DEPARTMENT OF ENVIRONMENTAL SCIENCE & ENGG.

Guru Jambheshwar University of Science & Technology

Hisar

Department of Civil Engg.

Vision: Pursuance for excellence to achieve sustainable development

Mission: To impact training for capacity to tackle various environmental challenges in eco Friendly manner**.**

Programme Educational Objectives (PEO)

1. Develop a professional to pursue career as a Civil Engineer with adequate technical knowledge and skills while using modern tools for problem solving and exhibiting qualities of communication, team membership, and leadership.
2. Develop ability to practice ethically focusing on social relevance, environmental sustainability, optimal solutions and safety of stakeholders.
3. Develop abilities of lifelong learning to continuously strive to enhance decision making abilities to investigate, design and develop complex facilities.

Programme Outcomes (PO)

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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

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

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

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSO)

1. Able to analyze various Civil Engineering structures and systems by using basic and advanced technologies.
2. Able to design civil engineering facilities and their elements and also use of modern software tools for the same.
3. Able to plan, monitor and supervise construction activities to complete civil engineering facilities satisfactorily.
4. Able to practice as construction professional through ethical practice while focusing on sustainability and economy.

SEMESTER-3								
Category	**Course Code**	**Course Name**	**Teaching Schedule**			**Hours/ Week**	**Credits**	**Duration of Exam (Hrs)**
			L	**T**	**P**			
BS	BSC 201-T	Mathematics –III	3	0	0	3	3	3
ESC	ESC-202-T	Engg. Mechanics	3	0	0	3	3	3
HSMC	HSMC -CVE201-T	Introduction to Civil engg.	3	0	0	3	3	3
PCC	PCC-CVE201-T	Surveying –I	3	0	0	3	3	3
PCC	PCC-CVE203-T	Engg. Geology	3	0	0	3	3	3
PCC	PCC-CVE205-T	Disaster Preparedness & Planning	2	0	0	2	2	3
PCC	PCC-CVE201-P	Surveying –I Lab	0	0	2	2	1	3
PCC	PCC-CVE203-P	Engg. Geology Lab	0	0	2	2	1	3
MC	MC 102-T	Environmental Science	3	0	0	3	0	3
	TOTAL							19

MC-Mandatory Course, which will be a non-credit subject and the student has to get pass marks in order to qualify for the award of degree

SEMESTER-4								
Category	**Course Code**	**Course Name**	**Teaching Schedule**			**Hours/ Week**	**Credits**	**Duration of Exam (Hrs)**
			L	**T**	**P**			
HSMC	HSMC-CVE202-T	Civil Engg- Societal & Global Impact	2	0	0	2	2	3
PCC	PCC-CVE202-T	Introduction to Fluid Mechanics	3	0	0	3	3	3
PCC	PCC-CVE204-T	Structural Analysis –I	3	0	0	3	3	3
PCC	PCC-CVE206-T	Engg Building and Drawing	3	0	0	3	3	3
PCC	PCC-CVE208-T	Environmental Engg.	3	0	0	3	3	3
PCC	PCC-CVE202-P	Introduction to Fluid Mechanics Lab	0	0	2	2	1	3
PCC	PCC-CVE204-P	Structural Analysis –I Lab	0	0	2	2	1	3
PCC	PCC-CVE206-P	Engg Building and Drawing Lab	0	0	2	2	1	3
PCC	PCC-CVE208-P	Environmental Engg. Lab	0	0	2	2	1	3
	TOTAL						18	

Note: The students will have to undergo survey camp within 4 weeks duration during summer vacations which will be evaluated in 5th sem.

SEMESTER-5								
Category	**Course Code**	**Course Name**	**Teaching Schedule**			**Hours/ Week**	**Credits**	**Duration of Exam (Hrs)**
			L	**T**	**P**			
PCC	PCC-CVE301-T	Advanced Fluid mechanics	3	0	0	3	3	3
PCC	PCC-CVE303-T	Structural Analysis-II	3	0	0	3	3	3
PCC	PCC-CVE-305-T	Surveying –II	3	0	0	3	3	3
PCC	PCC-CVE307- T	Design of Concrete	3	0	0	3	3	3

		structures-I						
PCC	PCC-CVE301-P	Advanced Fluid mechanics Lab	0	0	2	2	1	3
PCC	PCC-CVE303-P	Structural Analysis-II	0	0	2	2	1	3
PCC	PCC-CVE305-P	Surveying –II Lab	0	0	2	2	1	3
PCC	PCC-CVE307- P	Design of Concrete structures-I	0	0	2	2	1	3
OE	OEC-I	Open elective -I	3	0	0	3	3	3
HSMC	HSMC 301-T	Economics for Engineers	2	0	0	2	2	3
INT	INT-CVE-301-P	Survey Camp	0	0	0	0	1	3
MC	MC 104-T	Essence of Indian Traditional Knowledge	3	0	0	3	0	3
	TOTAL						22	

NOTE: Assessment of survey camp will be based on presentation/seminar, viva-voce, report and field work at the end of 4th sem.

OEC-I is to be offered by other Departments.

SEMESTER-6

Category	Course Code	Course Name	Teaching Schedule			Hours/ Week	Credits	Duration of Exam (Hrs)
			L	T	P			
PCC	PCC-CVE302-T	Transportation Engg.-I	3	0	0	3	3	3
PCC	PCC-CVE304-T	Sewerage and Sewage Treatment	2	0	0	2	2	3
PCC	PCC-CVE306-T	Soil Mechanics	3	0	0	3	3	3
PCC	PCC-CVE308-T	Design of Steel Structures-I	3	0	0	3	3	3
PCC	PCC-CVE302-P	Transportation Engg.-I Lab	0	0	2	2	1	3
PCC	PCC-CVE304-P	Sewerage and Sewage Treatment Lab	0	0	2	2	1	3
PCC	PCC-CVE306-P	Soil Mechanics lab	0	0	2	2	1	3
PE	PEC-I	Program Elective -I	3	0	0	3	3	3
OE	OEC-II	Open elective -II	3	0	0	3	3	3
HSMC	HSMC –302-T	Fundamentals of management for Engineers	2	0	0	2	2	3
	TOTAL						22	

Note: At the end of 6th sem, each student will undergo 4 to 6 weeks Internship/Practical Training -II in an industry/Research Institute.

OEC-II is to be offered by other Departments.

SEMESTER-7

Category	Course Code	Course Name	Teaching Schedule			Hours/ Week	Credits	Duration of Exam (Hrs)
			L	T	P			
PCC	PCC-CVE401-T	Estimation, Costing and Valuation	3	0	0	3	3	3
PCC	PCC-CVE403-T	Transportation Engg.-II	3	0	0	3	3	3

PCC	PCC-CVE405-T	Foundation engineering	3	0	0	3	3	3
PE	PEC-II	Program Elective -II	3	0	0	3	3	3
PE	PEC-III	Program Elective -III	3	0	0	3	3	3
OE	OEC-III	Open elective -III	3	0	0	3	3	3
PROJ*	PROJ-CVE401-P	PROJECT -I	0	0	8	8	4	3
INT**	INT-CVE-401-P	Industrial Training-II	0	0	2	2	1	3
		TOTAL					23	3

NOTE:

*** The project should be initiated by the student in the beginning of 7th sem and will be evaluated at the end of the semester on the basis of a presentation delivered, viva-voce and report by external examiner**

****Assessment of Industrial Training-II will be based on presentation/seminar, viva-voce, report and certificate for the practical training taken at the end of 4th sem.**

***** A viva of the students will be taken by external examiner (Principal/Director/Professor/or any senior Person with Experience more than 10 years) at the end of the semester.**

OEC-III is to be offered by other Departments

SEMESTER-8

Category	Course Code	Course Name	Teaching Schedule			Hours/ Week	Credits	Duration of Exam (Hrs)
			L	T	P			
PCC	PCC-CVE402-T	Construction Engg. & Management	3	0	0	3	3	3
PCC	PCC-CVE404-T	Hydrology and Water Resources	3	0	0	3	3	3
PE	PEC-IV	Program Elective -IV	3	0	0	3	3	3
PE	PEC-V	Program Elective -V	3	0	0	3	3	3
PROJ*	PROJ-CVE402-P	PROJECT-II	0	0	10	10	5	3
PROJ	PROJ-CVE404-P	SEMINAR	0	0	2	2	1	3
	TOTAL						18	

NOTE: * The project should be initiated by the student in continuation of the 7th sem and will be evaluated at the end of the 8th semester on the basis of its implementation (software/hardware), presentation delivered, viva-voce and report by external examiner and chairperson

Program Elective-I	
1.Air & Noise Pollution Control	PEC-CVE350-T
2.Solid and Hazardous Waste Management	PEC-CVE351-T
3. Environmental Impact Assessment and Life Cycle Analyses	PEC-CVE352-T
. 4. Water and Air Quality Modelling	PEC-CVE353-T
Any one MOOC Course-Not Studied(to be studied) till now of 3 credits	
Program Elective-II	
1. Pavement Design	PEC-CVE450-T
2. Geometric Design of Highways	PEC-CVE451-T
3. Traffic Engg. & Management	PEC-CVE452-T
Any one MOOC Course-Not Studied(to be studied) till now of 3 credits	
Program Elective-III	
1. Construction Management	PEC-CVE453-T
2. Advanced Construction Materials	PEC-CVE454-T

3. Advanced Construction Techniques	PEC-CVE455-T
Any one MOOC Course-Not Studied(to be studied) till now of 3 credits	
Program Elective-IV	
1. Design of Concrete Structures-II	PEC-CVE456-T
2. Design of Steel Structures -II	PEC-CVE457-T
3. Advanced Structural Analysis	PEC-CVE458-T
4. Bridge Engineering	PEC-CVE459-T
Any one MOOC Course-Not Studied(to be studied) till now of 3 credits	
Program Elective-V	
1. Irrigation & Design of Hydraulic Structures	PEC-CVE460-T
2. Open Channel Flow	PEC-CVE461-T
3. Groundwater Engg	PEC-CVE462-T
Any one MOOC Course-Not Studied(to be studied) till now of 3 credits	

Engineering Mechanics

General Course Information

Course Code ESC-ME201-T Course Credits: 3 Mode: Lecture (L) Type: ESC Contact Hours: 3 hours (L) Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcomes	RBT Level
CO1	Students will be able to describe scalar and vector techniques for analyzing forces in statically determinate structures.	L1
CO2	Students will be able to locate centroid, centre of gravity of different types of symmetrical and unsymmetrical sections.	L2
CO3	Students will be able to apply Newton's laws of Motions to solve real-world problems.	L3
CO4	Students will be able to examine the physical significance of moment of inertia e.g in railway, flyovers, Bridges, automobiles etc.	L4

Course Contents

UNIT-I

Review of Basic Force System: Laws of mechanics, Vector algebra review, Moment of a force about a point and axis, Couple and couple moment, Addition and subtraction of couples, Moment of a couple about a line, Resultant of a force system. Problems

Equilibrium of forces: Introduction, Lami's theorem, Methods for the equilibrium of coplanar forces, Analytical method for the equilibrium of coplanar forces, free body diagram, general equations of equilibrium, Tension in a string, Problems

UNIT-II

Truss and Frames: Types of frames, Types of stresses in frames (Tensile and compressive), Assumptions for forces in the members of a perfect frame, Analytical methods for the forces, Method of joints, Method of sections (or Method of moments), simply supported trusses, Problems

Centroid and centre of gravity: Definition, Centroid of regular shapes, Symmetrical sections, Unsymmetrical sections, Reference axis, Centre of gravity of solid bodies, Centroid and centre of gravity of hollow sections. Problems

UNIT-III

Moment of Inertia: Introduction and significance, Parallel axis theorem, Perpendicular axis theorem, Mass moment of inertia, Area moment of inertia of regular shapes: L-sections, T-sections, I-sections, Moment of inertia of unsymmetrical sections, hollow sections, Product of inertia, Properties of product of inertia, Principal axis. Problems

Particle dynamics- Rectilinear motion, Plane curvilinear motion (rectangular, path and polar coordinates), Newton's 2nd law (rectangular, path and polar coordinates), Work- kinetic energy, power, potential energy, Impulse-momentum (linear, angular), Impact (Direct and oblique). Problems

UNIT-IV

Virtual work: Introduction, Concept and principle of virtual work, Virtual displacements, Sign conventions, Applications of principle of virtual work on beams carrying point load, uniformly distributed load, Applications of virtual work on ladders. Problems

Friction: Introduction, Types of friction, Laws of friction, Equilibrium of a body on a rough horizontal plane and inclined plane, Equilibrium of a body on a rough inclined plane subjected to a force acting along the inclined plane, Equilibrium of a body on a rough inclined plane subjected to a force acting horizontally. Problems

Text and Reference Books

1. Irving H. Shames, Engineering Mechanics, 4th Edition, Prentice Hall
2. R.C. Hibbler (2017), Engineering Mechanics: Statics and Dynamics, Pearson Press.
3. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education
4. Reddy Vijaykumar K. and K. Suresh Kumar (2010), Singer's Engineering Mechanics
5. Bansal R.K.(2015), A Text Book of Engineering Mechanics, Revised eighth edition, Laxmi Publications
6. Khurmi R.S., Engineering Mechanics, 20th revised edition, S. Chand & Co.
7. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	2	1	1	1	1	1	3
CO2	3	3	2	2	2	1	1	1	1	2	1	3
CO3	3	3	3	2	1	2	1	1	1	2	1	3
CO4	3	3	3	3	2	3	2	2	2	1	2	3
CO5	3	3	2	1	1	2	1	1	1	1	1	3

Introduction to Civil Engg.

Sem-III

General Course Information:

Course Code: HSMC-CVE201-T Course Credits: 3 Mode: Lecture (L) Type: HSMC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Introduction to what constitutes Civil Engineering	L1(Remembering)
CO2.	Identifying the various areas available to pursue and specialize within the overall field of Civil Engineering	L2(Understanding)
CO3.	Analyzing various possibilities of a career in this field	L4(Analyzing)
CO4.	Evaluate the depth of engagement possible within each of these areas	L5(Evaluating)

Course Contents

UNIT – I

Construction materials

Stones -Characteristics of good building stones-common building stones and their uses

Bricks-Characteristics of good bricks-classification of bricks and their uses-

Timber-Classification of Timber and their uses-Cement-Types of cement and their uses

Components of building

Components of sub structure and their functions-Components of super structure and their functions -Types of forces – compression, tension, shear – Stress – Strain-Concrete- Ingredients of concrete and its importance in construction - Steel- Types of steel and its importance in construction

UNIT – II

Survey and Highway Engineering

Definition and classification of surveying – linear and angular measurements - levelling

Modes of transportation – Classification of highways - Classification of pavements – Super elevation.

UNIT – III

Irrigation and Water supply

Definition and classification of irrigation – Irrigation structures – dams, weirs, cross drainage works, canal drops- Quality of water-Treatment methods

UNIT – IV

Geotechnical Engineering

Origin of soil – types of soil – bearing capacity of soil – Types of foundation – shallow and deep

REFERENCES

1. B C Punmia, Ashok K Jain, Arun K Jain, (1st Edition, 2003), "Basic Civil Engineering", Laxmi Publications (P) Ltd.

2. G K Hiraskar, (1st Edition, 2004), "Basic Civil Engineering", Dhanpat Rai Publication.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	--	-	2	1	-	-	-	-	-	1	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	2	1	-
CO3	-	3	2	1	-	-	-	-	-	-	1	-	3	2	1
CO4	-	-	2	-		2	1	-	-	-	--	1	-	-	3

Surveying-I
Sem-III

General Course Information:

Course Code: PCC-CVE201-T Course Credits: 3 Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Calculate angles, distances and levels	**L1(Remembering)**
CO2	Identify data collection methods and prepare field notes	**L2(Understanding)**
CO3	Demonstrate the working principles of survey instruments	**L3(Applying)**
CO4	Estimate measurement errors and apply corrections	**L5(Evaluating)**
CO5	Interpret survey data and plot topographical maps	**L6(Creating)**

Course Contents

Unit-I

Fundamental Principles of Surveying: Definition, objects, classification, fundamental principles, methods of fixing stations.

Measurement of distances: Direct measurement, instruments for measuring distance, instruments for making stations, chaining of line, errors in chaining, tape corrections examples.

Compass and Chain Traversing: Methods of traversing, instruments for measurement of angles-prismatic and surveyor's compass, bearing of lines, local attraction, examples.

Unit-II

Leveling: Definition of terms used in leveling, types of levels and staff, temporary adjustment of levels, principles of leveling, reduction of levels, booking of staff readings, examples, contouring, characteristics of contours lines, locating contours, interpolation of contours.

Plane Table Surveying: Plane table, methods of plane table surveying, radiation, intersection, traversing and resection, two point and three point problems.

Unit-III

Theodolite and Theodolite Traversing: Theodolites, temporary adjustment of theodolite, measurement of angles, repetition and reiteration method, traverse surveying with theodolite, checks in traversing, adjustment of closed traverse, examples.

Tacheometry: Uses of tacheometry, principle of tacheometric surveying, instruments used in tacheometry, systems of tacheometric surveying-stadia system fixed hair method, determination of tacheometric constants, tangential systems, examples.

Unit-IV

Curves: Classification of curves, elements of simple circular curve, location of tangent points-chain and tape methods, instrumental methods, examples of simple curves. Transition Curves-Length and types of transition curves, length of combined curve, examples.

Vertical Curves: Necessity and types of vertical curves.

