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