Maharshi Dayanand University, Rohtak

(A State University established under Haryana Act No. XXV of 1975)
(NAAC Accredited 'A^{+}' Grade)

Scheme of Studies and Examination

B.Tech. (Civil Engineering)

7th and 8thSemester

Scheme effective from 2021-22

Course code and definitions:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
PROJ	Project

General Notes:

1. Mandatory courses are non-credit courses in which students will be required passing marks in internal assessments.
2. Students will be allowed to use non programmable scientific calculator. However, sharing of calculator will not be permitted in the examination.
3. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer, if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.

Scheme of Studies and Examination

B.Tech. (Civil Engineering) – 7th Semester

w.e.f. 2021-22

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Internal Assessment	Theory	Practical	Total	
1	Professional Core course	PCC-CE-401G	Construction planning and management	2	1	0	3	3	25	75	-	100	3
2	Professional Core course	PCC-CE-403G	Advanced steel structure	2	1	0	3	3	25	75	-	100	3
3	Professional Core course	PCC-CE-405G	Design of Hydraulic Structures	2	1	0	3	3	25	75	-	100	3
4	Professional Elective course	*	ElectiveIII **(Refer List-I)**	2	1	0	3	3	25	75	-	100	3
5	Professional Elective course	**	Elective IV **(Refer List-II)**	2	1	0	3	3	25	75	-	100	3
6	Professional Elective course	***	Elective V (**Refer List-III)**	2	1	0	3	3	25	75	-	100	3
7	Practical Training	PT-CE-425G	Industrial training viva							**Refer Note 1***			-
8	Project	PROJ-CE-427G	Project work-I	0	0	6	6	3	50		50	100	3
TOTAL								**21**	**200**	**450**	**50**	**700**	

Note:

1. The valuation of Industrial training viva (PT-CE-425G) will be based on seminar, viva-voce, report submitted by the students. According to performance, the students are awarded grades A, B, C, F. A student who is awarded 'F' grade is required to repeat Industrial training.

   Excellent:A;Good:B; Satisfactory: C; Not Satisfactory: F

2. *Choose any one subject from **LIST I.**
3. **Choose any one subject from **LIST II.**
4. ***Choose any one subjectfrom**LIST III.**

ELECTIVE- III (PEC) –LIST I

S.no	Name of course	Code	L-T-P	Credits
1.	Disaster Management and Mitigation	PEC-CEEL – 407 G	2-1-0	3
2.	Environmental Management	PEC-CEEL - 409 G	2-1-0	3
3.	Hydro Power Engineering	PEC-CEEL - 411 G	2-1-0	3

ELECTIVE- IV(PEC) –LIST II

S.no	Name of course	Code	L-T-P	Credits
1.	Ground water engineering	PEC-CEEL - 413 G	2-1-0	3
2.	Watershed Management	PEC-CEEL –415 G	2-1-0	3
3.	River Engineering	PEC-CEEL –417 G	2-1-0	3

ELECTIVE- V(PEC) –LIST III

S.no	Name of course	Code	L-T-P	Credits
1.	Railway and Airport Engineering	PEC-CEEL -419 G	2-1-0	3
2.	Traffic Engineering	PEC-CEEL -421 G	2-1-0	3
3.	Bridge Engineering	PEC-CEEL -423 G	2-1-0	3

Scheme of Studies and Examination
B.Tech. (Civil Engineering)– 8th Semester
w.e.f. 2021-22

Sr. No.	Category	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
				L	T	P			Internal Assessment	Theory	Practical	Total	
1	Professional Core course	PCC-CE-402G	Estimation, Costing and Valuation	2	1	0	3	3	25	75	-	100	3
2	Professional Elective course	*	Elective –VI **(Refer List-IV)**	2	1	0	3	3	25	75	-	100	3
3	Professional Elective course	**	Elective –VII **(Refer List-V)**	2	1	0	3	3	25	75	-	100	3
4	Open elective course	***	Open elective-I **(Refer List-VI)**	3	0	0	3	3	25	75	-	100	3
5	Seminar	S-CE-418G	Seminar	0	0	2	2	1	25	-	-	25	-
6	Mandatory courses (non-credit)	MC-317G*	Constitution of India	2	0	0	2	-	**Refer Note 1***				
7	Project	PROJ- CE-420-G	Project work-II	0	0	8	8	4	75		75	150	3
		TOTAL						**17**	**200**	**300**	**75**	**575**	

*__Note: 1. MC-317G__ is a mandatory non-credit course in which the students will be awarded gradesA, B, C, F as per their performance. A: Excellent, B: Good, C: Satisfactory, F: Not Satisfactory.

A student who is awarded 'F' grade is required to repeat course.

2. *Choose any one subject from **LIST IV**
3. **Choose any one subject from **LIST V**
4. ***Choose any one subject from **LIST VI**

ELECTIVE-VI (PEC) –LIST IV

S.no	Name of course	Code	L-T-P	Credits
1.	Ground Improvement Techniques	PEC-CEEL -404G	2-1-0	3
2.	Rock Mechanics	PEC-CEEL -406G	2-1-0	3
3.	Geotechnology	PEC-CEEL -408G	2-1-0	3

ELECTIVE-VII (PEC) –LIST V

S.no	Name of course	Code	L-T-P	Credits
1.	Advanced Structure Analysis	PEC-CEEL - 410G	2-1-0	3
2.	Finite Element Method	PEC-CEEL -412G	2-1-0	3
3.	Structural dynamics	PEC-CEEL -414G	2-1-0	3

OPEN ELECTIVE COURSES -I (OEC) – LIST VI

S.no	Code	Name of course	L-T-P	Credits
1.	OEC-PHY-101G	Material Science	3-0-0	3
2	OEC-CH-401G	Chemistry-II (Chemical Applications)	3-0-0	3
3	OEC –ME-402G	Operation Research	3-0-0	3
4	OEC-ME-410G	Quality Engineering	3-0-0	3
5	OEC –EE-412G	Electrical Power Generation	3-0-0	3
7.	OEC-CE-416G	Solid and Hazardous waste management	3-0-0	3
8	OEC-ECE-451G	Electronic Principles	3-0-0	3
9.	OEC-ECE-452G	Intelligent Instrumentation for Engineers	3-0-0	3
10	OEC-CSE-430G	Computer Communication	3-0-0	3

Course code	**PCC-CE- 401G**				
Category	Professional Core course				
Course title	**Construction Planning and Management**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

At the end of this course, the students should be able:

- To learn the Basic knowledge of construction management, bar/milestone chart,
- To get knowledge of PERT and CPM, CPM (Cost Model).
- To know the construction equipment's and selection of construction equipment's.

Note:
Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit -I

Module 1: Introduction

Project Management, Project Planning, Scheduling, Controlling, Methods of Planning and Programming, Bar Carts and Milestone Charts and Network Methods/Techniques.

Module 2: PERT (Programme evolution and review technique)

Time Estimates, Frequency Distribution, Mean, Variance and Standard Deviation, Probability Distribution, Beta Distribution, Expected Time, Time Computation, Network Analysis and Critical Path.

Unit -II

Module3: CPM (Critical path method)

CPM Networks, Earliest Event Time, Latest Allowable Occurrence Time, Earliest Start time, Earliest Finish Time, Latest Start Time, Latest Finish Time, Float, Critical Activity and Critical Path.

Module 4: CPM (Cost model)

Project Cost, Direct Project Cost, Indirect Project Cost, Total Project Cost and Optimum Duration, Slope of Direct Cost Curve and Steps in Time Cost Optimization.

Unit -III

Module 5: Construction Equipment

Classification of Major Equipment, Earth Excavating Equipment, Earth Cutting and Hauling Equipment, Earth Compacting and Grading Equipment, Concreting Plant and Equipment.

Module 6: Selection of construction equipment

Task Considerations, Cost Considerations, Equipment Engineering Considerations and Equipment Acquisition Options.

Unit -IV

Module 7: CPM (Updating)

Updating Process, Data Required for Updating, Steps in the Process of Updating, When to Update. PPT/BOT Techniques and its variance.

Module8: Resources Allocation

Resource's usage profiles, Histograms, Resources Smoothing, Resources Levelling and Risk associated in construction project Management.

Course Outcomes:

After completing this course, students should be able:

- Proficient enough to apply the concepts of the construction project management with time and cost estimates.
- Different Cost of the Projects with total cost of the Project and selection of construction equipment's

Recommended Book:

1. "Project Planning and Control with CPM/PERT", Dr. B.C. Punmia, Laxmi Publication New Delhi.
2. Construction Project Management", K KCHitkara,Tata McGraw Hills.
3. "Construction Equipments", by Mahesh Verma.
4. Construction Project Management an Integrated Approach", Peter Femings Yes Dec Publishing Pvt. Ltd. Chennai 2011

Course code	**PCC-CE- 403 G**				
Category	Professional Core course				
Course title	**Advanced Steel Structure**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives

- To impart practical knowledge of advanced steel structures and their application.
- To teach the students advance level design of steel structures.
- To make the students familiar with the relevant IS codes to be used in construction industries.
- To teach the students modern design methods such as design of light gauge steel.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Eccentric and Moment Connections

Beams-Column Connections, Connections Subjected to Eccentric Shear, Bolted Framed Connections, Bolted Seat Connections, Bolted Bracket Connections. Bolted Moment Connections, Welded Framed Connections, Welded Bracket Connections and Moment Resistant Connections.