REFERENCE BOOKS

1. Surveying Vol.I & II by B.C.Punmia
2. Surveying by C. Venkatramaiah
3. Surveying Vol.I by T.P.Kanitkar
4. Fundamentals of Surveying by S. K. Roy
5. Surveying and levelling by R. Subramaniam
6. Chandra A. M., Higher Surveying, New Age International Publishers, 2007.
7. Chandra A. M., Plane Surveying, New Age International Publ., 2007.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	2	-	--	--	--	-	--	--	-	-	1	-	-
CO2	-	3	-	1	-	-	-	-	-	-	1	-	2	1	-
CO3	-	3	-	-	-	-	-	-	-	-	1	-	2	1	3
CO4	-	3	-	-	-	-	-	-	-	-	1	-	-	1	3
CO5	-	3	-	-	-	-	-	3	-	-	-	1	-	1	3

Engineering Geology

Sem-III

General Course Information:

Course Code: PCC-CVE203-T Course Credits: 3 Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Describe weathering process and mass movement of rocks to soil	L1(Remembering)
CO2	Distinguish geological formations	L2(Understanding)
CO3	Identify geological structures and processes for rock mass quality	L3(Applying)
CO4	Identify subsurface information and groundwater potential sites through geophysical investigations	L5(Evaluating)
CO5	Apply geological principles for mitigation of natural hazards and select sites for dams and tunnels	L6(Creating)

Course Contents

Unit-I

General Geology: Branches and scope of geology, Importance of geology in Civil engineering. Earth-surface features and internal structure, weathering of rocks.

Mineralogy: Definition of a crystal and mineral, physical properties in mineral identification, rock forming minerals and their identification – quartz and its varieties, feldspar, hornblende, olivine, mica, garnet, kyanite, calcite, talc, bauxite, corundum, gypsum, fluorite, apatite, beryl, barite, asbestos, magnetite, hematite.

UNIT-II

Petrology: Formation and classification of rocks – Igneous, Sedimentary and metamorphic rocks, their texture and structures, properties of granite, pegmatite, dolerite, gabbro, charnockite, basalt, sandstone, conglomerate, breccia, limestone, shale, laterite, schist, gneiss, quartzite, marble, khondalite and slate. Drilling Techniques, Core Recovery, RQD, Engineering Properties of Rocks

Structural Geology: Outcrop, Strike and dip, types and classifications of folds, faults, joints, unconformities.

Engineering properties of rocks: Drilling, Core recovery, RQD, Sample preparation, tests on rock samples - compression, tensile, shear and slake durability tests.

UNIT-III

Ground Water: Water tables, aquifers, occurrence of ground water in different geological formations, springs, selection of a site for well sinking and ground water investigations.

Earthquakes and Landslides: Causes and effects of earthquakes and landslides, Remedial measures to prevent damage for engineering structures.

Subsurface Investigations: Soil Profile, Geophysical methods – Electrical Resistivity and Seismic refraction methods.

UNIT-IV

Dams: Types of dams, Requirements of dam sites, preliminary and detailed geological investigations for a dam site. Case histories of dam failures and their causes. Geology of the major dam sites of India. Factors affecting the seepage and leakage of reservoir and the remedial measures.

Tunnels: Purpose of tunneling, geological considerations for tunneling, geothermal step, over break, stand up time, and logging of tunnels.

REFERENCE BOOKS :

1. Parbin Singh., "Engineering and General Geology", Katson Publishers, 2009
2. David George Price, "Engineering Geology: Principles and Practice", Springer, 2009.
3. Chennakesavulu, N., "Text book of Engineering Geology", Mac Millan Ltd., New Delhi, 2009.
4.. K.V.G.K. Gokhale, "Principles of Engineering Geology", BS Publications, Hyderabad, 2005.

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	3	1	-	-	-	-	-	-	-	-	1	-	-
CO2	2	3	3	2	-	-	-	1	-	-	2	2	1	-	2
CO3	2	3	3	3	-	-	2	1	-	-	2	2	2	1	-
CO4	-	2	2	2	-	-	1	2	-	-	2	2	2	1	-
CO5	3	-	2	3	-	-	-	2	-	-	2	3	-	2	3

Disaster Preparedness & Planning

Sem-III

General Course Information:

Course Code: PCC-CVE205-T Course Credits: 2 Mode: Lecture (L) Type: PCC Contact Hours: 2 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Ability to understand Categories of Disasters	L2(Understanding)
CO2	Realization of the responsibilities to society	L3(Applying)
CO3	Analyzing Relationship between Development and Disasters	L4(Analyzing)
CO4	The application of Disaster Concepts to Management	L5(Creating)

Course Contents

Unit I

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

Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); man-made disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Unit II

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 and urban disasters.

Unit III

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 Management Authority.

Unit IV

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 development methods.

REFERENCE BOOKS

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
3. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
4. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation
5. . Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California,EMSA no.214, June 2003

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	-	-	1	-	-	-	1	2	1	-
CO2	-	-	-	-	-	3	-	2	-	-	-	1	1	-	2
CO3	-	-	-	1	-	3	3	2	2	-	-	1	2	-	
CO4	-	-	-	-	-	-	-	-	-	1	3	2	1	2	3

Surveying-I Lab

Sem-III

General Course Information:

Course Code: PCC-CVE201-P Course Credits: 1 Mode: Practical (P) Type: PCC Contact Hours: 2 hours Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of practical attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Calculate angles, distances and levels	L1(Remembering)
CO2	Identify data collection methods and prepare field notes	L2(Understanding)
CO3	Estimate measurement errors and apply corrections	L5(Evaluating)
CO4	Interpret survey data and plot topographical maps	L6(Creating)

LIST OF EXPERIMENTS:

1 Chain surveying: Chaining and chain traversing.

2 Compass traversing.

3 Plane table Survey methods of plane table surveying, two point problem.

4 Plane table Survey methods of plane table surveying three point problem.

5 Leveling: Profile leveling

6 Levelling : longitudinal section and cross sections levelling

7. Reciprocal leveling.

8. Permanent adjustment of level.

9. Contouring and preparation contour map.

10. Use of Tangent Clinometers

REFERENCE BOOKS

1. B.C. Punmia, Ashok Kumar Jain, Ashok Kr. Jain, Arun Kr. Jain., Surveying I & II, Laxmi Publications, 2005.

2. . Chandra A. M., Plane Surveying, New Age International Publ., 2007.

3. Charles D Ghilani, Paul R Wolf., Elementary Surveying, Prentice Hall, 2012.

4. Surveying Vol.I & II , B.C.Punmia

5. Surveying by C. Venkatramaiah

6. Surveying Vol.I by T.P.Kanitkar

7. Fundamentals of Surveying by S. K. Roy

8. Surveying and levelling by R. Subramaniam

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	-	-	-	-	-	-	1	1	-	1	3
CO2	3	3	2	2	-	-	-	-	2	-	1	1	-	2	3
CO3	2	1	1	-	-	-	-	-	-	-	1	1	1	2	2
CO4	2	1	3	-	-	-	-	-	2	-	1	1	1	2	3

Engineering Geology Lab

Sem-III

General Course Information:

Course Code: PCC-CVE203-P Course Credits: 1 Mode: Practical (P) Type: PCC Contact Hours: 2 hours (P) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of practical attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Describe different types of ores and minerals	L2(Understanding)
CO2	Distinguish geological formations	L2(Understanding)
CO3	Identify geological structures and processes for rock mass quality	L3(Applying)
CO4	Identify subsurface information and groundwater potential sites through geophysical investigations	L5(Evaluating)

LIST OF EXPERIMENTS:

1. Introduction to Crystallography – Identification of Crystals.
2. Introduction of minerals and the study of Physical properties, Identification of Quartz and feldspars.
3. Identification of pyroxenes and Amphiboles and other silicates.
4. Identification of important economic minerals.
5. Identification of important ore deposits.
6. Identification of Igneous rocks.
7. Identification of Sedimentary rocks.
8. Identification of metamorphic rocks.
9. Structural geology- strike and dip, three and 3-point problems point problems.

REFERENCE BOOKS

1. Chennakesavulu, N., “Text book of Engineering Geology”, MacMillan Ltd., New Delhi, 2009.
2. Structural Geology Manual.
3. . Parbin Singh., “Engineering and General Geology”, Katson Publishers, 2009
4. David George Price, “Engineering Geology: Principles and Practice”, Springer, 2009.
5. . Chennakesavulu, N., “Text book of Engineering Geology”, Mac Millan Ltd., New Delhi, 2009.
6. K.V.G.K. Gokhale, “Principles of Engineering Geology”, BS Publications, Hyderabad, 2005.

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	3	3	-	-	-	1	1	-	2	-	1	-	-
CO2	2	3	2	2	-	-	-	2	1	-	2	-	1	2	-
CO3	1	3	2	2	-	-	-	1	1	-	2	-	1	-	3
CO4	-	2	3	3	-	-	-	1	1	-	2	-	1	-	-

Civil Engg-Societal & Global Impact

Sem-IV

General Course Information:

Course Code: HSMC-CVE202-T Course Credits: 2 Mode: Lecture (L) Type: HSMC Contact Hours: 2 hours Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Srl.	Course Outcome At the end of the course, students will be able to:	RBT* Level
CO1	Recall aspects of the built environment and factors impacting the quality of life	L1(Remembering)
CO2	Understand the impact that Civil Engineering projects have on the society at large and on the global arena; and use resources efficiently and effectively.	L2 (Understanding)
CO3	Apply professional and responsible judgement and take a leadership role	L3(Applying)
CO4	Examine the potential of Civil Engineering for employment creation and its contribution to the GDP	L4(Analysis)
CO5	Value the sustainability of the environment, including its aesthetics	L5(Evaluating)
CO6	Formulate energy requirement with the extent of infrastructure and analyze how they are met, comparing the past present and future.	L6(Creating)

Course Contents

Unit I

Introduction to Course and Overview; Understanding the past to look into the future: Preindustrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis;Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering

Unit II

Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling);

Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability;

Unit III

Environment-Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and non-stationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability.

Built environment–Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring Sustainability

Unit IV

Civil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to employment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development;

REFERENCE BOOKS

1. Žiga Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht

2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition

3. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.

4. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.

5. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options

6. http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx

7. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014

8. Barry M. (2003) Corporate social responsibility – unworkable paradox or sustainable Paradigm Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. p 129-130

9. Blackmore J M., Plant R A J. (2008). Risk and resilience to enhance sustainability with application to urban water systems. J. Water Resources Planning and Management. ASCE. Vol. 134, No. 3, May.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	2	1	1	3	2	2	2	2	1	1	2	2	1
CO2	-	1	2	1	-	3	1	1	-	-	-	-	1	-	2
CO3	-	-	1	1	-	1	1	2	3	2	3	2	1	1	1
CO4	-	1	1	2	-	3	1	1	-	1	1	1	1	1	1
CO5	-	1	1	-	-	1	3	2	-	1	-	1	-	-	-
CO6	2	2	1	2	1	1	1	-	-	1	1	1	2	1	1

Introduction to Fluid Mechanics

Sem-IV

General Course Information:

Course Code: PCC-CVE202-T Course Credits: 3 Mode: Lecture (L) Type: PCC Contact Hours: 3 hours(L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes

Srl.	Course Outcome At the end of the course, students will be able to:	RBT* Level
CO1	Outline principles of hydrostatics and explain the concept of buoyancy and state of equilibrium	L1(Remembering)
CO2	Understand the properties of fluids and their behaviour under static and dynamic conditions and measure fluid pressure in a manometer	L2 (Understanding)
CO3	Use fluid measuring devices like venture meter, orifice meter, notches and mouthpiece	L3 (Applying)
CO4	Distinguish various types of flows and solve the problem on continuity equation, stream function and velocity potential function	L4(Analysing)
CO5	Evaluate Bernoulli's equation and use it to solve the problems of fluids	L5(Evaluating)
CO6	Formulate one-, two- and three-dimensional continuity equations in Cartesian coordinates	L6(Creating)

Course Content

Unit I

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.

Unit II

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

Unit III

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

Unit IV

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 - Definitionsof Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem.

REFERENCE BOOKS

1. Fluid Mechanics and Hydraulic Machines , Mahesh Kumar, Pearson Education, 2019
2. Fluid Mechanics and Hydraulic Machine by R. K. Bansal
3. Fluid mechanics and Fluid Power Engg. by D.S. Kumar
4. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010
5. Hydraulics and Fluid Mechanics, P N Modi and S M Seth, Standard Book House
6. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
7. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J.

C**ourse Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	-	-	-	-	1	1	2	1	1	1	1
CO2	2	1	1	2	2	-	-	-	-	-	1	-	2	1	1
CO3	2	2	1	1	-	-	-	-	1	1	1	1	1	1	1
CO4	1	1	2	2	3	-	-	-	2	2	2	1	1	2	2
CO5	2	3	2	2	1	-	-	-	1	2	1	1	1	-	1
CO6	2	2	1	2	1	-	-	-	2	-	1	2	2	2	1

Structural Analysis-1

Sem-IV

General Course Information:

Course Code: PCC-CVE204-T Course Credits: 3 Mode: Lecture Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes

Srl.	**Course Outcome** At the end of the course, students will be able to:	**RBT* Level**
CO1	Calculate deflection of statically determinate structures under various loading and support conditions	L2 (Understanding)
CO2	Apply basic concepts of structural mechanics for the analysis of beams and frames	L3(Applying)
CO3	Examine the basic concepts of structural mechanics for the analysis of truss, arches and cables, beams and columns	L4(Analysing)
CO4	Selection of beam columns and strut subjected to various types of loads	L5(Evaluating)

Course Content

Unit-I

Analysis of stresses and strains: Analysis of simple states of stresses and strains, elastic constraints, bending stresses, theory of simple bending, flexure formula, combined stresses in beams, shear stresses, Mohr's circle, Principle stresses and strains, torsion in shafts and closed thin walled sections, stresses and strains in cylindrical shells and spheres under internal pressure.

Theory of Columns: Slenderness ratio, end connections, short columns, Euler's critical buckling loads, eccentrically loaded short columns, cylinder columns subjected to axial and eccentric loading.

Unit-II

Bending moment and shear force in determinate beams and frames: Definitions and sign conventions, axial force, shear force and bending moment diagrams.

Three hinged arches: Horizontal thrust, shear force and bending moment diagrams.

Unit-III

Deflections in beams: Introduction, slope and deflections in beams by differential equations, moment area method and conjugate beam method, unit load method, Principle of virtual work, Maxwell's Law of Reciprocal Deflections.

Unit-IV

Analysis of statically determinate trusses: Introduction, various types, stability, analysis of plane trusses by method of joints and method of sections. Analysis of space trusses using tension coefficient method.

REFERENCE BOOKS

1. C.S. Reddy, Basic Structural Analysis, Publisher: Tata McGraw Hill, 2001.

2. C.K. Wang, Intermediate Structural Analysis, McGraw Hill, 1984.

3. B.G. Neal, Structural theorems and their application, Pergaman Press., 1972.

4. Bhavikatti, Structural Analysis Volume – I, Vikas Publishers, 3rd edition, 2008.

5. Timoshenko and Young, Theory of Structures, Publisher: Tata McGraw Hill, 2009.

6. Norries and Wilbur, Elementary Structural Analysis, Publisher: McGraw Hill, 1990.

7. Laursen H I, Structural Analysis, Publisher: McGraw Hill, 1988.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	-	-	-	2	2	1	1	1	2	2
CO2	3	2	2	2	2	-	-	-	1	1	1	1	3	1	1
CO3	3	3	2	2	1	1	1	1	-	2	2	2	3	1	2
CO4	2	3	2	2	2	1	-	-	1	1	1	1	2	1	2

Engineering Building and Drawing
Sem-IV

General Course Information:

Course Code: PCC-CVE206-T Course Credits: 3 Mode: Lecture (L) Type: HSMC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes

Srl.	**Course Outcome** At the end of the course, students will be able to:	**RBT* Level**
CO1	State the kind of material construction	L1(Remembering)
CO2	Recognize different problems regarding material in a building	L2(Understanding)
CO3	Supervise building constructions	L4(Analyzing)
CO4	Plan and draw constructional details of differing building components	L6(Creating)

*Revised Bloom's Taxonomy

Course Contents

Unit-I

Masonry Construction: Introduction, various terms used, stone masonry-Dressing of stones, Classifications of stone masonry, safe permissible loads, Brick masonry-bonds in brick work, laying brick work, structural brick work-cavity and hollow walls, reinforced brick work, Defects in brick masonry, composite stone and brick masonry, glass block masonry.

Unit-II

Damp-Proofing and Water-Proofing: Defects and causes of dampness, prevention of dampness, materials used, damp-proofing treatment in buildings, water proofing treatment of roofs including pitched roofs.

Roofs and Floors: Types of roofs, various terms used, roof trusses-king post truss, queen post truss etc.Floor structures, ground, basement and upper floors, various types of floorings.

Doors and Windows: Locations, sizes, types of doors and windows, fixures and fastners for doors and windows.

Acoustics, Sound Insulation and Fire Protection: Classification, measurement and transmission of sound, sound absorber, classification of absorbers, sound insulation of buildings, wall construction and accoustical design of auditorium, fire-resisting properties of materials, fire resistant construction and fire protection requirements for buildings.

Unit-III

Stones: Classification, requirements of good structural stone, quarrying, blasting and sorting out of stones, dressing, sawing and polishing, prevention and seasoning of stone.

Brick and Tiles: Classification of bricks, constituents of good brick earth, harmful ingredients, manufacturing of bricks, testing of bricks.

Tiles: Terra-cotta, manufacturing of tiles and terra-cotta, types of terra-cotta, uses of terra-cotta.

Limes, Cement and Mortars: Classification of lime, manufacturing, artificial hydraulic lime, pozzolona, testing of lime, storage of lime, cements composition, types of cement, manufacturing of ordinary Portland cement, testing of cement, special types of cement, storage of cement.

Mortars: Definition, proportions of lime and cement mortars, mortars for masonry and plastering.

Unit-IV

Timber: Classification of timber, structure of timber, seasoning of timber, defects in timber, fire proofing of timber, plywood, fiberboard, masonite and its manufacturing, important Indian timbers.

Ferrous and Non-Ferrous Metals: Definitions, manufacturing of cast iron, manufacturing of steel from pig iron, types of steel, marketable form of steel, manufacturing of aluminium and zinc.

Paints and Varnishes: Basic constituents of paints, types of paints, painting of wood, constituents of varnishes, characteristics and types of varnishes.

Plastic: Definition, classification of plastics, composition and raw materials, manufacturing, characteristics and uses, polymerization, classification, special varieties.

REFERENCE BOOKS:

1 Building Construction, Sushil Kumar, Standard Publishers, New. Delhi
2 Building Construction by B.C.Punmia, Lakshmi Publication Pvt. Ltd, New Delhi
3 Building Material by S.C.RangawalaCharotra Broths. Stall Anand.TulsiSadan, Station Road (W. Railway)
4 Construction Engineering, Y.S. Sane
5 Building Construction, Gurcharan Singh, Standard Pub., N. Delhi.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	1	1	1	3	3	2	2	2	2	3
CO2	3	2	2	2	2	1	2	1	1	2	2	2	2	1	3
CO3	3	2	3	2	3	1	1	1	3	3	3	2	2	3	1
CO4	3	2	3	3	3	2	2	2	3	2	2	2	1	3	2

Environmental Engg.

Sem-IV

General Course Information:

Course Code: PCC-CVE208-T Course Credits: 3 Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes

Srl.	**Course Outcome** At the end of the course, students will be able to:	**RBT* Level**
CO1	Identify and describe various elements of water supply, sewerage and air & noise pollution	L1 (Remembering)
CO2	Differentiate between various types of pollutants with their sources, effects on environment and quantifications	L2 (Understanding)
CO3	Analyze the effects of different kinds of pollution and outline their respective measures for treatment	L4(Analyzing)
CO4	Design and compare sewerage systems and storm water drains	L6(Creating)

Course Content

UNIT I

Water: Water Supply systems: Need for planned water supply schemes, Sources of Water, Water demand and Potable, 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.

UNIT II

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

Storm Water: Quantification and design of Storm water; Sewage and Sludge, Pollution due to improper disposal of sewage, National River cleaning plans, recycling of sewage –quality requirements for various purposes.

UNIT III

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

UNIT IV

Noise: Basic concept, measurement, effects and various control methods

Case studies on Pollution(Air, Water, Noise)

REFERENCE BOOKS

1. Environmental Pollution Control Engineering , C. S. Rao
2. Environmental Engineering, Vol. I ,S.K Garg ,.Khanna Publishers, New-Delhi.(1990)
3. Environmental Engineering by H.S.Peavy, D.R.Rowe, G.Tchobanoglous; 1991, Tata-Mcgraw Hill
4. Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan,Thompson / Brooks/Cole; Second Edition 2008
5. Introduction to Environmental Engineering, Vesilind, PWS Publishing Company 2000
6. Water Supply and Sewerage, E.W. Steel
7. CPHEEO Manual on Water Supply & Treatment
8. Manual on Water Supply and Treatment, (latest Ed.), Ministry of Works & Housing,New Delhi.
9. Integrated Solid Waste Management, Tchobanoglous, Theissen & Vigil. McGraw Hill Publication

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	-	1	3	1	-	-	-	1	2	1	1
CO2	1	2	1	2	-	2	3	1	-	-	-	1	2	-	2
CO3	2	3	2	1	1	1	3	1	1	2	-	1	2	-	-
CO4	3	2	3	1	2	-	2	1	3	2	2	1	1	3	2

Introduction to Fluid Mechanics Lab

Sem-IV

General Course Information:

Course Code: PCC-CVE202-P Course Credits: 1 Mode: Practical (P) Type: PCC Contact Hours: 2 hours (P) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes

Srl.	**Course Outcome** At the end of the course, students will be able to:	**RBT* Level**
CO1	Basic properties of fluids and its application.	L1 (Remembering)
CO2	Understand Various conditions in respect to the flow of fluids and the concept of floating bodies.	L2 (Understanding)
CO3	Analyse Flow measuring techniques and equipments with theories of fluid flow.	L4(Analyzing)
CO4	Formation of hydraulic models and modules and dimension analysis of fluids.	L6(Creating)

LIST OF EXPERIMENTS:

1 To determine meta-centric height of the ship model.

2 To verify the Bernoulli's theorem.

3 To determine coefficient of discharge for an Orifice-meter.

4 To determine coefficient of discharge of a venture-meter.

5 To determine the various hydraulic coefficients of an Orifice (C_d, Cc, Cv).

6 To determine coefficient of discharge for an Orifice under variable head.

7 To calibrate a given notch.

8 To determine coefficient of discharge for a mouth piece.

9 Drawing of a flow-net by Viscous Analogy Model and Sand Box Model.

10 To study development of boundary layer over a flat plate.

11 To study velocity distribution in a rectangular open channel.

12 Velocity measurements by current meter, float, double float (demonstration only).

13 Experiment on Vortex formation (demonstration only).

REFERENCES:

1. Fluid Mechanics and Hydraulic Machine by R. K. Bansal

2. Fluid mechanics and Fluid Power Engg. by D.S. Kumar
3. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010
4. Hydraulics and Fluid Mechanics, P N Modi and S M Seth, Standard Book House
5. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
6. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-
CO2	2	3	1	-	-	-	-	-	-	-	1	1	1	-	2
CO3	2	3	1	-	-	-	-	-	-	-	2	1	3	2	1
CO4	1	2	3	2	1	-	-	-	-	-	2	1	1	2	3

Structural Analysis-I Lab

Sem-IV

General Course Information:

Course Code: PCC-CVE204-P Course Credits: 1 Mode: Practical(P) Type: PCC Contact Hours: 2 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes

Srl.	Course Outcome At the end of the course, students will be able to:	RBT* Level
CO1	Basic application of mechanics involved commonly in the structures.	L1 (Remembering)
CO2	Apply the process of agitation on the structures.to get the desired values of the resultant action	L3 (Applying)
CO3	Various techniques to analyse the structures following the slope and deflection approach.	L4(Analyzing)
CO4	Formulate trusses or forces in each member of trusses using simplified approach.	L6(Creating)

LIST OF EXPERIMENTS:

1. Verification of reciprocal theorem of deflection using a simply supported beam.
2. Verification of moment area theorem for slopes and deflections of the beam.
3. Deflections of a truss- horizontal deflection & vertical deflection of various joints of a pin- jointed truss.
4. Elastic displacements (vertical & horizontal) of curved members.
5. Experimental and analytical study of 3 hinged arch and influence line for horizontal thrust.
6. Experimental and analytical study of behavior of struts with various end conditions.
7. To determine elastic properties of a beam.
8. Uniaxial tension test for steel (plain & deformed bars)
9. Uniaxial compression test on concrete & bricks specimens

Text Books:

1. Experimental Methods in Structural Mechanics Kukreja C B andSastry V V

2. C.S. Reddy, Basic Structural Analysis, Publisher: Tata McGraw Hill, 2001.

3. C.K. Wang, Intermediate Structural Analysis, McGraw Hill, 1984.

4. B.G. Neal, Structural theorems and their application, Pergaman Press., 1972.

5. Bhavikatti, Structural Analysis Volume – I, Vikas Publishers, 3rd edition, 2008

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	1	-	-	-	1	2	1	-	1
CO2	3	2	2	1	-	-	-	-	-	-	1	1	2	-	1
CO3	1	2	2	1	1	-	-	-	-	-	1	1	3	1	2
CO4	1	2	3	3	1	-	-	-	-	-	1	1	1	2	3

Engg. Building and Drawing Lab

Sem-IV

General Course Information:

Course Code: PCC-CVE206-P Course Credits: 1 Mode: Drawing(D) Type: PCC Contact Hours: 2 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes

Srl.	**Course Outcome** At the end of the course, students will be able to:	**RBT* Level**
CO1	State the kind of material construction	L1(Remembering)
CO2	Recognize different problems regarding material in a building	L2(Understanding)
CO3	Supervise building constructions	L4(Analyzing)
CO4	Plan and draw constructional details of differing building components	L6(Creating)

List Of Drawing

1. Different brick masonary bonds
2. Different types of trusses
3. Different types of doors and windows
4. Different types of defects in timber
5. Plan of a building

REFERENCE BOOKS:

1 Building Construction, Sushil Kumar, Standard Publishers, New. Delhi

2 Building Construction by B.C.Punmia, Lakshmi Publication Pvt. Ltd, New Delhi

3 Building Material by S.C.RangawalaCharotra Broths. Stall Anand.TulsiSadan, Station Road (W. Railway)

4 Construction Engineering, Y.S. Sane

5 Building Construction, Gurcharan Singh, Standard Pub., N. Delhi.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	1	1	1	3	3	2	2	2	2	3
CO2	3	2	2	2	2	1	2	1	1	2	2	2	2	1	3
CO3	3	2	3	2	3	1	1	1	3	3	3	2	2	3	1
CO4	3	2	3	3	3	2	2	2	3	2	2	2	1	3	2

Environmental Engg. Lab

Sem-IV

General Course Information

Course Code: PCC-CVE208-P Course Credits: 1 Mode: PRACTICAL(P) Type: PCC Contact Hours: 2 hours (P) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Identify physical, chemical and biological characteristics of water and wastewater	L2(Understanding)
CO2	Solve optimum dosage of coagulant	L3(Applying)
CO3	Evaluate break - point chlorination	L5(Evaluating)
CO4	Formulate the quality of water and wastewater	L6(creating)

*Revised Bloom's Taxonomy

Detailed Syllabus:

1. Determination of pH.
2. Determination of Conductivity.
3. Determination of Acidity of waste water.
4. Determination of Alkalinity of waste Water.
5. Determination of Chlorides.
6. Determination of Hardness of waste water.
7. Determination of Fluorides in waste water
8. Determination of Available Chlorine in bleaching powder.
9. Conducting Break Point Chlorination Test.
10. Determination of Residual Chlorine.
11. Determination of Dissolved Oxygen.
12. Determination of Chemical Oxygen Demand of waste water
13. Determination of Biochemical Oxygen Demand of waste water
14. Conducting Jar test for determining optimum dosage of coagulant.
15. Determination of Total Solids, Total Dissolved Solids & Settelable Solids.

REFERENCE BOOKS

Standard methods for the examination of water and wastewater. (2012). 21st Edition, Washington: APHA.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	1	-	-	1	2	-	-	-	1	2	1	1	2
CO2	1	2	3	1	-	1	2	-	-	-	1	2	1	-	2
CO3	1	2	3	1	-	1	2	-	-	-	1	2	1	-	3
CO4	1	2	3	1	-	1	2	-	-	-	1	2	1	2	3

Advanced Fluid Mechanics

Sem-V

General Course Information:

Course Code: PCC-CVE301-T Course Credits: 3 Mode: Lecture (L) Type: Core Course Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Illustrate drag and lift coefficients	**L2(Understanding)**
CO2	Demonstrate flow profiles in channel transitions and analyze hydraulic transients	**L3(Applying)**
CO3	Analyze compressible flows of liquids and gases	**L4(Analyzing)**
CO4	Design the working proportions of hydraulic machines	**L5(Evaluating)**
CO5	Design channels	**L6(Creating)**

Course Contents

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UNIT-I

Laminar Flow: Navier Stoke's equation, Laminar flow between parallel plates, Couette flow, laminar flow through pipes-Hagen Poiseuille law, laminar flow around a sphere-Stokes'law.

Flow through pipes: Types of flows-Reynold's experiment, shear stress on turbulent flow, boundary layer in pipes-Establishment of flow, velocity distribution for turbulent flow in smooth and rough pipes, resistance to flow of fluid in smooth and rough pipes, Stanton and Moody's diagram. Darcy's weisbach equation, other energy losses in pipes, loss due to sudden expansion, hydraulic gradient and total energy lines, pipes in series and in parallel, equivalent pipe, branched pipe, pipe networks, Hardy Cross method, water hammer.

Unit-II

Drag and Lift: Types of drag, drag on a sphere, flat plate, cylinder and airfoil, development of lift on immersed bodies like circular cylinder and airfoil.

Open Channel Flow: Type of flow in open channels, geometric parameters of channel section, uniform flow, most economical section (rectangular and trapezoidal), specific energy and critical depth, momentum in open channel, specific force, critical flow in rectangular channel, applications of specific energy and discharge diagrams to channel transition, metering flumes, hydraulic jump in rectangular channel, surges in open channels, positive and negative surges, gradually varied flow equation and its integration, surface profiles.

Unit-III

Compressible flow: Basic relationship of thermodynamics continuity, momentum and energy equations, propagation of elastic waves due to compression of fluid, Mach number and its significance, subsonic and supersonic flows, propagation of elastic wave due to disturbance in fluid mach cone, stagnation pressure.

Unit-IV

Pumps and Turbines: Reciprocating pumps, their types, work done by single and double acting pumps. Centrifugal pumps, components and parts and working, types, heads of a pump-statics and manometric heads,. Force executed by fluid jet on stationary and moving flat vanes, Turbines-classifications of turbines based on head and specific speed, component and working of Pelton wheel and Francis turbines, cavitation and setting of turbines.

REFERENCE BOOKS:

1 Fluid Mechanics and Hydraulic Machines , Mahesh Kumar, Pearson Education, 2019

2 Hydraulics & Fluid Mechanics by P.N.Modi and S.M.Seth

2. Fluid Mechanics by R. K. Bansal

3. Flow in Open Channels by S.Subraminayam

4. Introduction to Fluid Mechanics by Robert N.Fox & Alan T.Macnold

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-	-	-	-	-	-	2	1	-	-
CO2	3	2	3	-	1	-	2	2	-	-	2	3	1	2	-
CO3	3	-	1	-	-	-	-	2	-	-	-	2	3	2	1
CO4	1	-	3	-	-	-	-	1	1	-	2	2	2	3	1
CO5	2	-	3	-	-	-	-	1	-	-	-	2	2	3	1

Structural Analysis-II

Sem-V

General Course Information:

Course Code:PCC-CVE303-T Course Credits: 3 Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Explain Statically Indeterminate Structures	L2(Understanding)
CO2	Apply Slope deflection and moment Distribution Methods and Column Analogy Method in structural analysis	L3(Applying)
CO3	Analysis of Two hinged Arches	L4(Analyzing)
CO4	Evaluate bending stresses in beam subjected to Unsymmetrical Bending	L5(Evaluating)
CO5	Design Cable and suspension Bridges	L6 (Creating)

Unit-I

Statically Indeterminate Structures: Introduction, Static and Kinematic Indeterminacies, Castigliano's theorems, Strain energy method, Analysis of frames with one or two redundant members using Castigliano's 2^n theorem.

Unit-II

Slope deflection and moment Distribution Methods: Analysis of continuous beams & portal frames, Portal frames with inclined members.

Unit-III

Column Analogy Method: Elastic centre, Properties of analogous column, Applications to beam & frames.

Analysis of Two hinged Arches: Parabolic and circular Arches, Bending Moment Diagram for various loadings, Temperature effects, Rib shortening, Axial thrust and Radial Shear force diagrams.

Unit-IV

Unsymmetrical Bending: Introduction Centroidal principal axes of sections, Bending stresses in beam subjected to unsymmetrical bending, shear centre, shear centre for channel, Angles and Z sections.

Cable and suspension Bridges: Introduction, uniformly loaded cables, Temperature stresses, three hinged stiffening Girder and two hinged stiffening Girder**.**

Reference Books:

1. Statically Indeterminate Structures, C.K. Wang, McGraw Hill Book Co., New York
2. Advanced Structural Analysis, A.K. Jain, Nem Chand & Bros., Roorkee
3. Indeterminate Structures, R.L. Jindal, S. Chand & Co., New Delhi
.
4. Theory of Structures, Vol. I, S.P. Gupta & G.S.Pandit, Tata McGraw Hill, New Delhi.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	-	-	-	-	-	1	2	1	1	1
CO2	2	2	2	2	2	-	-	-	-	-	1	2	1	1	2
CO3	2	2	2	2	2	-	-	-	-	-	1	2	2	2	3
CO4	2	2	3	2	2	-	-	-	-	-	1	2	3	3	3
CO5	2	2	3	2	2	-	-	-	-	-	1	2	3	3	3

Surveying –II

Sem-V

General Course Information:

Course Code: PCC-CVE305-T Course Credits: 3 Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Understand mathematical adjustment of accidental errors involved in surveying measurements	L2(Understanding)
CO2	Carry out a geodetic survey, taking accurate measurements using instruments and adjusting the traverse	L3(Applying)
CO3	Plan a survey for applications such as road alignment and height of the building	L4(Analyzing)
CO4	Interpret survey data and plot topographical maps	L5 (Evaluation)
CO5	Create height maps and contours using photogrammetric measurements	L6 (Creating)

Course Contents

Unit-I

Trigonometrical Levelling: Introduction, height and distances-base of the object accessible, base of object inaccessible, geodetical observation, refraction and curvature, axis signal correction, difference in elevation between two points.

Triangulation: Triangulation systems, classification, strength of figure, selection of triangulation stations, grade of triangulation, field work of triangulation, triangulation computations, introduction to E.D.M. instruments.

Unit-II

Survey Adjustment and Treatment of Observations: Types of errors, definition of weight of an observation, most probable values, law of accidental errors, law of weights, determination of probable error (different cases with examples) principle of least squares, adjustment of triangulation figures by method of least squares.

Unit-III

Astronomy: Definitions of astronomical terms, star at elongation, star at prime vertical star at horizon, star at culmination, celestial coordinate systems, Napier's rule of circular parts, various time systems: sidereal, apparent, solar and mean solar time, equation of time-its cause.

Unit-IV

Elements of Photo-grammetry: Introduction: types of photographs, types of aerial photographs, aerial camera and height displacements in vertical photographs, stereoscopic vision and stereoscopies, height determination from parallax measurement, flight planning

Introduction of remote sensing and its systems: Concept of G.I.S and G.P.S. -Basic Components, data input, storage & output.