Module 2: Cold Formed Sections

Brief description of various types of cold-formed sections, local buckling, concepts of effective width and effective sections, elements with stiffeners, Design of compression and bending elements.

Unit-II

Module 3: Industrial Buildings

Loads, general arrangement and stability, design considerations, design of Purlins, design of roof trusses, industrial building frames, bracings and stepped columns.

Module 4: Towers

Transmission line towers, Microwave towers, Design loads, classification, Design and specification.

Unit-III

Module 5: Design of Water Tanks

Types of water tank, permissible stresses, design of circular, rectangular and pressed steel tanks including staging.

Module 6: Design of Steel Stacks

Types of steel stack, various loads consideration of steel stacks, Design of steel stacks including foundation.

Unit-IV

Module 7: Plate Girder

Elements of plate girder, Design steps of a plate girder, necessity of stiffeners in plate girder, various types of stiffeners, web and flange splices, Curtailment of flange plates, Design beam to column connections: Introduction, design of framed and seat connection.

Course Outcomes

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

- Apply the IS code of practice for the advanced design of steel structural elements.
- Design complicated structures like plate girder, Industrial structures and tanks.
- Design light gauge structures too.
- Use relevant IS code for above structural design.
- Students will be able to understand the advanced design of steel structure with practical application.

References:

1. Design of steel structures, A.S.Arya&J.L.Ajmani, Nemchand& Bros., Roorkee.
2. Design of steel structures (LSM), N,.Subramanian, Oxford Publication.
3. Design of steel structures, M.Raghupati, TMH Pub., New Delhi.
4. Design of steel structures, S.M.A.Kazmi&S.K.Jindal, Prentice Hall, New Delhi.
5. Design of steel structures, S.K.Duggal, TMH Pub, New Delhi.

Course code	**PCC-CE- 405 G**				
Category	Professional Core course				
Course title	**Design of Hydraulic Structures**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

- To understand design processes of hydraulic structures
- To further develop understanding on cross drainage works.
- To further develop understanding on design considerations of Dams
- To develop understanding on seepage conditions.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit- I

Module 1: River training works

Objectives and classifications of river training works, Methods of river training Bends and Meandering rivers, marginal embankments, spurs, cutoffs, bank pitching and launching apron. Design consideration of guide banks.

Module 2: Flood Routing

Flood routing categorization and methods,Basic equations in flood routing, Concept of Hydraulic routing, Hydrologic method of flood routing.

Unit II

Module 3: Design of Cross Drainage Works

Need of cross drainage works and their suitability, Canal regulation structures and design of cross drainage works, canal drops, operation and maintenance of canals.

Module 4: Hydraulic structure

Blight creep and Khosla theory, stream lines, critical exit gradient, need of weirs and barrage, Factors controlling the design of weirs and barrages and its components. Design of weirs.

Unit III

Module 5: Design of Spillways

Need of spillway, Design consideration of main spillway, Design of ogee spillway, crest of spillway and stilling basins.

Module 6: Design of Fall

Location and Necessity of falls, componentsof Sarda type fall and itsdesign, characteristics of sloping glacis falls.

Unit-IV

Module7:Dams

Planning and investigations of reservoir and dam sites, Choice of dams, preparation and protection of foundation and abutments. Dam construction problems, Forces acting on gravitydams, modes of failure and design criteria for structural stability of gravity dams, seepage line in a homogenous earth dam, equipotential lines, path lines, kozeny parabola.

Course Outcomes:

After completing this course, students should be able:
1.To identify the design lines of hydraulic structures
2. To being able to read charts for various designing purposes

Reference Books:

- Garg, S. K., "Irrigation Water Power & Water Resources Engg." Standard Publishers & Distributors, Delhi, latest edition
- Modi, P.N. "Irrigation, Water Resources and Water Power Engg." Standard Book House, N. Delhi latest edition
- Arora, K R "Irrigation Water Power & Water Resources Engg." Standard Publishers & Distributors, Delhi, latest edition
- Sharma, S.K., Principles and Practice of Irrigation Engineering, S.Chand& Co., latest edition
- Punmia, B.C., "Irrigation and Water Power Engg." Standard Publishing.

Course code	**PEC-CEEL- 407G**				
Category	Professional Elective course				
Course title	**Disaster Management and Mitigation**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

- To provide basic conceptual understanding of disasters and its relationships with development.
- Provide an understanding of the social nature of natural hazards and disasters
- Increase awareness of hazards and disasters around the world and the unequal social consequences stemming from disaster events.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Introduction: Terminology,Global and Indian scenario, role of engineer, importance of study in human life, long term effects of disaster. Geological Mass Movement and land disasters, Atmospheric disasters, Disaster Mitigation

Unit-II

Nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion, Man-made Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.

Unit -III

Damage profile analysis- Uttarkashi/Bhuj/Latur earthquakes, Kerala floods, cyclone Fani and Amphan, Bihar floods, Covid 19, Forest Related disasters, Mining disasters, Atmospheric disasters.

Unit IV

Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Use of Internet and software for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.

Course Outcomes:

After completing this course, students should be able:

- To know natural as well as manmade disaster and their extent and possible effects on the economy.
- To Plan national importance structures based upon the previous history.
- To acquaint with government policies, acts and various organizational structures associated with an emergency.
- To know the simple dos and don'ts in such extreme events and act accordingly.

Reference Books:

1. Singhal J.P. Disaster Management, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011

Course code	**PEC-CEEL- 409G**				
Category	Professional Elective course				
Course title	**Environmental Management**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:
The course should enable the students to:

- Global environmental issues and their Management.
- Green technologies for cleaner production.
- Major principles and steps required in environmental impact assessment.
- Causes of land degradation, biodiversity loss and methods of their management.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

UNIT-I

Global Environmental Problems: Global warming, green-house effect, ozone depletion, acid rain, oil pollution, radiation hazard and control, global climate change. Main clauses and basic steps for Environmental Management System certification. Environmental Laws/Acts.

UNIT-II

Cleaner Production Technologies Need and benefits, cleaner production techniques and options, zero impact manufacturing initiatives CDM and carbon credits/case studies.

UNIT-III

Environment Impact Assessment: Importance for environment management, constituents of environment impact assessment, project data for EIA study, prediction of impacts, EIA methodologies, constraints in implementation of EIA, impact prediction on water resources projects and other relevant case studies. Environment pollution.

UNIT-IV

Degradation of Land Resources: Deforestation: Forest land, deforestation and its effects onland use and Environmental quality, wetland and their importance in environment, causes and extent of wasteland, Soil degradation problems, erosion, salinization, water logging, land use management & planning.

Course Outcomes:

- An ability to understand the major global environmental issues, their causes, sources, management and laws/polices related to these technologies involved in eco-friendly production and mechanism of carbon credits.
- An ability to understand the major principles of environmental impact assessment.
- An ability to understand the implications of current rules and regulations in relation to environmental impact assessment.
- An ability to understand the causes, implications and management of local environmental issues like land degradation, wasteland and water logging.

Recommended Books:

1. Peavy, Rowe, 'Techobanoglous, Environmental Engg.' Tata McGraw Hill.
2. Mackenzie L. Davis, 'Environmental Engg.' Tata McGraw Hill.
3. Baljeet S. Kapoor; 'Environmental Engg. An overview', Khanna Publishers.
4. Glbert H. Masters, 'Environmental Engineering and Science', Prentice Hall of India Pvt. Ltd.
5. G.N. Panday, G.C. Carney Environmental Engineering, Tata McGraw Hill.
6. P.D. Sharma, Ecology and Environment, Rastogi Publications.

Course code	**PEC-CEEL- 411 G**				
Category	Professional Elective course				
Course title	**Hydro Power Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives

The objective of this Course is

- To introduce energy systems and renewable energy resources with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application.
- To explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternatives, renewable energy sources.
- To introduce basicsof turbine and powerhouse.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Introduction to Energy Sources

Sources of energy, Status of hydropower, thermal vs hydropower, advantages of hydropower, Energy contribution of hydropower in power system.

Module 2: Basics of Hydropower

Electrical load on hydropower, load curves, load factor, capacity factors, utility factors anddiversityfactors, load on hydropower stations, load curves, load duration curves, firm power, secondary power, Prediction of loads.

Unit-II

Module 3: Types of Hydropower Stations

Elements of Hydro power, classification of hydropower stations, run of river plants, General layout of run of river plants, Valley dam plants, storage and pondage.

Module 4: Basic features of Pump Storage Plants

Advantages of pump storage plants, types of pump storage plants, efficiency of pump storage plants, Reversible Turbines.

Unit-III

Module 5: Intakes

Intake structures: functions and their types, Components of intakes: forebay, trash racks, gates and valves, Force required to operate Gates.