REFERENCE BOOKS:

1. Surveying Vol.2 by B.C.Punmia
2. Surveying Vol.3 by B.C.Punmia
3. Surveying Vol2 by T.P.Kanitkar
4. Higher Surveying by A M Chandra

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	-	-	-	-	-	1	2	1	1	1
CO2	2	2	2	2	2	-	-	-	-	-	1	2	1	2	2
CO3	2	2	2	2	2	-	-	-	-	-	1	2	2	3	3
CO4	2	2	2	2	2	-	-	-	-	-	1	2	3	3	3
CO5	3	2	2	2	2	-	-	-	-	-	1	2	3	3	3

Design of Concrete Structures-I

Sem-V

General Course Information:

Course Code: PEC-CVE307-T Course Credits: **3** Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks- class performance measured through percentage of lecture attended (4 marks)- assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination- nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Recall various aspects of the Design of concrete structures	L1 (Remembering)
CO2	Explain the basic and application aspects of design of concrete structures	L2 (Understanding)
CO3	Choose appropriate design of different type of concrete structures for different type of civil work.	L3 (Applying)
CO4	Examine Limit State of Collapse for flexure- Shear- bond torsion and compression etc.	L4 (Analyzing)
CO5	Designdifferent type of concrete structures for various types of civil work.	L6 (Creating)

*Revised Bloom's Taxonomy

Course Contents

UNIT I

Introduction*:* Reinforced concrete- definition- properties of materials- grades of concrete and reinforcing steel- stress-strain curves- permissible stresses- shrinkage- creep- design philosophies working stress design- ultimate strength and limit state design method.

Limit State Design Method: Introduction- Limit States- Characteristic values- characteristic strength- characteristic loads- design values for materials and loads- factored loads.

UNIT II

Limit State of Collapse (Flexure): Types of failures- assumptions for analysis and design of singly reinforced- doubly reinforced sections- and flanged sections- Design of Lintels- Design of one-way slabs and two-way rectangular slabs- Circular slabs: Slabs with different edge conditions

Limit State of Collapse (Shear- bond and torsion): Introduction - Design for shear- structural components subjected to torsion- design of rectangular beam section for torsion- development length- continuation of reinforcement (beyond cut off points).

Limit State of Collapse (Compression): Columns and their classification- reinforcement in columns- assumptions- short and long (both tied and helical) columns subjected to axial load- short columns subject to axial- uniaxial and biaxial bending- Interaction Diagrams

UNIT III

Limit State of Serviceability*:* Deflection- effective span to effective depth ratio- modification factors for singly reinforced- doubly reinforcement and flanged beams- crack formation and its control.

UNIT IV

Limit State Design of miscellaneous structures: Design of isolated footings- Design of staircases.

Introduction to Working Stress Design Method : Application of SP 16 and Detailing of Reinforcement: Use of SP: 34- Codal Provision for RC Elements: (I) General (II) for ductility

REFERENCE BOOKS:

1. Design of Reinforced Concrete Structures-P.Dayaratnam-Oxford& IBH Pub.-N.Delhi.
2. Reinforced Concrete-Limit State Design- A.K.Jain- Nem Chand &Bros.-Roorkee.
3. Reinforced Concrete- I.C.Syal&A-K-Goel- A.H-Wheeler&Co.Delhi.
4. Reinforced Concrete Design- S.N.Sinha- TMH Pub.-N.Delhi.
5. SP-16(S&T)-1980- 'Design Aids for Reinforced Concrete to IS:456- BIS- N.Delhi.
6. SP-34(S&T)-1987 'Handbook on Concrete Reinforcement and Detailing'- BIS- N.Delhi.
7. Reinforced Concrete Design – Pillai and Menon- TMH- New Delhi.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	1	2	-	1	2
CO2	2	2	1	1	1	-	-	-	-	-	1	2	-	1	2
CO3	2	2	3	2	2	-	-	-	-	-	2	2	2	3	3
CO4	2	2	3	3	2	-	-	-	-	-	1	2	2	3	3
CO5	2	2	3	3	1	-	-	-	-	-	1	2	3	3	3

Advanced Fluid Mechanics Lab

Sem-V

General Course Information:

Course Code: PCC-CVE301-P Course Credits: 1 Mode: Practical (P) Type: PCC Contact Hours: 2 hours (P) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of practical attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO 1	Explain basic properties of fluids and its application.	L2(Understanding)
CO 2	Employ various conditions in respect to the flow of fluids and the concept of floating bodies.	L3(Applying)
CO 3	Examine properties and functioning of centrifugal pump.	L4(Analyzing)
CO 4	Determine the flow in various pipe fittings.	L5(Evaluating)
CO 5	To develop the momentum characteristics of a given jet.	L6(Creating)

LIST OF EXPERIMENTS:

1 To determine the coefficient of drag by Stoke's law for spherical bodies.

2 To study the phenomenon of cavitation in pipe flow.

3 To determine the critical Reynold's number for flow through commercial pipes.

4 To determine the coefficient of discharge for flow over a broad crested weir.

5 To study the characteristics of a hydraulic jump on a horizontal floor and sloping glacis including friction blocks.

6 To study the scouring phenomenon around a bridge pier model.

7 To study the scouring phenomenon for flow past a spur.

8 To determine the characteristics of a centrifugal pump.

9 To study the momentum characteristics of a given jet.

10 To determine head loss due to various pipe fittings.

REFERENCE BOOKS:

1. Hydraulics & Fluid Mechanics by P.N.Modi and S.M.Seth
2. Fluid Mechanics by R. K. Bansal
3. Flow in Open Channels by S.Subraminayam
4. Introduction to Fluid Mechanics by Robert N.Fox & Alan T.Macnold

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	1	-	-	-	-	-	1	2	1	1	1
CO2	2	1	1	2	1	-	-	-	-	-	1	2	1	1	1
CO3	2	2	2	2	1	-	-	-	-	-	1	2	1	2	2
CO4	2	2	2	2	1	-	-	-	-	-	1	2	2	3	3
CO5	2	2	2	2	1	-	-	-	-	-	1	2	2	3	3

Structural Analysis-II Lab

Sem-V

General Course Information:

Course Code: PCC-CVE303-P Course Credits: 1 Mode: Practical (P) Type: PCC Contact Hours: 2 hours (P) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of practical attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Basic application of mechanics involved commonly in the structures.	L2(Understanding)
CO2	Get the desired values of the resultant action in response to the agitation on the structures.	L3(Applying)
CO3	Various techniques to analyse the structures following the slope and deflection approach.	L4(Analyzing)
CO4	Evaluation of trusses or forces in each member of trusses using simplified approach.	L5(Evaluating)
CO5	Develop qualitative diagrams showing the displaced shape, bending moments	L6(Creating)

LIST OF EXPERIMENTS:

1. Experiment on a two hinged arch for horizontal thrust & influence line for Horizontal thrust
2. Experimental and analytical study of a 3-bar pin-jointed Truss.
3. Experimental and analytical study of deflections for unsymmetrical bending of a Cantilever beam.
4. Begg's deformeter- verification of Muller Breslau principle.
5. Experimental and analytical study of an elastically coupled beam.
6. Sway in portal frames - demonstration.
7. To study the cable geometry and statics for different loading conditions.
8. To plot stress-strain curve for concrete.

Reference Books:

1. Statically Indeterminate Structures, C.K. Wang, McGraw Hill Book Co., New York
2. Advanced Structural Analysis, A.K. Jain, Nem Chand & Bros., Roorkee
3. Indeterminate Structures, R.L. Jindal, S. Chand & Co., New Delhi

.

4. Theory of Structures, Vol. I, S.P. Gupta & G.S.Pandit, Tata McGraw Hill, New Delhi.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	1	-	-	-	1	2	1	-	1
CO2	3	2	2	1	-	-	-	-	-	-	1	1	2	-	1
CO3	1	2	2	1	1	-	-	-	-	-	1	1	3	1	2
CO4	1	2	3	3	1	-	-	-	-	-	1	1	1	2	3
CO5	1	2	3	3	-	-	-	-	-	-	2	1	1	2	3

Surveying-II Lab

Sem-V

General Course Information:

Course Code: PCC-CVE305-P Course Credits: 1 Mode: Practical (P) Type: PCC Contact Hours: 2 hours (P) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of practical attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Understand Theodilite along with chain/tape, compass on the field	L2(Understanding)
CO2	Apply Geometric and trigonometric principles of basic surveying calculations	L3(Applying)
CO3	Plan survey , taking accurate measurements , filed booking, plotting and adjustment of errors	L4(Analyzing)
CO4	Evaluate various types of surveys ,a s part of surveying team	L5(Evaluating)
CO5	Create drawing techniques in the development of topographic map	L6(Creating)

LIST OF EXPERIMENTS:

1. Theodilite Surveying
2. Single Plane observation of trigonometrically leveling
3. Two Plane Method
4. Determination of tachometric constants
5. Tangent Tachometry
6. Subtense Bar
7. Setting out of curves , building layout
8. Total Station

REFERENCE BOOKS:

1. Surveying Vol.2 by B.C.Punmia
2. Surveying Vol.3 by B.C.Punmia
3. Surveying Vol2 by T.P.Kanitkar

4. Higher Surveying by A M Chandra

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	1	-	-	-	1	2	1	-	1
CO2	3	2	2	1	-	-	-	-	-	-	1	1	2	-	1
CO3	1	2	2	1	1	-	-	-	-	-	1	1	3	1	2
CO4	1	2	3	3	1	-	-	-	-	-	1	1	1	2	3
CO5	1	2	3	3	-	-	-	-	-	-	2	1	1	2	3

Design of Concrete Structures-I Lab

Sem-V

General Course Information:

Course Code: PCC-CVE307-P Course Credits: 1 Mode: Practical (P) Type: PCC Contact Hours: 2 hours (P) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of practical attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

S. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Understand the structural drawings of various building components	L2(Understanding)
CO2	Apply the coding provisions of Indian Standards for detailing	L3(Applying)
CO3	Use the Auto Cad software tool for drawing concrete structures	L4(Analyzing)
CO4	Evaluate drawings of concrete structures	L5 (Evaluating)
CO5	Design concrete structures using Auto Cad software	L6 (Creating)

Students will be able to do:

Structural Drawings through AUTOCAD of the followings

1. Singly reinforced concrete beams
2. Doubly reinforced concrete beams
3. Cracking pattern of reinforced concrete beams
4. Simply supported and cantilever slabs
5. Flat slabs
6. Two way slabs
7. Columns.
8. Footings.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	2	-	-	-	-	-	1	1	1	1	1
CO2	1	2	2	1	2	-	-	-	-	-	1	1	1	2	2
CO3	1	1	2	1	3	-	-	-	-	-	1	2	2	2	2
CO4	2	1	3	2	3	-	-	-	-	-	1	2	3	3	3
CO5	2	2	3	2	3	-	-	-	-	-	1	2	3	3	3

Transportation Engg.-I

Sem -VI

General Course Information:

Course Code: PCC-CVE302-T Course Credits: 3 Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Quantify the specifications of various road construction materials required	**L2(Understanding)**
CO2	Perform geometric design of highways and expressways	**L3(Applying)**
CO3	Perform analysis and design of flexible and rigid pavements	**L4(Analyzing)**
CO4	Evaluate highway maintenance, drainage and economic issues	**L5(Evaluating)**
CO5	Perform the traffic studies necessary before making changes to or designing new road	**L6(Creating)**

Course Content

UNIT I

General: Different modes of transport, Development of Transport System, Phased development of Roads in India.

Planning of Highways: Planning & Management of Highways, Various road plans developed in India, Road patterns, Highway Surveys & Alignment, Design, Drawings, Estimates & Project Report.

Geometric Design of Highways: Introduction, Highways Classification, Right of way, Land width, width of formation, Thickness of pavement, Sight Distances, Stopping site distance, overtaking sight distance, overtaking zones, camber, Road Curves, Transition Curves, Super elevation. Widening at curves, IRC-recommendations for various geometric design parameters.

UNIT II

Construction of Roads: Various types of bituminous constructions and their selection, Construction of earth, gravel, water bound macadam, surface dressing, premixed carpet, bituminous macadam, bituminous concrete, mastic asphalt, cement concrete pavements.

Types of bituminous binders and properties: Manufacturing of bitumen, Paving bitumen specifications as per IS 73: 2013, comparison between bitumen, tar, cut back & emulsion, Modified binders and its rheology.

UNIT III

Pavements: Factors affecting design of pavements. Structure of Flexible pavement and its design procedure as per IRC 37:2001, 2012 and IRC72: 2007, Construction of Cement Concrete Roads & its layer specifications, Design of PQC pavements as per IRC 58 & SP 062.

Failures of flexible and rigid pavements: Causes of Failures and Remedial Measures, Maintenance of flexible and rigid pavements, pavement evaluation and its strengthening.

Traffic Studies: Definition of Traffic Engineering, Various faces of Traffic Engineering, Road user characteristics, Importance of traffic studies, spot speed, speed and delay and origin and destination studies. Traffic accident studies, Causes of accidents and Remedial Measures, Parking studies

UNIT IV

Drainage: Introduction, Importance & Principles of Highway Drainage, Surface Drainage, Sub Surface drainage.

Highway Maintenance: Introduction, Maintenance of Earth, gravel, WBM Roads, Bituminous Roads, Cement Concrete pavements.

Highway Economics: Economics of Pavement types, Economic Evaluation of Highway Schemes, Life Cycle Costing

REFERENCE BOOKS:

1. Khanna S.K. and C.E.G. Justo,HighwayEngineerin, Nemchand Bros(2012)
2. Kadyali L. R.; Highway Engineering, Nem Chand & Brothers, Roorkee (2004).
3. Sharma & Sharma; Principle and Practice of Highway Engineering, Asia Publishing House, New Delhi (2010)
4. Rao G. V.; Transportation Engineering, Tata McGraw Hill Publisher, New Delhi (1999)
5. Yoder E. J.; Principles of Pavement Design, John Wiley & Sons (1975).

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	-	-	-	-	-	-	-	-	3	1	2	-
CO2	1	2	3	1	-	-	-	-	1	-	1	3	1	2	3
CO3	1	2	3	-	1	-	-	-	-	-	1	3	2	3	3
CO4	2	3	2	1	1	-	-	-	-	-	2	3	1	2	3
CO5	1	2	3	3	1	-	-	-	1	-	2	3	1	2	3

Sewerage & Sewage Treatment
Sem -VI

General Course Information

Course Code: PCC-CVE304-T Course Credits: 2 Mode: Lecture (L) Type: PCC Contact Hours: 2 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Understand the concepts of sewage and sewage treatment	L2 (Understanding)
CO2	Apply environmental treatment technologies for sewage treatment	L3 (Applying)
CO3	Characterization of sewage using various parameters and methods	L4 (Analyzing)
CO4	Assess appropriate methods for sewage treatment	L5 (Evaluating)
CO5	Plan, design and operations of sewerage system and sewage treatment plant	L6 (Creating)

*Revised Bloom's Taxonomy

Course Content

UNIT-I

Collection of sewage: Importance of sanitation, Systems of sewerage – separate, combined and partially separate. Quantity of sanitary sewage and variations. Shapes of sewer – circular and egg shaped. Design of sewers, self-cleansing velocity and slopes, Construction and testing of sewer lines. Sewer materials. joints and appurtenances.

UNIT-II

Sewage Characterization: Quality parameters- BOD, COD, Solids, D.O., Oil & Grease. Indian Standards for disposal of effluents into inland surface sources and on land.

UNIT-III

Sewage Treatment: Objectives, sequence and efficiencies of conventional treatment units. Preliminary treatment, screening and grit removal units. Theory and design aspects of primary treatment, secondary treatment- activated sludge process & its modifications, Tricking filter, sludge digestion and drying beds. Stabilization pond, aerated lagoon, UASB process , septic tank and Imhoff tank.

UNIT-IV

Disposal of Sewage: Disposal of sewage by dilution – self-purification of streams. Sewage disposal by irrigation (sewage treatment).

REFERENCE BOOKS:

1. Waste Water Engineering: Metcalf and Eddy.
2. Sewage and Sewage Treatment: S.K. Garg.
3. Sewage and Sewage Treatment: S.R. Krishansagar.
4. Waste Water Engineering: B.C. Punmia.
5. Manual on Sewerage and Sewage Treatment: Ministry of Urban Dev., New Delhi.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	-	1	1	-	-	1
CO2	3	2	1	1	1	-	-	-	-	-	1	2	-	1	2
CO3	3	2	1	1	2	-	-	-	-	-	1	2	1	1	2
CO4	3	3	1	3	2	-	-	-	-	-	2	2	1	2	2
CO5	2	2	3	2	1	-	-	-	-	-	3	2	3	3	3

Soil Mechanics

Sem -VI

General Course Information

Course Code: PCC-CVE306-T Course Credits: 3 Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Describe and discuss basic concepts of soil properties and soil mechanics	L2 (Understanding)
CO2	Classify and determine the index and engineering properties of soil	L3 (Applying)
CO3	Apply the basic concepts of soil mechanics in civil engineering works	L3 (Applying)
CO4	Examine the permeability and compressibility characteristics of soils in engineering practices	L4 (Analyzing)
CO5	Evaluate earth pressures and apply to check external stability of retaining structures	L5 (Evaluating)

*Revised Bloom's Taxonomy

Unit-I

Soil Formation and Composition: Introduction, soil and rock, Soil Mechanics and Foundation Engineering, origin of soils, weathering, soil formation, major soil deposits of India, particle size, particle shape, inter particle forces, soil structure, principal clay minerals.

Basic Soil Properties: Introduction, three phase system, weight-volume relationships, soil grain properties, soil aggregate properties, grain size analysis, sieve analysis, sedimentation analysis, grain size distribution curves, consistency of soils, consistency limits and their determination, activity of clays, relative density of sands.

Classification of soils: Purpose of classification, classification on the basis of grain size, classification on the basis of plasticity, plasticity chart, Indian Standard Classification System.

Permeability of Soils: Introduction, Darcy's law and its validity, discharge velocity and seepage velocity, factors affecting permeability, laboratory determination of coefficient of permeability, determination of field permeability, permeability of stratified deposits.

Unit-II

Effective Stress Concept: Principle of effective stress, effective stress under hydrostatic conditions, capillary rise in soils, effective stress in the zone of capillary rise, effective stress under steady state hydro-dynamic conditions, seepage force, quick condition, critical hydraulic gradient, two dimensional flow, Laplace's equation, properties and utilities of flownet, graphical method of construction of flownets, piping, protective filter.

Compaction: Introduction, role of moisture and compactive effect in compaction, laboratory determination of optimum moisture content, moisture density relationship, compaction in field, compaction of cohesionless soils, moderately cohesive soils and clays, field control of compaction

Unit-III

Compressibility and Consolidation: Introduction, components of total settlement, consolidation process, one-dimensional consolidation test, typical void ratio-pressure relationships for sands and clays, normally consolidated and over consolidated clays, Casagrande's graphical method of estimating pre-consolidation pressure, Terzaghi's theory of one-dimensional primary consolidation, determination of coefficients of consolidation, consolidation settlement, Construction period settlement, secondary consolidation

Unit-IV

Shear Strength: Introduction, Mohr stress circle, Mohr-Coulomb failure-criterion, relationship between principal stresses at failure, shear tests, direct shear test, unconfined compression test, triaxial compression tests, drainage conditions and strength parameters, Vane shear test, shear strength characteristics of sands, normally consolidated clays, over-consolidated clays and partially saturated soils, sensitivity and thixotropy.

Earth Pressure: Introduction, earth pressure at rest, Rankine's active & passive states of plastic equilibrium, Rankine's earth pressure theory, Coulomb's earth pressure theory, Culmann's graphical construction, Rebhann's construction.

REFERENCE BOOK:

1 Basic and Applied Soil Mechanics by Gopal Ranjan, ASR Rao, New Age Intetrnational(P)Ltd.Pub.N.Delhi.

2 Soil Mechanics and foundation engineering by Dr. K. R. Arora.

3. Soil Engg. in Theory and Practice, Vol .I, Fundamentals and General Principles by Alam Singh, CBS Pub.,N.Delhi.

4. Engg.Properties of Soils by S.K.Gulati, Tata-Mcgraw Hill,N.Delhi.

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Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	1	1	1	1	2
CO2	2	2	1	1	1	-	-	-	-	-	1	2	1	1	2
CO3	2	2	1	1	1	-	-	-	-	-	1	2	1	1	2
CO4	2	2	2	3	-	-	-	-	-	-	1	2	1	1	2
CO5	2	3	3	3	-	-	-	-	-	-	1	2	1	1	2

Design of Steel Structures-I
Sem -VI

General Course Information:

Course Code: PEC-CVE308-T Course Credits: **3** Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks- class performance measured through percentage of lecture attended (4 marks)- assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination- nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Understandvarious aspects of the designs of steel structures	L2 (Understanding)
CO2	Apply the IS codes of practice for the design of steel structural elements.	L3 (Applying)
CO3	Analyze and design the behavior of various connections for both axial and eccentric forces.	L4 (Analyzing)
CO4	Examine and differentiate between gantry and plate girders	L4 (Analyzing)
CO5	Design of compression and flexural members using simple and built-up sections.	L6(Creating)

*Revised Bloom's Taxonomy

Course Contents

UNIT-I

Introduction: Properties of structural steel. I.S.Rolled sections and I.S. specification.

Connections: Importance- various types of connections- simple and moment resistant- riveted- bolted and welded connections.

Design of Tension Members: Introduction- types of tension members- net sectional areas- design of tension members- lug angles and splices.

UNIT-II

Design of Compression Members: Introduction- effective length and slenderness ratio- various types of sections used for columns- built up columns- necessity- design of built up columns- laced and battened columns including the design of lacing and battens- design of eccentrically loaded compression members.

Column Bases and Footings: Introduction- types of column bases- design of slab base and gusseted base- design of gusseted base subjected to eccentrically loading- design of grillage foundations.

UNIT-III

Design of Beams: Introduction- types of sections- general design criteria for beams- design of laterally supported and unsupported beams- design of built up beams- web buckling- web crippling and diagonal buckling.

UNIT-IV

Gantry Girders: Introduction- various loads- specifications- design of gantry girder.

Plate Girder: Introduction- elements of plate girder- design steps of a plate girder- necessity of stiffeners in plate girder- various types of stiffeners- web and flange splices (brief introduction)- Curtailment of flange plates- design beam to column connections: Introduction- design of framed and seat connection.

REFERENCE BOOKS:

1. Duggal- S.K. Limit State Design of Steel structures- McGraw Hill (2009.)
2. Ajmani- A. L. and Arya- A. S.- Design of Steel Structures- Nem Chand and Brothers (2000).
3. Subramanya- N- Design of Steel Structures- N. Subramanian- Oxford University Press(2008).
4. Design of steel structures, A.S.Arya & J.L.Ajmani, Nem chand & Bros., Roorkee.
5. Design of steel structures, M.Raghupati, TMH Pub., New Delhi.
6. Design of steel structures, S.M.A.Kazmi & S.K.Jindal, Prentice Hall, New Delhi.
7. Design of steel structures, S.K.Duggal, TMH Pub., New Delhi.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	-	-	-	1	2	-	1	2
CO2	2	2	2	2	1	-	-	-	-	-	1	2	1	2	2
CO3	2	2	3	3	1	-	-	-	-	-	2	2	3	3	3
CO4	2	2	3	3	1	-	-	-	-	-	1	2	3	3	3
CO5	2	2	3	3	1	-	-	-	-	-	1	2	3	3	3

Transportation Engg.-I Lab

Sem -VI

General Course Information

Course Code: PCC-CVE302-P Course Credits: 1 Mode: Practical Type: PCC Contact Hours: 2 hours (P) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Estimate earth work from longitudinal and cross-section details	L2 (Understanding)
CO2	Demonstrate quality control tests on pavements and pavement materials	L3 (Applying)
CO3	Conduct traffic studies for estimating traffic flow characteristics	L4 (Analyzing
CO4	Evaluate the pavement materials	L5(Evaluating)
CO5	Design grade intersections	L6 (Creating

*Revised Bloom's Taxonomy

List of Experiment

1. Flakiness and Elongation Index of aggregates.
2. Specific gravity and water absorption test on aggregates.
3. Specific gravity of bitumen.
4. Proportioning of aggregates.
5. Marshall's stability test.
6. Stripping test on aggregates.
7. Determination of bitumen content.
8. CBR lab test on soil.
9. Traffic volume study using videography technique.
10. Traffic speed study using videography technique.

REFERENCE BOOKS:

1. Khanna S.K. and C.E.G. Justo,HighwayEngineerin, Nemchand Bros(2012)

2. Kadyali L. R.; Highway Engineering, Nem Chand & Brothers, Roorkee (2004).
3. Sharma & Sharma; Principle and Practice of Highway Engineering, Asia Publishing House, New Delhi (2010)
4. Rao G. V.; Transportation Engineering, Tata McGraw Hill Publisher, New Delhi (1999)
5. Yoder E. J.; Principles of Pavement Design, John Wiley & Sons (1975).
6. L.R. Kadiyali, Traffic Engineering and Transportation Planning, Khanna Publishers.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	-	-	-	-	-	-	-	1	1	1	1	2
CO2	-	-	3	-	-	-	-	-	-	-	1	2	1	1	2
CO3	-	3	-	-	-	-	-	-	-	-	1	2	1	1	2
CO4	-		3	-	-	-	-	-	-	-	1	2	1	1	2
CO5	-	-	3	-	-	-	-	-	-	-	1	2	1	1	2

Sewerage and Sewage Treatment Lab

Sem -VI

General Course Information

Course Code: PCC-CVE304-P Course Credits: 1 Mode: PRACTICAL(P) Type: PCC Contact Hours: 2 hours (P) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

*Revised Bloom's Taxonomy

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Identify physical, chemical and biological characteristics of sewage	L2(Understanding)
CO2	Solve optimum dosage of coagulant of sewage	L3(Applying)
CO3	Analyze a sewage treatment plant	L4(Analyzing)
CO4	Evaluate break - point chlorination	L5(Evaluating)
CO5	Formulate the quality of Sewage	L6(creating)

Detailed Syllabus:

1. Determination of pH.
2. Determination of Conductivity.
3. Determination of Acidity of sewage
4. Determination of Alkalinity of sewage
5. Determination of Chlorides in sewage
6. Determination of Hardness of sewage
7. Determination of Fluorides in sewage
8. Determination of Available Chlorine in bleaching powder.
9. Conducting Break Point Chlorination Test.
10. Determination of Residual Chlorine.
11. Determination of Dissolved Oxygen.
12. Determination of Chemical Oxygen Demand of sewage
13. Determination of Biochemical Oxygen Demand of sewage
14. Conducting Jar test for determining optimum dosage of coagulant.

15. Determination of Total Solids, Total Dissolved Solids & Settelable Solids.

REFERENCE BOOKS

Standard methods for the examination of water and wastewater. (2012). 21st Edition, Washington: APHA.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	1	-	-	1	2	-	-	-	1	2	1	1	2
CO2	1	2	3	1	-	1	2	-	-	-	1	2	1	-	2
CO3	1	3	2	1		1	2	-	-	-	1	2	3	1	3
CO4	1	2	3	1	-	1	2	-	-	-	1	2	1	-	3
CO5	1	2	3	1	-	1	2	-	-	-	1	2	1	2	3

Soil Mechanics Lab

Sem -VI

General Course Information

Course Code: PCC-CVE306-P Course Credits: 1 Mode: Lecture (P) Type: PCC Contact Hours: 2hours (P) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Cite the soil conditions for design of structures	L1(Remembering)
CO2	Classify soils	L2(Understanding)
CO3	Interpret the soil after exploration from under ground samples	L3(Applying)
CO4	Determine index properties of soils	L4(Analyzing)
CO5	Determine engineering properties of soils	L5(Evaluating)

Detailed Syllabus:

1. Specific Gravity of soil particles.
2. Sieve Analysis.
3. Liquid Limit, Plastic Limit & Shrinkage Limit.
4. Proctor's Standard Compaction Test.
5. Determination of Field Density.
6. Constant Head Permeameter Test.
7. Variable Head Permeameter Test.
8. Unconfined Compression Test.
9. Triaxial Compression Test (U.U Test).
10. Consolidation Test.

REFERENCE BOOKS:

1.Soil Mechanics Laboratory Manual.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	-	1	-	-	-	2	2	2	1	3
CO2	1	2	-	-	-	-	1	-	-	-	2	2	2	1	3
CO3	1	2	-	-	-	-	1	-	-	-	2	2	2	1	3

Estimation, Costing and Valuation
Sem -VII

General Course Information

Course Code: PCC-CVE401-T Course Credits: 3 Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Explain the basics of preparing estimates, costs and valuation for civil engineering works	L2 (Understanding)
CO2	Prepare specifications for different items of civil works	L3 (Applying)
CO3	Analyze rates for various items of works	L4 (Analyzing)
CO4	Estimate quantities of different items of civil engineering works	L5 (Evaluating)
CO5	Prepare tender documents for civil work and perform valuation of different civil engineering structures.	L6 (Creating)

*Revised Bloom's Taxonomy

Course Contents

UNIT-I

Estimate: Principles of estimation, units, items of work, different kinds of estimates, different methods of estimation, estimation of materials in single room building, two roomed building with different sections of walls, foundation, floors and roofs, R.B. and R.VC.C. works, Plastering, White-washing, Distempering and painting, doors and windows, lump sum items, Estimates of canals, roads etc.

UNIT-II

Specification of Works: Necessity of specifications, types of specifications, general specifications, specification for bricks, cement, sand, water, lime, reinforcement; Detailed specifications for Earthwork, Cement, concrete, brick work, floorings, D.P.C., R.C.C., cement plastering, white and color washing, distempering, painting.

UNIT-III

Rate Analysis: Purpose, importance and requirements of rate analysis, units of measurement, preparation of rate analysis, procedure of rate analysis for items:- Earthwork, concrete works, R.C.C. works, reinforced brick work, plastering, painting, finishing(white-washing, distempering).

UNIT-IV

Public Works Account: Introduction, function of P.W. department, contract, guidelines, types of contracts, their advantages and disadvantages, Tender and acceptance of tender, Earnest money, security money, retention money, measurement book, cash book, preparation, examination and payment of bills, first and final bills, administrative sanction, technical sanction.

Valuation: Different terms used, the role of a valuer, purpose and necessity of the same. Capitalised Value, Years purchase ,sinking fund, depreciation, types of values, Purpose of valuation Different methods of valuation for

i. open plots , ii. open plots with existing residential & commercial structures iii. lease hold properties Use of valuation tables and formulae

REFERENCE BOOKS

1. Estimating & Costing in Civil Engg..: Theory & Practice by B.N.Dutta, S.Dutta & Co., Lucknow.
2. Estimating, Costing & Specification in Civil Engg. by M.Chakarborty, Calcutta
3. Estimating and Costing for Building & Civil Engg.Works by P.L.Bhasin, S.Chand & Co., N.Delhi.
4. .Building Construction Estimating by George H.Cooper, McGraw Hill Book Co., New York.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	1	-	1	-	-	3	2	-	-	2
CO2	2	2	1	1	-	1	-	2	-	1	3	2	1	1	2
CO3	2	2	1	1	-	1	-	2	-	1	3	2	1	1	2
CO4	2	2	1	1	-	1	1	2	-	1	3	2	1	1	2
CO5	3	3	3	2	-	2	2	2	-	3	3	3	3	3	3

Transportation Engg.-II

Sem -VII

General Course Information

Course Code:PCC-CVE403-T Course Credits:3 Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Understand the runway orientation and the runway length as per FAA & ICAO guidelines	L2 (Understanding)
CO2	Employ Railway Track specifications and perform geometric design of the railway track.	L3(Applying)
CO3	Analyze pavement and learn the concept of pavement maintenance management system	L4(Analysing)
CO4	Design turnout and crossings as per the Indian Railways	L5 (Evaluating)
CO5	Design the airport pavements including air-side marking & lighting as per ICAO & FAA guidelines	L6(Creating)

Course Contents

UNIT I

Railway Engineering: Permanent way, gauges in railway tracks, typical railway track cross-section, coning of wheels, Function of rails, requirement of rails, types of rail sections – comparison of rail types, length of rail, rail wear, rail failures, creep of rails, rail fixtures and fastenings – Fish plates, spikes, bolts, chairs, keys, bearing plates.

Sleepers: Functions and requirements of sleepers, classification of sleepers, timber, metal and concrete sleeper, comparison of different types of sleepers, spacing of sleepers and sleeper density.

UNIT II

Ballast: Function and requirements of ballast, types, comparison of ballast materials.

Geometric design: alignment, horizontal curves, super elevation, equilibrium, cant and cant deficiency, length of transition curve, gradients and grade compensation. Stations and yards, and their classification

Points and crossings: introduction, necessity of points and crossings, turnouts, points and crossings, design of a simple turnout.

Track Recording: Equipment, Mechanized Maintenance, High Speed Trans, Present & Future.

Signaling and interlocking: objects of signaling, engineering principle of signaling, classification of signaling, control of train movements, interlocking definition, necessity and function of interlocking, methods of interlocking, mechanical devices for inter locking. Traction and tractive resistance, stresses in track, modernization of railway track.

UNIT III

Airport Engineering: Airport site selection, various surveys for site selection. Classifications of obstructions, Imaginary surfaces, Approach zone and turning zone.Runway orientation, basic runway length, corrections for elevation, temperature & gradient, airport classification.

UNIT IV

Runway & Taxiway Design: Geometric design of runway, airport capacity, factors controlling taxiway layout, geometric design standards for taxiway holding aprons, Wind-rose diagram, Structural design of runway pavements LCN/PCN method of rigid pavement design, Pavement Evaluation for runway & taxiway, design of overlay, Terminal area, building area, parking area, apron, hanger typical airport layouts. Design of flexible and rigid runways as per FAA procedure, Specifications for the different layers of runway and taxiway pavements, Pavement management systems for runway pavements.

REFERENCE BOOKS

1. Rangawala, Railway Engineering, Charotar Publishing House, Anan (1989).
2. Aggarwal M.M., and Satish Chandra Railway Engineering, Oxford University Press (2002).
3. Horenjeff Robert, Airport Engineering, McGraw Hill International Publisher (2010)
4. Arora and Saxena, Railway Engineering, Dhanpat Rai & Sons, New Delhi (2006).
5. Khanna, Arora & Jain, Airport Planning and Design, Nem Chand & Brothers, Roorkee (1999).

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	-	1	-	-	-	-	-	1	1	-	-
CO2	1	1	3	-	-	-	-	-	-	-	1	1	1	2	3
CO3	1	3	2	1	-	-	-	-	-	-	1	1	3	1	2
CO4	1	-	3	3	2	1	-	-	-	-	2	1	1	3	2
CO5	1	-	3	3	2	1	-	-	-	-	2	1	1	3	2

Foundation Engineering

Sem -VII

General Course Information:

Course Code: PCC-CVE405-T Course Credits: **3** Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks- class performance measured through percentage of lecture attended (4 marks)- assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination- nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Describe and discuss the concepts of foundation engineering	L2 (Understanding)
CO2	Employ various methods of soil exploration for foundation engineering	L3 (Applying)
CO3	Analyze and determine earth pressure behind a retaining structure- for various soil and loading conditions.	L4 (Analyzing)
CO4	Evaluate the use of soil stabilization and geo-textiles in foundation engineering	L5 (Evaluating)
CO5	Develop and designvarious types of foundations for civil engineering works	L6 (Creating)

*Revised Bloom's Taxonomy

Course Contents

UNIT I

Introduction to soil exploration: Scope- Methods of soil exploration- spacing- significant depth-boring and sampling techniques- types of samples- sample disturbances- penetration tests (Standard Cone Penetration Test and Standard Penetration Test)- andGeophysical methods (Seismic Refraction Method & Electrical Resistivity Method).

Earth Pressure: Earth Pressures at rest condition- states of plastic equilibrium- Rankine's theory for active and passive conditions- Influence of surcharge- water table- wall friction- Numerical Problems for the determination of Active and Passive Earth Pressure diagrams- Critical height of an Unsupported Vertical Cut.