Module 6: Water Conveyance System

Classifications of Penstocks, Design criteria of penstocks, anchor blocks, typesof valves, water hammer effects, instantaneous closure of power canal, Surge tank and its classification.

Unit-IV

Module 7: Turbines

Type of turbines, criteria for selection, specific speed of turbines, unit power, unit discharge, cavitation in turbines, Design of the draft tube.

Module 8: Power Houses

General layout and arrangements of hydro-power units, number and size of units, substructure, spacing of units, super-structure, underground power stations.

Course Outcomes:

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

- Different energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternative energy sources and their technology and application.
- Explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternatives, renewable energy sources.
- Basics of turbine and powerhouse.

References:

- Water power Engineering by Dandekar and Sharma.
- Hydropower structures Volume III-By R S Varshney.
- Hydro Power Engineering by Dr Darde P N, Vayu Education,Delhi.
- Hydro-Electric Engineering Practice Vol.I, II& III Brown J.G.
- Water Power Engineering, Borrows, H.K.
- Water Power Development, Vol.I& II, Mosonyi,E.
- Water Power Engineering, M.M.Deshmukh.

Course code	**PEC-CEEL- 413G**				
Category	Professional elective course				
Course title	**Ground Water Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

1. To introduce the student to the principles of Groundwater governing Equations and Characteristics of different aquifers.
2. To understand the techniques of development and management of groundwater.
3. Some real- world example problems are also been incorporated to give an idea about the complexities and challenges encountered during the management of groundwater processes.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Hydrogeological Parameters

Ground water exploration and methods of investigations, Characteristics of ground water, forms of subsurface water, Global distribution of water, groundwater column, Ground water table fluctuation and its interpretations, Groundwater development and Potential in India, Groundwater balance.

Module 2: Groundwater Management

Database for Groundwater Management, Groundwater budgets, Water bearing formations of Rock and their properties, safe yield, Type of aquifers, Darcy's Law, Aquifer properties.

Unit-II

Module 3: Well Hydraulics

Objectives of Groundwater hydraulics, Governing equation for flow through porous medium - Steady flow, Dupuit assumptions, equilibrium equations for confined and unconfined aquifers, Heim's equilibrium formula.

Module 4: Unsteady State Flow

Governing equation for flow through porous medium - unsteady state flow – Jacob method – Chow method- Recovery test-pumping tests, Conjunctive use – Collector well and Infiltration gallery, well loss coefficient, Partially penetrating wells - Wells in a leaky confined aquifer, interference of wells.

Unit-III

Module 5: Water Withdrawals and Uses– water for energy production, water for agriculture, water for hydroelectric generation; flood control, analysis of surface water supply, open wells in unconsolidated formations, sanitary protection of open wells.

Module 6: Tube well

Tube wells types, site selection, components, strains and its types, design of tube wells in different aquifers, drilling operation and its different methods, Construction and working of tube wells, verticality and alignment, development of tube wells, gravel packing, well sickness, corrosion and failure of tube wells, silting of tube well, optimum capacity of well.

Unit-IV

Module 7:Groundwater Conservation

Reclaimed wastewater recharge, Soil aquifer treatment, Aquifer Storage and Recovery, Seawater Intrusion and Remediation – Ground water Basin management and Conjunctive use, Contamination source inventory and remediation schemes.

Module 8: Artificial Recharge

Artificial recharge of ground water, recharge techniques induced infiltration, water spreading, flooding, basins, ditching, modification of natural channels, irrigation, recharge pits, shafts, Hydraulics of recharge wells.

Course Outcomes: The students will be able to**.**

- Understand aquifer properties and its dynamics.
- Get an exposure towards well design and practical problems of groundwater aquifers.
- To understand the importance of artificial recharge and groundwater quality concepts.
- Gain knowledge on conservation of groundwater.
- Understand different tube wells and their components.

Recommended Books:

- Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2010.
- Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York, 2000.
- S.P. Garg, Groundwater and Tube Wells, Oxford & IBH Publishing Co., 1993.
- Fitts R Charles, "Groundwater Science". Elsevier, Academic Press, 2002.

Course code	**PEC-CEEL- 415G**				
Category	Professional Elective course				
Course title	**Watershed Management**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

- To understand different watershed behaviour.
- To be able to interpret runoff data and quantify erosion by using various modelling methods.
- To understand land use classification and impact of land use changes on hydrological cycle parameters.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Introduction and Basic Concepts: Concept of watershed, need for watershed management, different stakeholders and their relative importance, watershed management policies and decision making. Sustainable integrated watershed management, natural resources management, agricultural practices, integrated farming, Soil erosion and conservation; Principles of soil erosion- causes and types of soil erosion,estimation of soil erosion from small watersheds. Control of soil erosion, methods of soil conservation-structural and non-structural measures.

Unit-II

Integrated Watershed Management: Introduction to integrated approach, Integrated water resources management, conjunctive use of water resources, rainwater harvesting; roof catchment system. Watershed Modeling: Standard modeling approaches and classifications, system concept for watershed modeling, overall description of different hydrologic processes, modeling of rainfall-runoff process, subsurface flows and groundwater flow.

Unit-III

Social Aspects of Watershed Management: Community participation, Private sector participation, Institutional issues, Socio-economy, Integrated development, Water legislation and implementations, Case studies. Use of modern techniques in watershed management: Applications of Geographical Information System and Remote Sensing in Watershed Management, Role of Decision Support System in Watershed Management.

Unit-IV

Storm Water, Flood and Drought Management: Storm water management, design of drainage system, flood routing through channels and reservoir, flood control and reservoir operation, case studies on flood damage. Drought Management: Drought assessment and classification, drought analysis techniques, drought mitigation planning.

Course Outcomes:

At the end of the course, students shall be able:

1. To identify causes of soil erosion.
2. Plan and design of soil conservation measures in a watershed.
3. Plan and design water harvesting and groundwater recharge structures.
4. Plan measures for reclamation of saline soils.

Reference:

1. Murthy, V.V.N. and M.K. Jha Land and Water Management, Kalyani Publishers, 2015
2. Watershed Management by Madan Mohan Das and M.D. Saikia, Prentice Hall of India, 2013
3. Watershed Management Muthy, J. V. S., , New Age International Publishers, 1998

Course code	**PEC-CEEL- 417 G**				
Category	Professional Elective course				
Course title	**River Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	**0**	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

- Acquaint the students to basic concepts of rivers and their significance.
- To stimulate the students to think systematically and objectively about contemporary river problems.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Introduction: classification of streams, sediment transport and budgets, River morphology and various classification schemes. River basins; erosion from river catchments and its transportation by rivers; Regimes of Flow: Ripple and dune regime, anti-dune regime, importance of regimes of flow, Bed Load Transport:Bedload equations.

Unit-II

Behaviour of Rivers: River channel patterns, Straight River channels, causes, characteristicsand shapes of meanders and control, cutoff, Braided Rivers, Bed forms, Instability of rivers, Delta formation and control.

Unit-III

Mechanics of Alluvial Rivers, Rivers and restoration structures, Socio-cultural influences and ethics ofstream restoration. Bio-engineering techniques, Classification review, Natural channel design analysis, Time series, Analysisof flow, Sediment and channel geometry data.

Unit IV

Rivertraining and protection works: Classification of River training, Types of training works, Protection for bridges with reduced waterway, Design of guide bank, Embankment andspurs, other river/flood protection work.

Course Outcomes:

After completing this course, students should be able:

- To realize the significance of river engineering in today life.
- To understand the processes involved in Bio-engineering Techniques.
- To appreciate the role of River Training and Protection Works

Recommended Books:

1. River Behaviour Management and Training (Vol. I & II), CBI&P, New Delhi.
2. Irrigation & Water Power Engineering- B. C. Punmia and Pande B. B. Lal.
3. River Engineering by Margeret Peterson.
4. Principles of River Engineering by (The non-tidel alluvial) PH Jameen.

Course code	**PEC-CEEL- 419 G**				
Category	Professional elective course				
Course title	**Railway and Airport Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

At the end of this course, the student should be able:

- To impart understanding about the various types of railways,
- To classify different tunnels and its techniques of excavation.
- To understand airport engineering.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module–1: Development of railways in India, Permanent way and railway track components, different gauges in India, conning of wheels, function and types of rails, rail sections, defects in rails, creep of rails, rail joints and welding of rails, sleepers – types, spacing and density, rail fixtures and fastenings, ballast, sub-grade and embankment.

Module–2: Geometric design of railway track: gradients, grade compensation, speed of trains on curves, super elevation, cant deficiency, negative super elevation, curves, widening on curves.

Unit-II

Module– 3: Railway traction and track resistance, stresses in railway track, rails, sleepers, ballast. Points and crossings-turnouts, switches, crossings. Track junctions- types, splits, diamond, gauntlet, scissorcrossovers.

Module– 4: Railway stations: Requirements, classifications, platforms, loops, sidings. Railway yards – types, required equipments in yards. Signaling and control system – objectives, classification, Interlocking of signals and points.