UNIT II

Stability of Slopes: Infinite slopes- Critical Depth of a cohesive Infinite Slope- types of failure- Swedish Slip Circle Method- Taylor's stability Number and Stability Curves- Concept of factors of safety- Bishop's Method of slices- Effect ofsudden draw down and submergence.

Design of Shallow Foundation: Bearing Capacity- Definitions- depth of foundation- Terzaghi's generalbearing capacity equation- IS code equation- factors affecting bearing capacity- Influence of eccentric and inclined loads. Bearing capacity by penetration tests- Plate load test.

Design Criteria for Shallow Foundations- Stability- Shear- and Settlement Failures

UNIT III

Pile Foundations: Types- function- selection of piles- pile driving formulae- point- bearing andfriction piles. Load carrying capacity of single pile- group action- spacing of piles- Negative skin friction- Concept of under reamed piles.

Caissons and Wells: Introduction-components- shapes- stability of well foundation- sinking of well- tilts andshifts.

UNIT IV

Drainage and Dewatering of Soil: Methods of Ditches and Sump- Well Point System- Shallow Well System- Deep Well Drainage- Vacuum Method- Electro Osmosis Method- Seepage Analysis for various conditions of Fully penetrating slot and partially penetrating slot- Protective Filters.

Soil stabilization and Geo-textiles: Need and advantages ofGround Improvement techniques- Stabilization (Mechanical- Lime- Cement- bitumen- Chemical) of Soils and its advantages- Geo-textiles (Concept- Types- Functions- Use of Geo-textiles in Earth Dam Construction- Road Works- Railway works- Erosion Control and in Bearing capacity Improvement

REFERENCES BOOKS:

1. Foundation Analysis and Design- by J.E. Bowles McGraw Hill Book Company- NewYork.
2. Foundation Engineering by Peck- Wiley Eastern India Limited- New Delhi.
3. . Soil Dynamics and Machine Foundations by Swami Saran- Galgotia Publishers- New Delhi
4.. Basic and Applied Soil Mechanics- by Gopal Ranjan Rao- ASR Rao- New Age Int. (P) Ltd. Pub.- New Delhi.
5.Soil Mechanics and Foundations by B. C. Punmia- Ashok Kumar Jain & Arun Kumar Jain- Laxmi Publications- New Delhi.
6.Soils and Foundations- by Cheng Liu & Jack B Evett- Prentice-Hall Inc.- USA.
7.A Text Book of Soil Mechanics Foundation Engg. by VNS Murthy – U.B.S- New Delhi.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	-	-	-	-	-	2	2	1	1	2
CO2	2	2	1	2	1	-	-	-	-	-	1	2	2	2	2
CO3	2	2	2	2	1	-	-	-	-	-	1	2	3	3	3
CO4	2	2	3	3	1	-	-	-	-	-	1	2	2	2	3
CO5	2	2	3	3	1	-	-	-	-	-	1	2	2	3	3

Construction Engineering & Management

General Course Information:

Course Code: PCC-CVE402-T Course Credits: **3** Mode: Lecture (L) Type: PCC Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks- class performance measured through percentage of lecture attended (4 marks)- assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination- nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Do basic planning for a construction project.	L2 (Understanding)
CO2	Draw networks and solve using CPM and PERT	L3 (Applying)
CO3	Analyze resource allocation for a project.	L4 (Analyzing)
CO4	Evaluate project monitoring and control.	L5 (Evaluating)
CO5	Perform quality assurance and control.	L6 (Creating)

*Revised Bloom's Taxonomy

Unit-I

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

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.

Unit-II

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 of completion.

Unit-III

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

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 in Construction

Unit-IV

Project Monitoring & Control-Supervision, record keeping, periodic progress reports, and 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 Modeling (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 and health.

Text/Reference Books:

1. Varghese, P.C., "*Building Construction"*, Prentice Hall India, 2007.
2. *National Building Code*, Bureau of Indian Standards, New Delhi, 2017.
3. Chudley, R., *Construction Technology*, ELBS Publishers, 2007.
4. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
5. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
6. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, PearsonEducationIndia, 2015
7. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, LaxmiPublications,2016.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	2	2	1	1	1
CO2	3	2	1	1	-	-	-	-	-	-	2	2	1	1	1
CO3	2	3	1	1	2	-	-	-	-	-	2	2	-	1	1
CO4	2	3	2	2	2	-	-	-	-	-	2	2	3	2	1
CO5	2	2	3	3	2	-	-	-	-	-	3	2	2	3	3

Hydrology And Water Resources

Sem -VIII

General Course Information

Course Code: PCC-CVE404-T Course Credits: **3** Mode: Lecture (L) Type: PCC Contact Hours: 3 hours Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	State and outline the concepts of Irrigation Engineering	L1 (Remembering)
CO2	Understand the basics of groundwater and hydraulics of subsurface flows.	L2 (Understanding)
CO3	Illustrate abstractions from precipitation	L3 (Applying)
CO4	Analyze the water requirement of crops, capacities of Distributaries and Canal.	L4 (Analyzing)
CO5	Plan and design Irrigation System (Canal network, irrigation structures, diversion head works, spillways and energy dissipations works etc.)	L6 (Creating)

*Revised Bloom's Taxonomy

Course Content

Unit I

HYDROLOGY: Hydrologic cycle, Precipitation: introduction, forms of precipitation, types of precipitation, measurement of precipitation, selection of rain gauge station. Hyetograph and mass curve of rainfall, Evaporation: Definition, factors affecting, measurement, evaporation control. Evapo-transpiration, Infiltration.

Definition, components of hydrographs, unit hydrograph, base flow separation, Prepositions of unit hydrograph-problems.

Types of Aquifers – Darcy's Law – Dupuit's Assumptions – Confined Aquifer – Unconfined Aquifer – Recuperation Test – Transmissibility – Specific Capacity – Pumping Test – Steady Flow Analysis Only.

Unit II

Soil-water relationship and irrigation methods: Soil-water relationship, root zone soil water, infiltration, consumptive use, field capacity, wilting point, available moisture in soil, Gross Command Area, Culturable

Command Area, intensity of irrigation, delta, base period, Kor depth, core period, frequency of irrigation, duty of water, relation between delta, duty and base period, irrigation requirement, **Methods of Irrigation-**flooding methods, border strip method, check basin and furrow method, assessment of irrigation water, sprinkler irrigation system.

Canal irrigation:Component of canal distribution system, alignment of channels, losses in irrigation channels, design discharge, silt theories and design of alluvial channels, comparison of Kennedy's and Lacey's theories, canal section and design procedure, Garrets and Lacey's diagrams.

Unit III

Cross Drainage Works: Classification and their selection, Hydraulic Design Aspects of Aqueducts, Syphon Aqueducts, Super Passage, Canal Syphon and Level Crossing, Design of Canal Transitions.

Diversion Canal Headworks: Various components and their functions, layout plan, selection of site for diversion headworks, Causes of failure of weir/barrages on permeable foundation, Bligh's creep theory, Khosla's method of independent variables, use of Khosla's curves, various corrections..

Unit IV

Regulation works: Canal falls-necessity and location, development of falls, design of cistern element, roughening devices.Design of Sarda type fall.Design of straight Glacis fall. Off-take alignment, Cross-Regulator and DistributoryHeadRegulators, devices to control silt entry into the off-taking channel and Silt Ejector, Canal Escapes.**Dams:** Design principles for gravity and earthen dams

Reference Books

1. Irrigation, Water Resources and Water Power Engg. byP.N.Modi.
2. Fundamentals on Irrigation Engg. by Bharat Singh
3. Irrigation Engg& Hydraulic Structures by S.K.Garg.
4. Irrigation Engg. byS.K.Sharma.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	2	2	1	1	1
CO2	3	2	1	1	-	-	-	-	-	-	2	2	1	1	1
CO3	2	3	1	1	2	-	-	-	-	-	2	2	-	1	1
CO4	2	3	2	2	2	-	-	-	-	-	2	2	3	2	1
CO5	2	2	3	3	2	-	-	-	-	-	3	2	2	3	3

Program Elective-I	
1. Air & Noise Pollution Control	PEC-CVE350-T
2.Solid and Hazardous Waste Management	PEC-CVE351-T
3. Environmental Impact Assessment and Life Cycle Analyses	PEC-CVE352-T
. 4. Water and Air Quality Modelling	PEC-CVE353-T
Program Elective-II	
4. Pavement Design	PEC-CVE450-T
5. Geometric Design of Highways	PEC-CVE451-T
6. Traffic Engg. & Management	PEC-CVE452-T
Program Elective-III	
4. Construction Management	PEC-CVE453-T
5. Advanced Construction Materials	PEC-CVE454-T
6. Advanced Construction Techniques	PEC-CVE455-T
Program Elective-IV	
5. Design of Concrete Structures-II	PEC-CVE456-T
6. Design of Steel Structures -II	PEC-CVE457-T
7. Advanced Structural Analysis	PEC-CVE458-T
8. Bridge Engineering	PEC-CVE459-T
Program Elective-V	
4. Irrigation & Design of Hydraulic Structures	PEC-CVE460-T
5. Open Channel Flow	PEC-CVE461-T
6. Groundwater Engg	PEC-CVE462-T

Air and Noise Pollution Control

Sem VI

General Course Information:

Course Code: PEC-CVE350-T Course Credits: 3 Mode: Lecture (L) Type: PE-I Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Understand sources of air pollution , air pollution problems	**L1(Remembering)**
CO2	Demonstrate a detailed knowledge of study the effect of meteorological parameters in the dispersion of air pollutants	**L3(Applying))**
CO3	Analyze Environment legislation and regulations for air and noise pollution	**L4(Analyzing)**
CO4	Evaluate efficiency of various air pollution control devices used for particulate removal	**L5(Evaluating)**
CO5	Design, operate and control the devices used for gaseous emission control and noise emission control	**L6(Creating)**

Course Contents

UNIT I

Air pollutants, Sources, classification, Combustion Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects,Smoke, smog and ozone layer disturbance, Greenhouse effect.

UNIT II

Air sampling and pollution measurement methods, principles and instruments, ambient air quality and emission standards, Air pollution indices, Air Act, legislation and regulations

UNIT III

Control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation etc. Biological air pollution control technologies, Indoor air quality.

UNIT IV

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 control methods

REFERENCE BOOKS

1. C. S. Rao, "Environmental Pollution Control Engineering", Wiley Eastern Limited, 2000.
2. M. N. Rao, H. V. N. Rao, Air pollution, Tata McGraw Hill Pvt. Ltd, New Delhi, 1993.
3. G.K. Nagi, M.K. Dhillon, G.S. Dhaliwal, Commonwealth Publishers, Noise Pollution.
4. S.K. Garg, Khanna publishers, Sewage Disposal and Air Pollution Engineering.
5. S.M. Khopkar, Environmental pollution analysis, New Age International Publications

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	1	2	1	-	-	-	1	1	-	-
CO2	1	2	3	-	-	1	2	1	-	-	1	1	1	2	3
CO3	1	3	-	-	-	1	2	1		1	1	2	3	-	1
CO4	-	2	3	2	-	1	2	-	-	-	2	2	1		3
CO5	-	2	3	1	-	1	2	-	2	-	2	3	1	3	2

Solid and hazardous waste management

Sem VI

General Course Information:

Course Code: PEC-CVE351-T Course Credits: 3 Mode: Lecture (L) Type: PE-I Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks- class performance measured through percentage of lecture attended (4 marks)- assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination- nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Describe the principles of solid & hazardous waste management.	**L1(Remembering)**
CO2	Acquire knowledge on specialized solid & hazardous waste treatment	**L2(Understanding)**
CO3	Illustrate various techniques for treatment of solid waste and hazardous waste	**L3(Applying)**
CO4	Analyze policies regarding solid and hazardous wastes including legal implications.	**L4(Analyzing)**
CO5	Design & optimize techniques in solid & hazardous waste management	**L6(Creating)**

Course Contents

UNIT-I

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.

UNIT-II

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

UNIT-III

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

UNIT-IV

Current Management Practices- Environmental audit- Pollution Prevention- Facility Development and operation- Site Remediation: Quantitative risk assessment- site and subsurface characterization- Containment- remedial alternatives.

REFERENCE BOOKS

1. Solid and Hazardous Waste Management , M.N. Rao and Razia Sultana

2. Environmental Hazards-Smith- Keith
3. Environmental Hazards-Iqbal- M-Srivastava- A.S. and Siddiqu- T.Q.
4. Basic Environmental Technology-Nathanson- J.A.

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	1	2	1	-	-	-	2	1	-	-
CO2	2	1	-	1	-	1	1	2	-	1	1	2	1	-	2
CO3	1	3	3	2	1	1	2	1	1	-	2	2	1	2	2
CO4	1	2	2	1	--	1	1	2	-	1	2	2	3	1	1
CO5	1	1	3	3	3	1	1	1	1	-	2	2	1	3	2

Environmental Impact Assessment and Life Cycle Analysis

Sem VI

General Course Information:

Course Code: PEC-CVE352-T Course Credits: 3 Mode: Lecture (L) Type: PE-I Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks- class performance measured through percentage of lecture attended (4 marks)- assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination- nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Be aware of the environmental legislations- policies of the country and of international environmental conventions and protocols	L1(Remembering)
CO2	Identify the environmental attributes to be considered for the EIA study	L2(Understanding)
CO3	Illustrate objectives of the EIA studies	L3(Applying)
CO4	Evaluate the methodology to prepare rapid EIA	L5(Evaluating)
CO5	Formulate the methodology Environmental Auditing	L6(Creating)

Course Contents

UNIT – I

Basic Concepts of Environmental Impact Assessment: Description of the project and the environmental setting- identification of impacts- measurement and monitoring- prediction and assessment of impacts and communication of impacts.

UNIT – II

Environmental Impact Assessment Methodologies: Checklists- matrices- networks and overlays Prediction and Assessment of Impact on the physical environment- on the resources- and on the socio-economic- Environmental cost benefit analysis Sustainable development. Life Cycle Assessment -Environmental Risk Analysis- Definition of Risk

UNIT – III

Environmental auditing: Definition and types of audits- EMS audits- performance audits; compliance audits- registration audits ISO 14000 series of standards and environmental auditing- Methodologies for Environmental Auditing: Objectives- audit teams- planning audits- conducting audits- reporting audit findings

UNIT – IV

EIA related to the following sectors - Infrastructure –construction and housing Mining – Industrial - Thermal Power - River valley and Hydroelectric Acts: Water act- Water Cess act- Air act- Environment Protection act and their amendments- Wildlife act and Forest acts. Case Studies on EIA

REFERENCE BOOKS

1. . Environmental Impact Analysis by R.K. Jail and L.V. Urban.
2. Environmental Impact Assessment by Canter.
3. Environmental Impact Assessment by J. Glasson

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	-	1	1	-	1	2	1	1	-	-
CO2	-	2	-	-	-	2	1	1	-	-	2	1	1	2	1
CO3	1	2	-	-	-	1	1	-	-	-		1	1	-	1
CO4	1	2	1	2	--	-	-	-	1	--	2	1	1	2	1
CO5	1	2	1	2	-	-	-	-	1	-	2	1	1	2	1

Water and Air Quality Modeling

Sem VI

General Course Information:

Course Code: PEC-CVE353-T Course Credits: 3 Mode: Lecture (L) Type: PE-I Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks- class performance measured through percentage of lecture attended (4 marks)- assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination- nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1	Define different mathematical models for air and water quality	**L1(Remembering)**
CO2	Recognize the risks of disposal of treated wastewater into the river	**L2(Understanding)**
CO3	Predict the quality of water and air through modeling	**L4(Analzing)**
CO4	Evaluate the physical- chemical and biological water quality which is essential for the abatement of water pollution	**L5(Evaluating)**
CO5	Design sound and sustainable water and air models under specified conditions	**L6(Creating)**

Course Contents

UNIT – I

Water and air quality management- Introduction to Mathematical Models: kinds of mathematical models – model development- Model requirements and limitations- validation effluent and stream standards; ambient air quality standards.

UNIT – II

Water quality model development- D.O. Models for Streams: Dissolved oxygen model for streams sources and sinks of dissolved oxygen estimation of system parameters Streeter Phelps model - oxygen 'sag' curve-determination of deoxygenation and re-aeration coefficients- Benthal oxygen demand mass transport mechanisms

UNIT – III

Models for Estuary and Lakes: Assumptions- Benefits- Limitations- Physical- chemical and biological processes in estuaries and lakes;

Mass transport of solutes- degradation of organic compounds- application of concepts to predict groundwater contaminant movement- seawater intrusion – basic concepts and modeling

UNIT – IV

Air quality models: Micrometeorological processes- wind rose- dispersion- coefficients and stability classes- Gaussian and dispersion model- Stack height computation- Regional air quality models- Source inventories and significance. Air pollution modeling and prediction – Plume rise modeling techniques- modeling for non-reactive pollutants- single source – short term impact- multiple sources and area sources- model performance and utilisation- computer models.

REFERENCES BOOKS

1. Environmental Engineering Peavy- Rowe and Tchobanglous- McGraw Hill.
2. Water and Waste Water Engineering (Vol. 1&2)- Fair- Geyer &Okun- John Wiley- New York.
3. Water Supply Engineering P.N. Modi- Standard Book House New-Delhi.
4. Standard Methods for the Examination of Water and Waste Water- American Public Health Association.
5. Environmental Engg.: by Howard s. Peavy& Others- MGH International.
6. Metacaf – EDDY – Waste-water engineering revised by George Teholonobus (TMH)
7. Manual on Water Supply and Treatment by Ministry of Urban Development- New Delhi.
8. Water Supply and Sewerage- McGhee- McGraw Hill.
9. Environmental Engineering- Vol. I- S.K. Garg- Khanna Publishers- New-Delhi.

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	1	-	-	-	-	-	-	1	1	-	-
CO2	1	2	-	-	-	2	2	2	-	-	-	1	1	-	2
CO3	-	3	-	1	2	1	3	1	-	-	2	1	3	-	1
CO4	1	3	1	2	-	1	-	-	2	1	2	2	3	1	2
CO5	1	1	3	2	2	1	1	-	1	-	1	1	1	3	2

Pavement Design

Sem VII

General Course Information

Course Code: PEC-CVE450-T Course Credits: 3 Mode: Lecture (L) Type: PE-II Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Identify the stresses, deflections and designs of flexible and rigid pavements	L2(Understanding)
CO2	Calculate stresses and ESWL in flexible and rigid pavements	L3(Applying)
CO3	Analyze the warping, friction, wheel load stress and calculate the combined stress	L4 (Analyzing)
CO4	Evaluate method for designing of various types of pavements	L5 (Evaluating
CO5	Design the flexible and rigid pavements using various methods	L6 (Creating)

Course Contents

UNIT-I

Introduction: Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements

Stresses and Deflections in Flexible Pavements: Stresses and deflections in homogeneous masses. Burmister's two layer theory, three layer and multi-layer theories; wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels. Repeated loads and EWL factors; sustained loads. Pavement behaviour under transient traffic loads

UNIT-II

Flexible Pavement Design Methods For Highways and Airports: Empirical, semi-empirical and theoretical approaches, development, principle, design steps, advantages; design of flexible pavements as per IRC

UNIT-III

Stresses in Rigid Pavements: Types of stresses and causes, factors influencing the stresses; general considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses

UNIT-IV

Rigid Pavement Design: Types of joints in cement concrete pavements and their functions, joint spacings; design of CC pavement for roads and runways as per IRC, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method. Design of continuously reinforced concrete pavements; Maintenance, repair and rehabilitation of pavements including design of bituminous and concrete overlays as per IRC.

REFERENCE BOOKS

1. Principles and Practice of Highway Engineering, L.R.Kadiyali, Khanna Publications
2. Highway engineering, Khanna S.K. & Justo C.E.G. Nem Chand

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	1	-	-	-	-	-	1	2	1	1	2
CO2	1	1	2	1	1	-	-	-	-	-	1	2	1	2	3
CO3	2	3	3	2	1	-	-	-	-	-	1	2	3	3	3
CO4	2	3	3	3	1	-	-	-	-	-	1	2	3	3	3
CO5	2	2	3	3	1	-	-	-	-	-	1	2	3	3	3

Geometric Design of Highways

Sem VII

General Course Information

Course Code: PEC-CVE451-T Course Credits: 3 Mode: Lecture (L) Type: PE-II Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Describe various aspects of the geometric designs of different types of roads and highways	L2(Understanding)
CO2	Draw Horizontal and Vertical Alignment of different kinds of roads.	L3(Applying)
CO3	Analyze design controls and elements of roads and highways.	L4 (Analyzing)
CO4	Evaluate design consideration of highways	L5 (Evaluating)
CO5	Design highways and expressways using IRC standards and guidelines.	L6 (Creating)

Course Contents

UNIT-I

Introduction: Classification of rural highways and urban roads, Objectives and requirements of highway geometric design;

Design Controls: Topography, vehicle characteristics and design vehicle, driver characteristics, speed, traffic flow and capacity, levels of service, pedestrian and other facilities, environmental factors; Design Elements: Sight distances

UNIT-II

Horizontal alignment - design considerations, stability at curves, super elevation, widening, transition curves; curvature at intersections

Vertical alignment - grades, ramps, design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends

UNIT-III

Design of expressways, IRC standards and guidelines for design problems; Cross Section Elements: Right of way and width considerations, roadway, shoulders, kerbs traffic barriers, medians, frontage roads; Facilities for pedestrians, bicycles, buses and trucks, Pavement surface characteristics - types, cross slope, skid resistance, unevenness;

UNIT-IV

Design Considerations: Design considerations for rural and urban arterials, freeways, and other rural and urban roads; Design of Intersections: Characteristics and design considerations of at-grade intersections; Rotary intersections; Grade separations and interchanges - Design of Parking lots

Books

1. Principles and Practice of Highway Engineering, L.R.Kadiyali and N.B.Lal, Khanna Publications
2. Traffic Engineering and Transportation Planning, L.R.Kadiyali, Khanna Publications
3. Highway Engineering, C.E.G.Justo and S.K.Khanna, Nem Chand and Brothers.
4. IRC Codes for Signs, Markings and Mixed Traffic Control in Urban Areas.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	1	1	-	-	-	-	-	1	1	1	2	2
CO2	2	2	2	2	1	-	-	-	-	-	1	2	2	2	2
CO3	1	2	2	2	1	-	-	-	-	-	1	2	3	3	3
CO4	1	2	3	3	1	-	-	-	-	-	1	2	3	3	3
CO5	2	2	3	3	1	-	-	-	-	-	1	2	3	3	3

Traffic Engineering and Management

Sem VII

General Course Information

Course Code: PEC-CVE452-T Course Credits: 3 Mode: Lecture (L) Type: PE-II Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Explain general principles of traffic engineering and management.	L2 (Understanding)
CO2	Apply traffic safety and traffic pollution measures for public good	L3 (Applying)
CO3	Analyze traffic problems and plan for traffic system's various uses	L4 (Analyzing)
CO4	Evaluate traffic and parking problems through traffic surveys	L5 (Evaluating)
CO5	Design Channels, Intersections, signals and parking arrangements	L6 (Creating)

Course Content

UNIT I

Traffic Planning And Characteristics :Road Characteristics – Road user characteristics – PIEV theory – Vehicle – Performance characteristics – Fundamentals of Traffic Flow – Urban Traffic problems in India – Integrated planning of town ,country ,regional and all urban infrastructure – Towards Sustainable approach. – land use & transport and modal integration.

UNIT II

Traffic Surveys : Traffic Surveys – Speed, journey time and delay surveys – Vehicles Volume Survey including nonmotorized transports – Methods and interpretation – Origin Destination Survey – Methods and presentation – Parking Survey – Accident analyses -Methods, interpretation and presentation – Statistical applications in traffic studies and traffic forecasting – Level of service – Concept, applications and significance.

UNIT III

Traffic Design And Visual Aids : Intersection Design – channelization, Rotary intersection design – Signal design – Coordination of signals — Grade separation – Traffic signs including VMS and road markings – Significant roles of traffic control personnel – Networking pedestrian facilities & cycle tracks.

UNIT IV

Traffic Safety And Environment: Road accidents – Causes, effect, prevention, and cost – Street lighting – Traffic and environment hazards – Air and Noise Pollution, causes, abatement measures – Promotion and integration of public transportation – Promotion of non-motorized transport.

Traffic Management : Area Traffic Management System – Traffic System Management (TSM) with IRC standards –- Traffic Regulatory Measures-Travel Demand Management (TDM) – Direct and indirect methods – Congestion and parking pricing – All segregation methods- Coordination among different agencies – Intelligent Transport System for traffic management, enforcement and education

REFERENCE BOOKS:

1. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010
2. SP:43-1994, IRC Specification, "Guidelines on Low-cost Traffic Management Techniques" for Urban Areas, 1994
3. Kadiyali.L.R. "TrafficEngineering andTransportPlanning", KhannaPublishers, Delhi, 2013
4. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	-	1	1	-	-	-	1	2	1	1	2
CO2	1	1	2	1	-	1	1	-	-	-	1	2	1	2	3
CO3	2	3	3	2	-	2	2	-	-	-	1	2	3	3	3
CO4	2	3	3	3	-	2	2	-	-	-	1	2	3	3	3
CO5	2	2	3	3	-	2	2	-	-	-	1	2	3	3	3

Construction Management

Sem VII

General Course Information

Course Code:PEC-CVE453-T Course Credits: 3 Mode: Lecture (L) Type: PE-III Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Understand and Apply various material & equipment management techniques in a project	L2(Understanding)
CO2	Illustrate the project planning, scheduling, time-cost optimization, resource allocation and project controlling	L3(Applying)
CO3	Analyze the rate analysis for the various construction activities	L4(Analyzing)
CO4	Estimate the cost for the building and the road projects	L5 (Evaluating
CO5	Prepare the contract documents for a given project &Assemble bill of quantities	L6(Creating)

Course Content

UNIT I

Quantity Surveying and Cost Estimation: Definitions, objectives, role and functions of quantity surveyor, Pre-tender survey, Quantity measurements, Bill of quantities, analysis of rates for different items of work. Specifications. General and detailed specifications for different items of work. Estimates and budgets types and their preparation. Estimate of Buildings, Roads, Building Bye Laws, Taking-off quantities, Methods of measurement, e-tendering, Bill of quantities.

UNIT II

Contracts: Definition, need, importance, types of contracts and their characteristics, procedure for tendering and contracts, evaluation and examination of tenders, award of work, Joint Ventures, Concession Agreements. Valuation, its types.Determination of value of a property, Calculation of standard rent. Definitions, functions, characteristics of project, planning and principles of Planning and Management.

UNIT III

Network Techniques: Bar milestone charts Planning and scheduling of PERT / CPM, Time cost optimization, Probability concepts Allocation of resources and resource levelling, Updating, controlling and monitoring, Work Breakdown Schedule (WBS).

UNIT IV

Material& Equipment Management: Importance, scope, objectives and functions, identification of source and vendor analysis, purchase, procurement procedure, inventory control, EOQ analysis. Importance, need, functions and principles of equipment management, types of equipment and their uses, selection planning and matching of construction plant and equipment.

Account Procedure of PWD Works: Classification of Works, Muster Roll, and Deposit works. Cash Book, Imprest, temporary Advance, Stores, Indent, Tools and Plants

REFERENCE BOOKS:

1. Seetharaman S., Construction Engineering and Management, Umesh Publication Delhi(2001).
2. Punima B. C. and Khandelwal; Project Planning and Control with PERT and CPM,Laxmi Publication New Delhi(2002).
3. K.K. Chitkara, Construction project management: planning, scheduling and controlling, Tata McGraw-Hill (1998).
4. B. Sengupta and H Guha, "Construction management and planning", Tata McGraw Hill(1995).
5. L.S. Srinath, PERT and CPM principles and Application, Third edition, Affiliated east-west press Pvt Ltd(2001)
6. J. Singh, Heavy Construction-Planning, equipment and method, Oxford & IBH Publishing Co. Pvt(1993)
7. Datta B. N. Estimating and Costing in Civil Engineering, U.B.S. Publisher(2010)
8. Kohli D. D.; A Text book on Estimating and Costing and Accounts, S. Chand & Company New Delhi(1994).
9. R.L. Peurifoy, W.B. Ledbetter and C.J. Schexnayder, "Construction planning and methods", Fifth editions, McGraw Hill International edition(1996).

Course Articulation Matrix:

Course Outcomes	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	1	-	-	1	-	1	1	1	-	-
CO2	1	3	2	-	1	1		-	2	-	3	1	1	2	3
CO3	1	3	1	-	-	1	-	-	-	1	1	1	3	-	1
CO4	1	2	-	2	-	-	-	-	-	-	1	-	1	-	3
CO5	1	3	2	1	-	-	-	-	-	-	2	-	1	3	3

Advanced Construction Materials

Sem VII

General Course Information

Course Code: PEC-CVE454-T Course Credits: 3 Mode: Lecture (L) Type: PE-III Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Explain about advance construction material, special concretes and special constructions	L2 (Understanding)
CO2	Use advance construction material for special constructions	L3(Applying)
CO3	Examine different construction material for specialized constructions	L4(Analyzing)
CO4	Select appropriate construction material for tunneling and formwork, high rise structures	L5 (Evaluating)
CO5	Designing fire resistant and low cost houses.	L6 (Creating)

Course Contents

UNIT I

Advanced Construction Materials: Plastics, Timber products and Preservation, materials for thermal insulation, materials for sound insulation. Smart Materials and their applications.

UNIT II

Special Concretes: Light Weight Concrete, Vaccuum Concrete, Waste Material Based Concrete, Fiber reinforced concrete, Polymer Concrete Composites, Ferrocement, Concreting at High and Low Temperatures, Self-Compacting Concrete (SCC), Ready Mixed Concrete (RMC) and its characteristics and advantages, Shotcrete and concreting in tunnels.

UNIT III

Techniques for Tunneling and Formwork: Earthwork including cut and cover method, TBM, EBM and trenchless technology, Slip Form Shuttering, Latest type of Formwork, e.g. DOKA.

High Rise Structures: Construction techniques for high rise buildings, chimneys, dams. Special problems of high-rise construction & optimization of space

UNIT IV

Fire Resistance in Structures: Fire hazards in buildings and preventive measures,

Low Cost Housing: Types, Design and advantages.

Special Constructions: Pre-Cast and Pre-Fabricated Construction and Modular Construction, production and utilization in various types of structures, Environmental and Economic Benefits.

REFERENCE BOOKS

1. Low Cost Houses, Publications by HUDCO, India Habitat Centre, Lodhi Road, New Delhi(1982)

2. F. Glower, Structural Pre-cast Concrete, Oxford Publishers.(1974)

3. Neil Jackson and R. K. Dhir, Civil Engineering materials, Macmillan Fourth edition.(1996)

4. M.L. Gambhir , Neha Jamwal, Building Materials, Products, properties and systems, Mc Graw Hill(2011)

5. M.L. Gambhir, Concrete Technology, Mc Graw Hill(2013)

6.. Subir Sarkar, Subhajit Sarawati, Construction Technology, Oxford University Press (2008).

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	-	1	-	-	-	1	1	1	1	2
CO2	2	1	1	1	1	-	1	-	-	-	1	1	1	2	2
CO3	2	1	2	2	1	-	1	-	-	-	1	2	2	3	3
CO4	2	2	3	2	1	-	1	-	-	-	1	2	2	3	3
CO5	2	2	3	2	1	-	2	-	-	-	1	2	3	3	3

Advanced Construction Techniques
Sem VII

General Course Information

Course Code: PEC-CVE455-T Course Credits: 3 Mode: Lecture (L) Type: PE-III Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Describe advance construction techniques for different types of structures.	L2(Understanding)
CO2	Use advance construction techniques for sub structure, super structure and special structures	L3(Applying)
CO3	Examine different construction techniques for various type of constructions	L4 (Analyzing)
CO4	Select appropriate civil engineering techniques for rehabilitation, strengthening and demolition of structures	L5 (Evaluating
CO5	Constructing earth quake resistant structures	L6 (Creating)

Course Content

UNIT-I

Sub Structure Construction: Box jacking, Pipe jacking ,Under water construction of diaphragm walls and basement ,Tunneling techniques ,Piling techniques ,Driving well and caisson ,sinking cofferdam ,cable anchoring and grouting ,Driving diaphragm walls, Sheet piles ,Laying operations for built up offshore system ,Shoring for deep cutting ,Large reservoir construction ,well points ,Dewatering for underground open excavation.

UNIT II

Super Structure Construction For Buildings : Vacuum dewatering of concrete flooring, Concrete paving technology ,Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections ,Erection techniques of tall structures, Large span structures ,launching techniques for heavy decks, in-situ pre-stressing in high rise structures, Post tensioning of slab,aerial transporting –Handling and erecting lightweight components on tall structures

UNIT III

Construction Of Special Structures: Erection of lattice towers, Rigging of transmission line structures ,Construction sequence in cooling towers, Silos, chimney, sky scrapers ,Bow string bridges, Cable stayed bridges ,Launching and pushing of box decks ,Construction of jetties and break water structures –Construction sequence and methods in domes –Support structure for heavy equipment and machinery in heavy industries –Erection of articulated structures and space decks.

UNIT IV

Rehabilitation And Strengthening Techniques :Seismic retrofitting, Strengthening of beams, Strengthening of columns, Strengthening of slab, Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation, Micro piling and underpinning for strengthening floor and shallow profile, Sub grade water proofing, Soil Stabilization techniques.

Demolition : Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.

REFERENCE BOOKS:

1. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.
2. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
3. Jerry Irvine, Advanced Construction Techniques, CA Rocketr, 1984
4. Peter.H.Emmons, “Concrete repair and maintenance illustrated”, Galgotia Publications Pvt. Ltd., 2001.
5. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University Press, New Delhi, 2008.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	1	-	-	-	1	1	1	1	2
CO2	2	2	1	1	1	-	1	-	-	-	1	1	1	2	2
CO3	2	2	2	2	1	-	1	-	-	-	1	2	2	3	3
CO4	2	2	3	3	1	-	1	-	-	-	1	2	2	3	3
CO5	2	2	3	3	1	-	2	-	-	-	1	2	3	3	3

Design of Concrete Structures-II
Sem VIII

General Course Information

Course Code: PEC-CVE456-T Course Credits: 3 Mode: Lecture (L) Type: PE-IV Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Explain design of special concrete structures like continuous/ curved beams, stair-cases, water tanks, domes, retaining walls and bridges.	L2(Understanding)
CO2	Employ the concepts of structural engineering for the construction of special structures.	L3(Applying)
CO3	Examine the structural aspects of special structures.	L4 (Analyzing)
CO4	Evaluate the structural condition of special structures	L5 (Evaluating)
CO5	Design special concrete structures like continuous/ curved beams, stair-cases, water tanks, domes, retaining walls and bridges.	L6 (Creating)

*****Revised Blooms Taxonomy

UNIT I

Continuous Beams: Basic assumptions, Moment of inertia, settlements, Modification of moments, maximum moments and shear, redistribution of moments for single and multi-span beams, design examples.

Stair- Cases: Type of stair-cases, Effective span of stairs, Distribution of loads on different types of stair cases, Design examples.

UNIT II

Water Tanks: Estimation of Wind and earthquake forces, design requirements, rectangular and cylindrical underground,Intze tanks, design considerations, design examples.

UNIT III

Design of curved beams in plan: Analysis and Design of curved beams fixed at both ends, ring beams

Design of Domes: Meridional and hoop stress in spherical and conical domes.

UNIT IV

Retaining walls: Design of cantilever and counter fort type retaining walls.

Introduction to Bridge Engineering: Definition, components of a bridge, classifications, importance of bridges. Need for investigations, selection of bridge site, I.R.C. loadings.