Unit-III

Module–5: Railway track - construction, drainage, maintenance. Recent developments in railways – high speed trains, modernization in track for high speed, Metro rails, Monorail, automation in operation and control, Safety in railways – accidents and remedial measures.

Module–6: Tunnels- Site selection, Classification, Size and shape of a tunnels, Methods and techniques of underground excavation in tunnels, Alignment of a Tunnel, Mucking, Lighting and Ventilation in tunnel, Drainage of tunnels, Safety in tunnel construction.

Unit-IV

Module–7: Airport Classification on the basic of community size, types of services, Aircraft Characterizes, selection of site and factors affecting site selection of airport, Airport layout plan.

Module–8: Geometric design of Runways, Airport capacity, factors effecting runway capacity, Airport markings and lightings.

Course Outcomes:

After completing this course, students should be able:

- To realize the significance of Railways and tunnels in today life.
- To understand the processes involved in railway and tunnel maintenance.
- To realize the significance of Airports in today life.
- To understand the processes involved design of airports

Recommended Books:

1. Highway Engineering – S.K.Khanna&C.J.Justo, Nemchand& Bros., 7th Edition (2000).
2. Principles and Practices of Highway Engineering – Dr.L.R.Kadiyali&Dr.N.B.Lal – Khanna publishers – (2003).
3. G.V. Rao Airport Engineering, Tata McGraw Hill Pub. Co., New Delhi
4. Airport Engineering Planning and design, Subhash C. Saxena

Course code	**PEC-CEEL- 421 G**				
Category	Professional elective course				
Course title	**Traffic Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

- Acquaint the students to basic concepts of Traffic and their significance.
- To stimulate the students to think systematically and objectively about various traffic problems

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Traffic Characteristics: Importance of traffic characteristics. Road user characteristics. Vehicular characteristics. Max dimensions and weights of vehicles allowed in India. Effects of traffic characteristics on various design elements of the road.

TrafficStudies: Traffic volume study, speed study and origin and destination study. Speed and delay study. Use of photographic techniques in traffic surveys.

Unit-II

Traffic Accidents: Accident surveys. Causes of road accidents and preventive measures, Capacity and Level of Service: Fundamental diagram of traffic flow, Relationship between speed, volume and density, Level of service, PCU, Design service volume, Capacity of non-urban roads. IRC recommendations, Brief review of capacity of urban roads.

Unit-III

Traffic Control Devices: Signs, Signals, markings and islands. Types of signs, Types of signals, Design of Signal, Intersections at grade and grade separated intersections. Types of grades separatedintersections, Parkingsurveys: On street parking, off street parking.

Unit-IV

Road safety audit, RSA team, RSA Report, Elements of RSA, Detrimental effects of traffic. Vehicular air pollution and Situation in India, Motor vehicle act, Vehicular emission norms in India and abroad. Alternate fuels. Factors affecting fuel consumption.

Course Outcomes:

After completing this course, students should be able:

- To realize the significance of traffic engineering in today life.
- To understand the processes involved in traffic studies.
- To appreciate the role of Traffic regulations.

Recommended Books:

- Principles of Transportation Engineering by Chakroborty& Das, Prentice Hall, India.
- Highway Engg by S.K.Khanna& C.E.G. Justo, Nem Chand Bros., Roorkee.
- Traffic Engg and Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.
- Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-HillPublishingCo. Ltd. N.Delhi.

Course code	**PEC-CEEL- 423 G**				
Category	Professional elective course				
Course title	**Bridge Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives

- To understand the load-carrying capacity of various types of bridges, upon learning the structural responses to different kinds of loads.
- To design short and medium span bridges, with confidence using existing codes of practice, taking into account of the structural strength, service life and durability.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Introduction

Component and classification of bridge, Historical bridges (in India and overseas), short history of bridge development, importance of bridge Investigation: Need for investigations, selection of bridge site, preliminary data to be collected, design discharge and its determination, linear waterway, economical span, vertical clearance above HFL, scour depth, choice of bridge type. Site selection-Soil Exploration for site importance of Hydraulic factors in Bridge Design.

Module 2: Planning and layout of bridges

Hydraulic design - Geological and geotechnical considerations, Standard Specifications: For road bridges, I.R.C. loadings and code provisions for standard specifications. Railway bridges, Railway bridge code. General arrangement drawing. Design aids using computer software systems.

Unit-II

Module 3:Concrete bridges

Bridge deck and approach slabs, Slab design methods, Design of bridge deck systems, Slab-beam systems (Guyon-Massonet and Hendry Jaeger methods), Box girder systems- analysis, design and detailing.

Module 4: Steel and composite bridges

Advantages and disadvantages, Orthotropic decks, Box girders, Composite steel-concrete bridges, Truss bridges- analysis and design.

Unit-III

Module 5: Sub-structure

Piers, Columns and towers,Caissons, Abutments and retaining walls, Analysis and design - Shallow and deep foundations

Module 6: Bridge appurtenances

Expansion joints, Design of joints, Types and functions of bearings, Design of elastomeric bearings, Railings, Drainage system and lighting.

Unit-IV

Module 7: Long span bridges

Design principles of continuous box girders, Curved and skew bridges, Cable stayed and suspension bridges, Seismic resistant design, Seismic isolation and damping devices.

Module 8: Construction techniques

Cast in-situ, Prefabricated, Incremental launching, Free cantilever construction, Inspection, Maintenance and rehabilitation, Current design and construction practices.

Course Outcomes:

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

- Understand the fundamentals and codes of practice of bridge design.
- Design the bridge deck and box girder systems using appropriate method.
- Devise the steel truss and composite steel-concrete bridges.
- Propose the sub-structure components such as pier, abutments and bridge bearings.
- Design the various types of long span bridges, curved and skew bridges.

Referenced Books:

1. Krishna and Raju “Bridge Engineering”.
2. Wai-Fah Chen Lian Duan, "Bridge Engineering Handbook", CRC Press, USA, 2000.
3. R.M. Barker and J.A. Puckett, “Design of Highway Bridges”, John Wiley & Sons, New York, 1997.
4. P.P. Xanthakos, "Theory and Design of Bridges", John Wiley & Sons, New York, 1994.
5. D.J. Victor, “Essentials of Bridge Engineering,” Oxford & IBH Publishing, New Delhi, 2001.

Course code	**PROJ- CE-427G**				
Category	Project				
Course title	**Project Work –I**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	0	**0**	**6**	**3**	
External marks:	50 Marks				
Internal marks:	50 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

The object of Project Work I is to start the project work early in the seventh semester and enable the student to take up investigative study in the broad field of Civil Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the department on an individual basis or in a group, under the guidance of a supervisor. This is expected to provide a good initiationfor the student(s) in R&D work.
The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.
6. Preparing a review paper forpresentation/Publication in national conference/ International conference/ Journals, if possible.

Course code	**PCC-CE- 402 G**				
Category	Professional Core course				
Course title	**Estimation, Costing and Valuation**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives: The objective of this Course is

- To analyze cost/revenue data and carry out make economic analyses in the decision-making process to justify or reject alternatives/projects on an economic basis.
- Prepare engineering students to obtain professional licensure.
- To function in the business and management side of professional engineering practice.
- To preparation estimate of the civil engineering works.
- To preparation specification of construction items.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Introduction

Purpose of estimating and valuation, Principle of estimation, unit of measurement, item work, Different kinds of estimates,Different methods of estimation.Introduction to estimates of other Civil engineering structures.

Module 2: Building Estimate

Estimation of quantity of load bearing structure with single room & two rooms,Estimation of quantity single storied residential building. Estimation of materials in multi-storey buildings with different sections of walls, foundation, floors and roofs, reinforced brick work, R.C.C works, finishing works and Lump sum items, Estimates of canals, dams, barrages and other structures.

Unit-II

Module 3: Specification

Objectives and Necessity of specification,Types of specification, General specification, Specification ofdifferent construction materials, Specification as per building

classification,Language of specific writing.Specification of Works:Detailed specification for earthworks, cement, concrete, brickwork, flooring, D.P.C, R.C.C, cement plastering, painting and other finishing.

Module 4:Market Survey

Traditional and modular materials, Market survey of construction materials, Wages of labour, Tool's plant and equipment of construction.

Unit-III

Module 5: Rate Analysis

Prerequisites, factors affecting rate analysis, over head expenses, Procedure for rate analysis: schedule of rates, labour requirement for different works, material requirement for different works, Rate analysis of different Items of work (Earth work, Concrete works, R.C.C works, Reinforce Brick work, plastering, painting, finishing).

Module 6:Abstracting and Billing

Purpose of abstract, preparation of abstract, measurement book, cash book, preparation, examination and payment of bills, first and final bills, administrative sanction, technical sanction. Billing – maintenance of muster roll,record of bills, vouchers and receipt book

Unit-IV

Module 7: Tendersand Contracts

Tender notice and documents, acceptance of tender, Earnest money, security money, retention money, Contract-contractor: terms and conditions of contract, Agreement, Form of Contract, Responsibility of owner, Architect, Contractor and Engineer.Preparation of pay bill, measurement of work for payment of contractors, different types of payment – first &final, running advance and final payment.