Text Books

1. Reinforced Concrete Structures, P. C. Varghese, Tata McGraw Hill
2. Advanced Reinforced Concrete Structures, P. C. Varghese, Tata McGraw Hill
3. Reinforced Concrete Design, M.L. Gambhir, Macmillan India Ltd., New Delhi
4. Limit State Design of Reinforced Concrete, A.K. Jain, Nem Chand and Bros., Roorkee
5. Behaviour, Analysis and Design of R.C.C. Structural Elements, I.C. Syal and Ummat, A.H. Wheelers, New Delhi
6. Elements of Bridge Engineering, D. Johnson Victor, Oxford and IBH Publishers, New Delhi.
7. Plain and Reinforced concrete, Vol. 2, O P Jain and J. Krishna, Nem Chand and Bros., Roorkee
8. Reinforced Concrete Design, S U Pillai and D Menon, Tata McGraw Hill

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	-	-	-	1	1	1	2	2
CO2	2	2	2	2	1	-	-	-	-	-	1	1	1	2	2
CO3	2	2	2	2	1	-	-	-	-	-	1	1	1	2	2
CO4	2	2	3	3	1	-	-	-	-	-	1	1	2	3	3
CO5	2	2	3	3	1	-	-	-	-	-	1	1	2	3	3

Design of Steel Structures-II
Sem VIII

General Course Information

Course Code: PEC-CVE457-T Course Credits: 3 Mode: Lecture (L) Type: PE-IV Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Understand the concept and design of plastic and steel structures	L2(Understanding)
CO2	Analyze wind forces as per IS codes on various structures	L3(Applying)
CO3	Analyze and design the various tubular steel structures, roof trusses based on latest Indian standards	L4 (Analyzing)
CO4	Develop Conceptual knowledge about cold form sections.	L5 (Evaluating)
CO5	Design the plastic and steel structures	L6 (Creating)

*****Revised Blooms Taxonomy

UNIT I

Elementary Plastic Analysis and Design: Introduction, Scope of plastic analysis, shape factor, mechanisms, plastic collapse, plastic analysis of beams and portal frames, design of beams.

UNIT II

Design of Steel Stacks: Introduction, various loads to be considered for the design of steel stacks, design of steel stacks including foundation.

Cold formed Sections: Introduction and brief description of various types of cold formed sections.

UNIT III

Design of round tubular structures - Introduction, sectional properties, permissible stresses, grades of steel tubes, tubular tension members, tubular compression members, tubular flexural members, combined bending and axial stresses.

Tubular Light Poles: calculation for wind loads, design and analysis of tubular street light poles.

Towers: Basic introduction to transmission and telecommunication towers.

UNIT IV

Roof trusses: Introduction, types, components, design considerations, design of roof trusses.

Water Tank: Analysis and design of rectangular water tank

Text Books

1 Design of Steel Structures, A.S. Arya and J.L. Ajmani, Nem Chand Brothers, Roorkee

2 Design of Steel Structures, Ram Chandra, Vol. I & II, Standard Book House

3 Design of Steel Structures, P. Dayaratnam, Wheeler Publishing, New Delhi.

Reference Books

1 BIS Codes IS 800:2007, IS 801:1975, IS 875

2 Design of Steel Structures, B.C. Punmia, Laxmi Publication, Delhi

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	-	-	-	-	-	1	1	1	1	1
CO2	2	2	2	1	1	-	-	-	-	-	1	1	1	2	2
CO3	2	2	2	1	1	-	-	-	-	-	1	1	1	2	2
CO4	2	2	3	2	1	-	-	-	-	-	2	1	2	3	3
CO5	2	2	3	2	1	-	-	-	-	-	2	1	2	3	3

Advanced Structural Analysis

Sem VIII

General Course Information:

Course Code: PEC-CVE458-T Course Credits: **3** Mode: Lecture (L) Type: PE-IV Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks- class performance measured through percentage of lecture attended (4 marks)- assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination- nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Understand various methods of structural analysis	L2 (Understanding)
CO2	Apply various system matrices for development of different type of structures	L3 (Applying)
CO3	Analyze two hinged and three hinged arches and cables	L4 (Analyzing)
CO4	Evaluate deflections in complex structures using stiffness and matrix methods	L5 (Evaluating)
CO5	Develop system flexibility matrices for different types of structures using System Approach and subsequently analyze the structures.	L6 (Creating)

*Revised Bloom's Taxonomy

Course Contents

UNIT I

Analysis of typical structures: Two hinged and three hinged arches- influence lines for thrust- radial shear and bending moment- Analysis of cables.

Introduction to system approach: Force and Displacement methods

UNIT II

Matrix Force Method: Introduction to flexibility approach- Choice of redundant- static equilibrium matrix- deformation compatibility matrix- member flexibility matrix- static equilibrium and deformation compatibility checks. Application for trusses- continuous beams and rigid frames

UNIT III

Matrix Displacement or Stiffness Method: Introduction to displacement approach- calculation of kinematic indeterminacy- development of stiffness matrices for continuous beams and rigid jointed frames- Development of matrix displacement approach and application to continuous beams and rigid frames

UNIT IV

Transformation Matrices: Element Approach: Introduction to Element Approach- Development of force transformation matrices and system flexibility matrix using element approach- Development of transformation matrices and system stiffness matrix using element approach- Analysis of structures using element approach..

REFERENCE BOOKS:

1. Gere J. M. and Weaver W.; Matrix Analysis of Framed Structures- CBS Publishers & Distributors
2. Pandit G. S. and Gupta S. P.; Structural Analysis – A Matrix Approach; Tata McGraw Hill Education Pvt. Ltd
3. Martin H. C.; Matrix Structural Analysis- McGraw Hill Book Company- New York
4. Prakash Rao D. S.; Structural Analysis – A Unified Approach- Tata McGraw Hill Publishing
5. Reddy C. S.; Basic Structural Analysis- Tata McGraw Hill Publishers
6. Structural Analysis, Bhavikatti S.S.,Vikas Pub.House, N.Delhi

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	2	-	-	-	-	-	1	2	1	1	2
CO2	2	2	2	2	2	-	-	-	-	-	1	2	2	2	2
CO3	2	2	3	3	2	-	-	-	-	-	2	2	3	3	3
CO4	2	2	3	3	2	-	-	-	-	-	1	2	3	3	3
CO5	2	2	3	3	3	-	-	-	-	-	1	2	3	3	3

Bridge Engineering
Sem VIII

General Course Information:

Course Code: PEC-CVE459-T Course Credits: **3** Mode: Lecture (L) Type: PE-IV Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks- class performance measured through percentage of lecture attended (4 marks)- assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination- nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Describe and discuss the design and specifications of various types of bridges	L2 (Understanding)
CO2	Specify various sub-surface investigations required for bridge construction and use them to calculate the hydraulic design requirements of different bridges.	L3 (Applying)
CO3	Analyze and perform design of RC slab culverts - RC T-Beam Bridges and steel bridges	L4 (Analyzing)
CO4	Evaluate various elements of sub-structures of a bridge	L5 (Evaluating)
CO5	Design various types of bearings and joints in bridge structures.	L6 (Creating)

*Revised Bloom's Taxonomy

Course Contents

UNIT-I

Introduction: Definition- components of bridge- classification of bridges- selection of site- economical span- aesthetics consideration- necessary investigations and essential design data.

Standard Specifications for Roads and Railways Bridges: General- Indian Road Congress Bridge Code- width of carriage way- clearance- various loads to be considered for the design of roads and railway bridges- detailed explanation of IRC standard live loads.

UNIT-II

Design Consideration for R. C. C. Bridges: Various types of R.C.C. bridges (brief description of each type)- design of R.C.C. culvert and T-beam bridges.

UNIT-III

Design Consideration for Steel Bridges: Various types of steel bridges (brief description of each)- design of truss and plate girder bridges.

UNIT-IV

Hydraulic & Structural Design: Piers- abutments- wing-wall and approaches.

Brief Description: Bearings- joints- articulation and other details.

Construction- inspection and maintenance of bridges including case studies

Introduction to suspension bridges- cantilever bridges- cable-stayed bridges

REFERENCE BOOKS:

1. Essentials of Bridge Engineering- D.J.Victor- Oxford & IBH Pub.N.Delhi.
2. Design of Bridges- N.Krishna Raju- Oxford & IBH- N.Delhi.
3. Bridge Deck Analysis- R.P.Pama&A.R.Cusens- John Wiley & Sons.
4. Design of Bridge Structures- T.R.Jagadish&M.A.Jairam- Prentice Hall of India- N.Delhi.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	2	-	-	-	-	-	1	2	1	2	2
CO2	1	2	2	2	2	-	-	-	-	-	1	2	2	2	2
CO3	1	2	2	2	2	-	-	-	-	-	1	2	2	3	3
CO4	2	2	3	3	2	-	-	-	-	-	1	2	3	3	3
CO5	2	2	3	3	2	-	-	-	-	-	1	2	3	3	3

Irrigation & Design of Hydraulic Structures
Sem VIII

General Course Information:

Course Code: PEC-CVE460-T Course Credits: **3** Mode: Lecture (L) Type: PE-V Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks- class performance measured through percentage of lecture attended (4 marks)- assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination- nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Explain concepts and designs of hydraulic structures and water distribution systems for irrigation.	L2 (Understanding)
CO2	Compute the irrigation water requirement of crops.	L3 (Applying)
CO3	Analyzing alignments for construction of water distribution system and construction of hydraulic structures for them.	L4(Analyzing)
CO4	Evaluate the water losses in canal & systems	L5(Evaluating)
CO5	Help in designing of hydraulic structures for irrigation water distribution systems.	L6(Creating)

*Revised Bloom's Taxonomy

Course Contents

UNIT I

Water requirement of crops: Irrigation systems: Need-minor and major- command area development - Crops and crop seasons in India- cropping pattern- duty and delta- Quality of irrigationwater- Soil-water relationships: soil characteristics significant from irrigation considerations- root zone soil water- infiltration- consumptive use- irrigation requirement- frequency of irrigation- Methods of applying water to the fields: surface- sub-surface- sprinkler and trickle / drip irrigation

Reservoirs: Types- capacity of reservoir- fixing of control levels - yield of reservoir- reservoir regulation- erosion and sedimentation- economic height of dam- selection of suitable site.

UNIT II

Dams and spillways: Embankment dams: Classification- selection of site for dam- design considerations- estimation and control of seepage- slope protection Gravity dams: forces on gravity dams- causes of failure-

elementary and practical profile- structural joints- keys and water seals- galleries- outlets- Arch and buttress dams: types Spillways: components of spillways- types- terminal structures- types of gates for spillway crests Weir and barrage- types of weirs- Theories of seepage for design of weirs

UNIT III

Distribution system: Canal systems- alignment of canals- canal losses- estimation of design discharge Design of 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: economics of lining- types of lining- Drainage of irrigated lands: necessity- methods

UNIT IV

Hydraulic structures for distribution system: Surface and sub-surface flow considerations for design of canal structures:hydraulic jump- seepage forces- uplift forces Canal falls- cross regulator- distributary head regulator- canal escapes: types- components and design considerations

Cross drainage works: need- types- design considerations different units of headworks- sediment control in canals- river training for canal headworks-

REFERENCE BOOK:

1. G L Asawa- Irrigation Engineering- Wiley eastern
2. S K Garg- Irrigation Engineering & Hydraulic Structures- Khanna Publishers
3. P N Modi- Irrigation Engineering & Hydraulic Structures
4. Bharat Singh- Fundamentals of Irrigation Engineering- Nem Chand- Roorkee(1988)
5. S.R. Sahasrabudhe- Irrigation Engineering and Hydraulic Structures- S K Kataria& Sons- New Delhi(2014)
6. P Novak- A I BMoffat- C Nalluri& R Narayanan- Hydraulic Structures- Taylor &Francis(2014)

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	-	-	-	1	2	2	2	2
CO2	2	2	2	2	1	-	-	-	-	-	1	2	2	3	3
CO3	2	2	2	2	1	-	-	-	-	-	1	2	2	3	3
CO4	2	3	3	3	2	-	-	-	-	-	1	2	2	3	3
CO5	2	3	3	3	2	-	-	-	-	-	2	2	2	3	3

Open Channel Flow
Sem VIII

General Course Information:

Course Code: PEC-CVE461-T Course Credits: **3** Mode: Lecture (L) Type: PE-V Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks- class performance measured through percentage of lecture attended (4 marks)- assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination- nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Outline types of flow in river and channels	L1(Remembering)
CO2	Understand flow patterns and dynamics through open channels.	L2 (Understanding)
CO3	Select and utilize hydraulic machine correctly according to the circumstances	L3 (Applying)
CO4	Examine the hydraulic jump pattern and its applications.	L4 (Analyzing)
CO5	Evaluating the importance of various hydraulic machines	L5 (Evaluating)

*Revised Bloom's Taxonomy

Course Contents

Unit I

Flow in Open Channels: Difference between pipe flow and channel flow- Types of channels- Classification of flows- Sub Critical and Supercritical Flows- Velocity distribution in channel.

Flow Measurement: Flow over notches and weirs- Pitot tube floats and current meters for velocity measurement- Flow over Spillways- Sluice gates- Freeoverfall flow.

Unit II

Unsteady flow and Hydraulic jump: Froude number and types of hydraulic jump- Applications Jumps in channels. Unsteady flow equation- Pre jump and post jump depths- length of Hydraulic Jump and energy dissipation- Surges.

Concepts of Specific energy and specific Force: Specific energy and specific curve- Momentum Equation in open channels- Specific force & specific force curve Critical depth and its computation.

Unit III

Gradually Varied Flow: Channel transitions- Non-uniform flow in open channels- Dynamic equation for GVF- Water surface profiles in channels of different slopes GVF flow computations. Design of Channels- Most efficient channel sections.

Unit IV

Pumps and Turbines: Reciprocating pumps- their types- work done by single and double acting pumps. Centrifugal pumps- components and parts and working- types- heads of a pump-statics and manometric heads- Force executed by fluid jet on stationary and moving flat vanes.- Turbines-classifications of turbines based on head and specific speed- component and working of Pelton wheel and Francis turbines- Cavitation.

REFERENCE BOOKS:

1. K. Subramanya- "Flow in Open Channels"- Tata McGraw Hill- New Delhi.
2. K.G. Ranga Raju- "Flow Through Open Channels"- Tata McGraw Hill- New Delhi.
3. F. M. Hendersen- "Open Channel Flow"- McMillan- New York.
4. R. H. French- "Open-Channel Hydraulics"- McGraw Hill Publishing Company- New York.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	-	-	-	-	-	-	1	2	1	1	2
CO2	2	2	2	2	1	-	-	-	-	-	1	2	1	2	2
CO3	2	2	2	2	2	-	-	-	-	-	1	2	2	3	3
CO4	2	2	2	2	1	-	-	-	-	-	1	1	2	2	2
CO5	2	3	3	3	2	-	-	-	-	-	1	2	2	3	3

Groundwater Engineering
Sem VIII

General Course Information:

Course Code: PEC-CVE461-T Course Credits: **3** Mode: Lecture (L) Type: PE-V Contact Hours: 3 hours (L) Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks- class performance measured through percentage of lecture attended (4 marks)- assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination- nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes

S. No.	**Course outcomes** At the end of the course students will be able to:	RBT* Level
CO1	Define the discharge in well for different aquifers.	L1(Remembering)
CO2	Learn the principles and dynamics of groundwater flow.	L2 (Understanding)
CO3	Use various methods for ground water exploration	L3 (Applying)
CO4	Examine the reasons of groundwater depletion and fluctuations	L4 (Analyzing)
CO5	Appraise the principles of well hydraulics and methods of well construction.	L5 (Evaluating)

*Revised Bloom's Taxonomy

Course Contents

UNIT I

Principles of Ground water flow: Definition and occurrence of ground water flow- Role of ground water in a hydrologic cycle- Mechanical energy and fluid potential- Hydraulic head- Darcy's law- Heterogeneity and anisotropy- Range and validity of Darcy's law- Types of aquifer and its properties- Compressibility- Specific storage- Storativity- Ground water flow equation- Solution of flow equation- Analytical solutions- Steady flow in a confined and unconfined aquifer- Graphical solutions- Flow lines and Equipotential lines- Flow net- Refraction of flow lines.

UNIT II

Well Hydraulics: Introduction- Drawdown due to abstraction from well- Steady and unsteady abstraction from well- Well interference- Pumping test analysis- Infiltration wells and gallery.

Well Construction: Method of construction of shallow and deep well- well log- well completion- horizontal well

UNIT III

Groundwater Conservation: Regional groundwater budget- Resource assessment- Estimation of recharge- artificial recharge.

Groundwater quality: Indian and international standards- Pollution of groundwater sources- Advection and dispersion- sorption and diffusive mass transfer- remedial and preventive measures.

UNIT IV

Exploration: Geophysical- Electric resistivity method- Seismic refraction method- Saline water intrusion in aquifers- Groundwater levels fluctuation.

REFERENCE BOOKS:

1. Raghunath H M- Groundwater- New Age International(2007).
2. David Keith Todd- Groundwater Hydrology- Wiley India Edition(2007).
3. Franklin W. Schwartz and Hubao Zhang- Fundamentals of Groundwater- John Wiley(2003).
4. Bear- J. Hydraulics of Groundwater- McGraw-Hill(1979).
5. Freeze- R.A. and Chery- J.A- Groundwater. Prentice Hall-Inc- Englewood Cliffs- New Jersey(1979)

Course Articulation Matrix:

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CO1	2	2	1	1	1	-	-	-	-	-	1	2	1	1	2
CO2	2	2	1	2	1	-	-	-	-	-	1	2	1	2	2
CO3	2	2	1	2	2	-	-	-	-	-	1	2	2	2	2
CO4	2	2	1	1	1	-	-	-	-	-	1	2	2	2	2
CO5	2	2	3	2	2	-	-	-	-	-	2	2	2	3	3