Module 8: Valuation

Purpose of valuation, principles of valuation,Types of property, Depreciation, Sinking fund, Lease hold and free hold property, obsolescence, Gross income, Outgoing and Net income, Capitalized value and year's purchase. valuation of a building – cost method, rental – return method.

Course Outcomes:

At the end of the course, students shall be able:

- To understand the methodology of Cost-driven design optimization.
- To get understanding of contract models, contract plans and specifications.
- The students will learn the purpose and importance of valuation

Referenced Books:

1. Dutta BN – Estimating &costing.
2. Chakraborty – Estimate costing &specification in civil engg.
3. Kohli &kohli – Atext book on estimating &costing (Civil) with drawings Ambala ramesh Publications.

Course code	**PEC-CEEL- 404 G**				
Category	Professional Elective course				
Course title	**Ground Improvement Techniques**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

At the end of this course, the students should be able:

- To various problems associated with soil deposits and methods to evaluate them.
- To improve the characteristics of difficult soils as well as design techniques required to implement various ground improvement methods.
- To impart fundamental knowledge of Ground Improvement Techniques
- To make capable of choosing and designing the appropriate method of Ground Improvement according to site conditions and requirement.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Module 1:Introduction to Ground Improvement

Definitions, Objectives of soil improvement, Classification of ground improvement techniques, considerations in the selection of the best soil improvement technique.

Module 2: Mechanical Modification

Objectives, Classification of ground modification techniques, Principle of modification for various types of soils, Soil distribution of India-Reclaimed soils.

Unit-II

Module 3: Drainage & Preloading- Drainage of slopes, Pre-loading, Assessment of ground condition for preloading, Vertical drains, Pre-loading with sand drains, Fabric drains, Wick drains, theories of sand drain, Electro kinetic dewatering

Module 4: Hydraulic Modification-Objectives,Principle and Techniques, Gravity drain,Lowering of water table, Methods of dewatering- open sumps and ditches, Single and multi-stage well point systems, Deep wells, Vacuum and electro-osmosis methods. Discharge equations, Stabilization by thermal and freezing techniques.

Unit-III

Module 5: Chemical Modification-Objectives, Effects and Methods, Techniques - sandwich technique, Granular and chemical admixtures, Cement stabilization; Criteria for cement stabilization, Lime stabilization, other chemicals, Bitumen, Tar or asphalt in stabilization, Stabilization using Fly ash

Module 6: Grouting- Grouting and its effects, Groutability and grouting materials, Suspension and solution grouts, Compaction grouting, Jet grouting, Injection methods,Grouting procedure and grout monitoring, Applications of grouting.

Unit-IV

Module 7 Earth Reinforcement-I

Stone columns, Lime Piles-Functions, Methods of installation,Estimation of load carrying capacity and settlement; Soil nailing-construction sequence, Analysis of nailed soil, Methods of installation, Ground Anchors– applications, types and components, Anchor tests.

Module 8 Earth Reinforcement-II

Principles and basic mechanism of reinforced earth, Simple design, Synthetic and natural fiberbasedGeotextilesand their applications, Filtration, Drainage,Separation and erosion control.

Course Outcomes:

On completion of the course the students will be able to

- Acquire about various techniques of ground improvement
- Knowledge about types of chemical stabilization and their construction method
- Techniques to utilise native soil for construction activities
- To identify and evaluate the deficiencies in soil deposits and capable of providing alternative methods to improve its quality.

Recommended Books:

1. Pappala, A.J., Huang,J., Han, J., and Hoyos, L.R., "Ground Improvement and Geosynthetics; Geotechnical special publication No.207, Geo Institute, ASCE, 2010.
2. Cox, B.R., and Grifiths S.C., "Practical Recommendation for Evaluation and mitigation of Soil Liquefaction" in Arkansas, (Project Report), 2010.
3. Day, R.W., "Foundation Engineering Handbook, McGraw – Hill Companies, Inc. 2006.
4. Rowe, R.K., "Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.

Course code	**PEC-CEEL- 406G**				
Category	Professional elective course				
Course title	**Rock Mechanics**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

- To classify rocks and to understand stares-strain characteristics,
- To study the failure criteria, and influence of in-situ stress in the stability of various structures and various technique to improve the in-situ strength of rocks.
- Explain Pressure arch theory on different openings.
- Explain Creep, Convergence, Rock burst & Coal bumps.
- Describe the governing factors& protective measures against subsidence.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Module 1: Importance of rock mechanics

History of Rock Mechanics, Distribution of rocks- Archean Rocks, Cuddapah Rocks, Vindhyan Rocks, Palaeozoick Rocks, Mesozoic rocks, Gondwana Rocks, Deccan Traps, Steriographic presentation of Geological data.

Module 2: Engineering Classification of Rock

Terzaghi's rock load classification, Deere Miller, CMRS and RSR System. Index properties and classification of rock masses, Competent and incompetent rock, Rock discontinuity qualitative description, RQD, RMR system.

Unit-II

Module 3: Strength of Rocks

Behaviour of rock under hydrostatic compression and deviatric loading - Modes of rockfailure, Factors influencing rock behaviour, Strength criteria for Isotropic Intact Rocks, Modulus of Isotropic Intact Rocks, Mohr - Coulomb failure criterion stress strain models.

Module 4: Stability of Rock Slopes

Rock slopes - role of discontinuities in slope failure, Modes of failure – Rotational, Plane and wedge failures, Plane failure method of analysis, Wedge method of analysis, Toppling failure, Remedial measures and protection against slope failure.

Unit-III

Module 5:In-situ Stresses in Rocks and Laboratory Tests on Rocks

Stress distribution in rocks, In-situ stresses and their measurements, Hydraulic fracturing, Flat jack, Over coring and under coring methods - stress around underground excavations; Tests for physical properties, Compressive strength, Tensile strength.

Module 6: Field Tests on Rocks and Rock Mass

Geophysical methods seismic refraction method, Electrical resistivity method, Deformability tests– Plate jack test, Goodman jack test, Field shear test, Field permeability test, Open end test, and packerstest.

Unit-IV

Module 7: Rock Foundation

Drilling, Blasting and underground open excavation, Criteria for design of underground excavations and ribs support multiple excavations, Estimation of bearing capacity- factor of safety, Settlement in rocks.

Module 8: Rock Reinforcement

Intact, Fractured rocks,Reinforcement of fractured and joined rocks - shotcreting, bolting, anchoring, rock bolting, grouting and other methods, Rock grouting installation methods.

Course Outcomes:

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

1. Define Rock mechanics & explain its importance.
2. Explain engineering Classification of rock masses (by deer &miller).
3. Describe procedure for collecting of samples, its preparation as specimen.
4. Explain different tests for measuring rock strengths.
5. Explain objectives & methods of rock exploration.

Recommended Books

1. Goodman, R.E., Introduction to rock mechanics, John Willey and Sons, 1989.
2. Hudson, A. and Harrison, P., Engineering Rock mechanics – An introduction to the principles, Pergamon publications, 1997.
3. T. Ramamurthy, Editor, Engineering in Rocks for Slopes Foundations and Tunnels, PHI Learning Pvt. Ltd., 2007

Course code	**PEC-CEEL- 408 G**				
Category	Professional elective course				
Course title	**Geotechnology**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

- To emphasize the importance of soil investigations.
- To provide the knowledge for slope stability
- To identify factors controlling stability analysis for different soil
- To understand different types of bracings and sheet piles
- To identify different parameters for improving the soil.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Stability of slopes, factors affecting slope stability, Causes of failure, factors of safety in the basis of different parameters, stability analysis of slopes-total stress analysis, effective stress analysis.
Stability of infinite slopes types of failures of finite slopes, analysis of finite slopes-mass procedure, method of slices, friction circle method, Fellinius method to locate centre of most critical slip circle, Taylor's stability number.

Unit-II

Braced Cuts, sheeting and bracing for deep excavation, movements associated with sheeting, and bracing, modes of failure of braced cuts, pressure distribution behind sheeting.
Cofferdams, types of cofferdams, design and lateral stability of braced cofferdams, design data for Cellular cofferdams, stability analysis of cellular cofferdams on soil and rock.

Unit-III

Cantilever Sheet Piles Purpose of sheet piles, cantilever sheet piles, depth of embedment in granular soils-rigorous method Simplified procedure, cantilever sheet pile penetrating clay.
Anchored Bulkheads Methods of design, free earth support method in cohesionless and cohesive soils, fixed earth support method in cohesionless soils-Equivalent beam method.

Unit-IV

Soil Stabilization, soil improvement, shallow compaction, mechanical treatment, lime stabilization, cement stabilization, dynamic compaction and consolidation, bituminous stabilization, pre-compression, grouting, reinforced earth.
Machine Foundations-necessity, Terminology, characteristics elements of a vibratory system, criteria for satisfactory action of a machine foundation, degree of freedom of a block foundation, Barken's soil spring constant, Barken's method of a determining natural frequency of a block foundation subjected to vertical oscillations.

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

- To understand the importance of stability analysis for different slopes.
- To assess different bracing system for supporting the soil
- To improve bearing capacity using soil stabilization
- To describe different elements of machine foundations.

Reference Books

- Punmia, B.C., Soil Mechanics and Foundation Engineering, Laxmi Publications Pvt. Ltd., New Delhi, 1995.
- Gopal Ranjan, ASR Rao, Basic and Applied Soil Mechanics, New Age Intetrnational Ltd. Publishers- N.Delhi, Edition No. - 3rd, 2016.
- Nainan P Kurian, Design of foundation Systems Principles and Practices, Narosa, 2011
- Donald P. Coduto, Man-Chu Ronald Yeung and William A. Kitch, Geotechnical Engineering, Principles and Practices, PHI Learning Private limited, 2011.
- Basic and Applied Soil Mechanics by Gopal Ranjan and ASR Rao, NewageInt.Pub.
- Soil Dynamic by Shamsher Prakash, McGraw Hill.
- Soil Mechanics & Foundation Engineering by Bharat Singh, Shamsher Prakash, Nem Chand & Bros, Roorkee.

Course code	**PEC-CEEL- 410 G**				
Category	Professional elective course				
Course title	**Advanced Structure Analysis**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

At the end of this course, the student should be able to impart understanding about the advanced structures and its analysis.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module –1: Review of basic structural analysis.

Review of work and energy Principles, Maxwell-Betti's and Castiglano'stheorem, Principle of virtual work, Degrees offFreedom, Static and Kinematic Indeterminacy.

Unit-II

Module –2: Matrix approach to flexibility method

Development of flexibility matrices for beam, 2D frame, Grid and truss elements, Analysis of 2D frames, Trusses and grids.

Module-3: Matrix approach to stiffness method

Development of stiffness matrices for beam, 2D frame, Grid and truss elements, Transformation of coordinates, Element load vector, Assembly of global stiffness matrix and load vector, Analysis of 2D frames, Trusses and grids.

Unit-III

Module-4: Partially discontinuous structures

Partial discontinuities in a member, Development of stiffness matrices for members with Partially discontinuity, Analysis of partially discontinuous beams.

Module-5: Methods of Sub-Structure Analysis and Stresses

Structure analysis using sub-structure technique, Effects of axial forces on flexural stiffness.

Unit-IV

Module-6: Beams Curved in Plan

Forces developed at a section of curved beam, Torsion factor, Analysis of beam curved in plan, Semi- circular beam fixed at two ends subjected to concentrated load and UDL.

Module-7: Computer Programs for Matrix Structural Analysis

Course Outcomes:

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

- Analysis structures using advanced methods of analysis.
- Apply this knowledge for the design of various civil engineering structures using software.

Recommendedbook:

1. "Matrix Analysis of Structures", Gere & Weaver, CBS Publishers and Distributors, Delhi-110032.
2. "Structural analysis", T.S. Thandavamoorthy, Oxford University Press.
3. "Concepts and applications of finite element analysis" Robert D. Cook, Wiley India Pvt. Ltd.
4. "Advanced Structural Analysis", Ashok K. Jain, Nem Chand and Bros., Roorkee.
5. H. C. Martin, "Introduction to Matrix Methods of Structural Analysis." McGraw Hill.
6. Amin Ghali, Adam Neville, Tom G. Brown "Structural Analysis: A Unified Classical and Matrix Approach," CRC Press.

Course code	**PEC-CEEL- 412 G**				
Category	Professional elective course				
Course title	**Finite Element Method**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

The objective of this course is to enrich the student's knowledge about the FEM as applied to one- and two-dimensional problems of engineering and applied science.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module-I: Introduction: Field conditions, Boundary conditions, Functional approximation, Finitedifferences method, Development of finite element method.

Module-2: Element Properties: Displacement models, Relation between the nodal degrees of freedom and generalized coordinates, Convergence requirements, Natural co-ordinate systems, Shape functions, Element strains and stresses, Development of element stiffness, Matrix and equivalent nodal loads, Static condensation.

Unit-II

Module-3: Isoparametric Elements: Isoparametric, Super-parametric and sub-paramatric elements, Computation of stiffness matrix of isoparametric elements, Convergence criteria for isoparametric elements, Numerical integration technique using Gauss Quadrature.

Module-4: One Dimensional Element: Truss element, Analysis of plane truss problem, Hermitian beam element, Beam on elastic foundation and solution of beam problem.

Unit-III

Module-5: Plane Stress and Plane Strain Analysis: Triangular elements, Rectangular elements, Isoparametric elements, Patch test and axisymmetric solid element.

Module-6: Plane Bending Analysis: Displacement functions, Plate bending elements, Reducedintegration, Stress smoothing technique.

Unit-IV

Module-7: Direct Stiffness Method of Analysis and Solution Technique: Assemblage of elements, Direct stiffness method, Boundary conditions and reactions, Gauss elimination and Matrix decomposition.

Module- 8: Finite Element Analysis Software: Pre-and Post-processors finite element analysis software, Error estimates and adaptive meshing.

Course Outcomes:

After completing this course, students should be able:

- Analysis structures using advanced methods of analysis.
- Apply this knowledge for the design of various civil engineering structures using software.

Recommended Book:

1. Krishnamurthy, C.S.,'Finite Element Analysis-Theory and Programming', TMH Pub.N.Delhi.
2. Cook, R.D.,Malkus,D.S. and Plesha,M.E.,'Concept and Applications of Finite Element Analysis', John Wiley & Sons, New York.
3. Desai, C.S. and Abel,J.F.,'Introduction to the Finite Element Method', Affiliated EastWest Press Pvt.Ltd.N.Delhi.
4. ManickaSelvam,V.K.,'Finite Element Primer', Dhan.

Course code	**PEC-CEEL- 414 G**				
Category	Professional elective course				
Course title	**Structural Dynamics**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	2	**1**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives

The objective of the course is to understand the behaviour of structure especially building to various dynamic loads: such as wind, earthquake, machine vibration and ambient vibration.

- Introduce fundamentals of vibrations of SDOF system.
- Introduce damped and undamped system.
- Introduce free and forced vibration.
- Introduced free and forced vibration of MDOF system.
- Introduced free and forced vibration of continuous system

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module 1: Introduction

Importance of structural dynamics, Difference between static loading and dynamic loading, brief history of vibration, Terminology, Sources of vibration, types of excitations, Principle and working of piezoelectric transducers, Spring action and damping; Degrees of freedom; Application of Newton's laws, D'Alembert's principle.

Module 2: Single degree of freedom systems

Free vibration of SDOF (Single Degree of Freedom) systems, undamped, Damped, viscously damped systems; Coulomb damping material and radiation damping. Response of viscously damped SDOF systems to harmonic excitation; Vibration Isolation, Logarithmic decrement.

Unit-II

Module 3: Forced vibrations of SDOF system

Forced vibrations of SDOF system, Response of undamped and damped system subjected to harmonic loading, response to SDOF subject to harmonic base excitation, Duhamel's integral, response to general system of loading, dynamic load factor, response spectrum.

Module 4: Free vibration of MDOF (Multi Degree Freedom System)

Free vibration of MDOF (Multi Degree Freedom System), Natural frequencies, Normal modes, Orthogonality of normal modes, Eigen Values Shear buildings modeled as MDOF systems. Free vibrations, Natural frequencies,

Unit-III

Module 5: Forced vibrations

Forced vibrations, Motion of shear buildings, Model Superposition Method, Response to shear buildings, Base motion, Harmonic fixed excitation. Damped motion of shear buildings, Equations for damped shear buildings, uncoupled damped equations,Condition's for damping uncoupled.

Module 6: Dynamic analysis of base stuffiness matrices

Dynamic analysis of base stuffiness matrices, Lumped mass and consistent mass formulation, Equations of motion.

Unit-IV

Module 7: Vibration of Continuous Systems: Free vibrations of Continuous systems-axial and transverse vibration of bars / beams. Response of continuous systems to dynamic loads. Energy Principle, Rayleigh-Ritz method.

Module 8: Deterministic Earthquake Response of Systems

Rigid Foundation, Types of Earthquake Excitation, Response to Rigid – Soil Excitation, Lumped SDOF elastic systems,Lumped SDOF elastic system, Distributed Parameter Elastic Systems – SRSS, CQC combination of modal responses.

Course Outcomes

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

- Convert structure into SDOF system
- Find response of free and force vibration (harmonic, periodic and transient) of SDOF system.
- Find natural frequency and mode shapes of MDOF system
- Carry out modal analysis of MDOF system

Recommended Book:

1. Chopra, A.K., "Dynamics of Structures", Prentice Hall, 3rd Edition, NY, 1970.
2. Clough, R.W. &Penzin, J., "Dynamics of Structures", McGraw Hill, 1993.
3. Humar, J.L., "Dynamics of Structures", Prentice Hall, 1990.

Coursecode	OEC-PHY-101G				
Category	Open Elective Course				
Coursetitle	**Material Science**				
Scheme and Credits	L	T	P	Credits	Semester- 8th
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of exam	03 Hours				

Course objectives: The course intend to provide the knowledge of

- Crystal structure and defects in solids.
- Classification of different solids.
- Properties of semiconductor, dielectric and magnetic materials.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT - 1 Crystal Structure

Space lattice and translation vectors, Unit cell, Bravais lattice, Closed packed structures, Miller indices, Diffraction of electromagnetic waves by crystals: X-rays, electrons and neutrons,Bragg's law, X-ray diffraction (Laue and Powder method), Point defects in solids - Schottky and Frenkel defects.

UNIT - 2 Electrical Properties

Classification of solids into conductors, semiconductors and insulators, Semiconductor Materials: intrinsic and extrinsic, Fermi level and electron & hole concentrations at equilibrium, Carrier transport:diffusionanddrift,p-njunction, Zener and Avalanche breakdown.

UNIT - 3 Magnetic Properties

Atomic magnetic moments and origin of magnetization,Types of magnetic materials, Ferromagnetism: molecular field, Curie temperature, Domain theory, Hysteresis and its applications.

Superconductivity: Properties of superconductors, Meissner effect, London equations, Elements of BCS Theory, Applications of superconductors.

UNIT - 4 Dielectric Properties

Molecular theory, Polarization, Electric displacement vector, susceptibility, dielectric constant, permittivity and various relations between these parameters, Gauss's law in the presence of a dielectric, Energy stored in a uniform electric field, Concept of local molecular fields and Claussius - Mossotti relation.

Course learning outcome: At the end of the course, the student should at least be able to:

- Segregate crystals based on their structure and apply effects of defects on manipulating properties of solids.
- Distinguish between insulator, conductor and semiconductor. They should know the difference between intrinsic and extrinsic semiconductors and about the fermi level position in these semiconductors.
- Select various dielectric, magnetic materials for specific applications in different fields.

Suggested reference books:

1. Concepts of Modern Physics- Arthur Beiser (TMGH)
2. Solid State Physics- S.O. Pillai (New Age Int. Ltd. Pub.)
3. Modern Physics for Engineers- S.P. Taneja (R. Chand)
4. Engineering Physics- SatyaPrakash (Pragati Prakashan)
5. Engineering Physics- Malik &Singh(McGrawHill)
6. Charles Kittel, Introduction to Solid State Physics, 7th Edition, John Wiley & Sons,2008.
7. S O Pillai, Solid State Physics, 8th edition, New Age international Publishers,2018

Course code	OEC-CH-401-G				
Category	Open Elective Course				
Course title	**Chemistry-II (Chemical Applications)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 8th**
	3	0	**0**	3	
Course Outcomes	1. Distinguish between the structures, reactions and synthesis of polymers, lubricants, metals, alloys and nanomaterials. 2. Comparison of new analytical techniqueswith the classical methods 3. Chemical analysis of corrosion. 4. Assessment of Green chemistry,environmental chemistry and non-conventional energy sources in present context.				

Duration of Exam 3 Hrs	Class Work 25 MarksTheory Exam 75 Marks Total 100 Marks

Note: Examiner will set 9 questions in all with two questions from each unit and one question covering all sections which will be Q.1. This Q1 is compulsory and of short answer type. Each question carries equal marks (15 marks). Examinee have to attempt 5 questions in total, selecting atleast one from each unit.

UNIT-I

Polymers: Mechanism of polymerization and synthesis of polymers. Molecular weight, Crystallinity,melting point and glass transition temperature. Copolymerization. Elastomers-structure and applications, Conducting polymers and applications. Solubility of polymers. Synthesis, properties and uses of PE,PVC, PMMA, Urea-formaldehyde resins, melamine-formaldehyde resins. Composites: characteristics, types and applications.

Modern Analytical techniques: Principle and Applications of Mass spectrometry, Thermal analysis- TGA, DTA and Electron microscopy. Introduction to Scanning tunneling microscope and Atomic force microscope. (12)

UNIT-II

Surfactants and Lubricants: Classification of surfactants.Introduction of micelles. Critical micelle concentration and its determination, cleaning action of detergents. Lubricants-physical and chemical properties, types and mechanism of lubrication.Additives of lubricants.

Corrosion: Introduction, Types ofChemicaland electrochemical corrosion, Theory of electrochemical corrosion. Factors affecting corrosion andMethodsof controlling corrosion. (8)

UNIT-III

Nanomaterials: Properties and application of fullerenes, fullerols, carbon nanotubes and nanowires. Nanomaterials, Applications of nanomaterials incatalysis, telecommunication and medicine.

Metals and Alloys: Phase rule and applications to one (water system), two(Pb-Ag) and three component systems (acetic acid, water &chloroform). Iron-carbon phase diagram. Alloys: Introduction, types (alloys of steel, alloys of Cu, Al and Pb).

(10)

UNIT-IV

Environmental and green chemistry: Air, water and noise pollution. Optimum levels of pollution. Significance and determination of COD, and BOD. Greenhouse effect and global warming, e-Waste, radioactive pollution. Applications of green chemistry and green technology. Concept ofatomic and molecular economy and its use in green chemistry.

Energy science: Analysis of coal. Petroleum refining, liquid fuels, anti-knock agents. Cracking of oils. Limitations offossil fuels. Alternative and non-conventional sources of energy – solar, wind, geo, hydro-power andbiomass- theiradvantages and disadvantages. Nuclear energy, reactors and nuclear waste disposal. Safetymeasures for nuclear reactors.

(12)

Suggested Text Books:

1) Introduction to Nanoscience, by S. M. Lindsay
(2) A Textbook of Engineering Chemistry, by Shashi Chawla
(3) Engineering Chemistry, by S. S. Dara
(4) Engineering Chemistry, by P. C Jain and M. Jain
(5) Journal of Biochem. Biophys. Methods, Vol 67 (2006) pp 151-161
(6) International Journal of Environmental and Analytical Chemistry, Vol 91 (2011), pp 272-279
(7) Advanced Polymer Chemistry, by M. Chanda
(8) A Textbook of Environmental Chemistry, by O. D. Tyagi and M. Mehra
(9) Energy Scenario beyond 2100, by S. MuthukrishnaIyer
10) Physical Chemistry of Metals, by L. S. Darken and R. W. Gurry
11) Surfactants and Polymers in Aqueous Solution, by K. Holmberg, B. Jonsson, B. Kronbergand B. Lindman
12) Physical Metallurgy, by R. E. Reed-Hill

Course Outcomes

Thecourse will enable the student to:

- Distinguish between the structures, reactions and synthesis of polymers, surfactants, lubricants, metals, alloys, colloids and nanomaterials.
- Compare new analytical techniques with the classical methods that use gravimetric and volumetric analysis.
- Carry out chemical analysis of corrosion
- Assess green chemistry, environmental chemistry and non-conventional energy sources in the present context.

Course code	OEC –ME-402G				
Category	Open Elective Courses (OEC)				
Course title	**OPERATIONS RESEARCH**				
Scheme and Credits	L	T	P	**Credits**	Semester-8th
	3	0	0	3	
Objectives:	The aims of operation research include: solving operational questions, solving questions related to resources' operations, and solving decision-making questions. Operational research has a relation with different areas of study and it has several applications. Operation research is considered as a tool of productivity. In comparison to traditional approaches, operation research provides more extensive, quantitative, and detailed information about different issues and managers can implement their decisions based on quantitative analyses. Operation research will be a good assistance for managers in different areas.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction: Definition, role of operations research in decision-making, applications in industry. Concept on O.R. model building –Types & methods.

Linear Programming (LP): Programming definition, formulation, solution- graphical, simplex GaussJordan reduction process in simplex methods, BIG-M methods computational, problems.

UNIT-II

Deterministic Model: Transportation model-balanced & unbalanced, north west rule, Vogel's Method, least cost or matrix minimal, Stepperg stone method, MODI methods, degeneracy, assignment, traveling salesman, problems.

Advanced Topic Of LP: Duality, PRIMAL-DUAL relations-its solution, shadow price, economic interpretation, dual-simplex, post-optimality & sensitivity analysis, problems.

UNIT-III

Waiting Line Models: Introduction, queue parameters, M/M/1 queue, performance of queuing systems, applications in industries, problems.
Project Line Models: Network diagram, event, activity, defects in network, PERT & CPM, float in network, variance and probability of completion time, project cost- direct, indirect, total, optimal project cost by crashing of network, resources leveling in project, problems.

UNIT-IV

Simulation: Introduction, design of simulation, models & experiments, model validation, process generation, time flow mechanism, Monte Carlo methods- its applications in industries, problems.
Decision Theory: Decision process, SIMON model types of decision making environment-certainty, risk, uncertainty, decision making with utilities, problems.

Course Outcomes (COs): At the end of the course, the student shall be able to:
CO 1- Discuss the role of operations research in decision-making, and its applications in industry and should be able to formulate and design real-world problems through models & experiments.
CO 2- Knowledge of various types of deterministic models like linear programming, transportation model etc.
CO 3- Explore various types of stochastic models like waiting line model, project line model, simulation etc.
CO 4- Deduce the relationship between a linear program and its dual and perform sensitivity analysis.
CO 5- Describe different decision making environments and apply decision making process in the real world situations

Text Books:

1) Operation Research – TAHA, PHI, New Delhi.
2) Principle of Operations Research – Ackoff, Churchaman, arnoff, Oxford IBH, Delhi.

Reference Books :

1) Operation Research- Gupta & Sharma, National Publishers, New Delhi.
2) Quantitative Techniques- Vohra, TMH, New Delhi 8. Principles of operation Research (with Applications to Managerial Decisions) by H.M.Wagher, Prentice Hall of India, New Delhi.
3) Operation Research – Sharma, Gupta, Wiley Eastern, New Delhi.
4) Operation Research – Philips, Revindran, Solgeberg, Wiley ISE.

Course code	OEC-ME-410G				
Category	Open Elective Courses (OEC) (Semester-VIII) List-III				
Course title	**QUALITY ENGINEERING**				
Scheme and Credits	L	T	P	**Credits**	Semester-VIII
	3	0	0	3	
Objectives:	To understand the concept of QualityEngineering which emphasizes growth, creativity, and analytical thinking.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Section A

Basic Concepts of Quality: Definitions of Quality and its importance in industry, Quality function, Quality Characteristics, Quality process, Quality Traits, Applications of Quality Concept, Introduction to quality control, Computer aided quality control, Total quality control(TQC) and its implementation, Elements of TQC, Quality Circle, Objectives of quality circle, Role of management in quality circle, Quality in service organizations, characteristics of a service organization, Important service dimensions, Design of service quality.

Section B

Basic Statistical Concepts: The Concept of variation, Distinction between variables and attributes data, The frequency distribution, graphical representation of frequency distribution, Quantitative description of distribution, the normal curve, concept of probability, laws of probability, probability distributions, hyper geometric distribution, binomial distribution, The Poisson distribution.

Section C

Quality systems: Quality systems, Need for quality System, Need for standardization, History of ISO:9000 series standards and its features, steps to registration, India and ISO:9000, Automated inspection systems technologies, Different forms of Inspection, Industrial inspection,

Section D

Total Quality Management: IntroductionTQM, Concepts, Characteristics of TQM, Relevance of TQM, Approaches to TQM Implementation, TQM philosophies, Taguchi Philosphy, JIT, Kaizen, Six Sigma approach, 5-S approach

Course Outcomes: Upon completion of this course the student will be able to:

CO1 - Attain the basic techniques of quality improvement, fundamental knowledge of statistics and probability

CO2 - Use control charts to analyze for improving the process quality.

CO3 - Describe different sampling plans

CO4 - Acquire basic knowledge of total quality management

CO5 - Understand the modern quality management techniques

Text Books:

1. Quality planning and Analysis, Juran and Gryna, TMH, New Delhi
2. Quality Management, Kanishka Bed, Oxford University Press, New Delhi
3. Introduction to SQC, Montgomery DC, 3e, Wiley, New Delhi
4. Fundamentals of quality control and improvement, A Mitra, Mcmillan pub. Company, NY

Reference Books:

1. Fundamentals of Applied Statistics, Gupta and Kapoor, Sultan Chand and Sons, New Delhi.

Course code	**OEC-CE- 416 G**				
Category	Open elective course				
Course title	**Solid and Hazardous Waste Management**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Course Objectives:

- To understand the sources of solid and hazardous wastes.
- To understand methods of solid and hazardous waste disposal.
- To gain knowledge of E-Waste management.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE CONTENT

Unit-I

Module:1 Sources and Composition of Municipal Solid Waste

Introduction, Sources and Types of solid waste, Composition of Solid Waste and its Determination, Properties of Municipal Solid Waste

Module:2 Solid Waste Generation and Collection

Quantities of Solid Waste, Measurements and methods to measure solid waste quantities, Solid waste generation and collection, Factors affecting solid waste generation rate, Quantities of materials recovered from MSW.

Unit-II

Module:3 Handling, Separation and Processing of Solid Waste

Material separation by pick in, screens, float and separator magnets and electromechanical separator and other latest devices at site; Waste handling, separation and processing of solid waste at residence, Commercial and industrial site.

Module:4 Disposal of Municipal Solid Waste

Landfill: Classification, planning, sitting, permitting, landfill processes, landfill design, landfill operation, use of old landfill.

Unit-III

Module:5 Hazardous Waste Management

Identification and classification of hazardous solid waste. The magnitude of the problem; Hazardous waste: Risk assessment, Environmental legislation, Characterization and site assessment.

Module:6 Biological Treatment of Solid and Hazardous Waste

Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; oxidative and reductive processes.

Unit-IV

Module:7 Radioactive Waste Management

Fundamentals Sources, measures and health effects; nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options.

Module:8 Electronic waste management

E waste- Definition, composition; environmental and human health issues, recovery of metals from E waste, E waste management,

Course Outcomes:

After completing this course, students should be able:

- To realize the significance of solid and hazardous waste management in today life
- To understand the processes involved in solid and hazardous waste management
- To comprehend the techniques for various waste management
- To appreciate the role of common/integrated waste management plants

Suggested Books:

1. Basics of Solid and Hazardous Waste Mgmt. Tech. by KantiL.Shah 1999, Prentice Hall.

2. Solid And Hazardous Waste Management 2007 by S.C.Bhatia Atlantic Publishers & Dist.

3. John Pichtel Waste Management Practices CRC Press, Taylor and Francis Group 2005.

Course code	**OEC-ECE-451-G**				
Category	**Open Elective Course**				
Course title	**Electronic Principles**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objective:

1. Study the basic principles of electronic systems.
2. Understand working of Digital electronics.
3. Understand the working of Display devices.

UNIT 1 SEMICONDUCTOR DIODE: P-N junction and its V-I Characteristics, P-N junction as a rectifier, Switching characteristics of Diode. Diode as a circuit element, the load-line concept, half -wave and full wave rectifiers, clipping circuits, clamping circuits, filter circuits, peak to peak detector and voltage multiplier circuits.

UNIT 2 ELECTRONIC DEVICES: LED, Zener Diode as voltage regulator, BJT, UJT, MOSFET, Thyristor, DIAC, TRIAC.

UNIT 3 DISPLAY DEVICES: LED, LCD, Seven Segment, Sixteen Segment.

UNIT 4 DIGITAL ELECTRONICS: Binary, Octal and Hexadecimal number system and conversions, Boolean Algebra, Truth tables of logic gates (AND, OR, NOT) NAND, NOR as universal gates, Difference between combinational circuits and sequential circuits, Introduction to flipflops (S-R & J-K).

TEXT BOOK: 1.Integrated Electronics: Millman &Halkias ;McGrawHill
2.Modren Digital Electronics: R.P. Jain; McGraw-Hill

REFERENCE BOOKS:1.Electronics Principles: Malvino ;McGrawHill
2.Electronics Circuits: Donald L. Schilling & Charles Belove;McGrawHill
3.Electronics Devices & Circuits: Boylestad&Nashelsky ; Pearson.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the working of electronic components.
2. Understand the Digital System and various displays.

Coursecode	**OEC-CSE-430G**				
Category	Open Elective Course				
Coursetitle	**Computer Communication**				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Learning Objectives:

1. To Build an understanding of the fundamental concepts of computer networking and familiarizing the student with the basic taxonomy and terminology of the computer networking and data communication.
2. To outline various models, topologies and devices of Computer Networks.
3. To explain the functions of various layers in Network Reference Model.
4. To apply different network concepts in various network communication protocols.

Unit 1

Introduction to Data Communication: Need, components, Data representations communication model, Characteristics of an effective Communication system, Transmission modes: Simplex, Half Duplex and Full Duplex. Serial and parallel transmission. Unicasting, Multicasting, Broadcasting, Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM), Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying,

MULTIPLEXING: FDM, WDM, TDM, packet switching and circuit switching.

Transmission Media: Copper cable, Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable. Introduction to Computer Network: applications, benefits and problems, Types of Networks: PAN, LAN, MAN and WAN.

Unit 2

Network Topologies: Introduction to Computer Network Topologies: Mesh Topology, Bus Topology, Star Topology, Ring Topology, Tree Topology, Hybrid Topology, Irregular – Topology.

OSI and TCP/IP Model: Layering architecture of networks, OSI model, Functions of each layer, Services and Protocols of each layer

Unit 3

Media Access Control, Random Access: ALOHA, CSMA and CSMA/CD. Controlled Access: Reservation, Polling and Token Passing. Channelization: FDMA, TDMA and CDMA

Ethernet: Features and types of LANs, Types of Ethernets- Thicknet, Thinnet, Fast Ethernet and Gigabit and 10G Ethernet etc. Concept of Carrier Sense Multiple Access (CSMA)/CD in Ethernet,

Network addressing: Physical addressing, logical addressing and port addressing, MAC addressing in Ethernet, IP V4 addressing: concept of subnet, network and host address, IP address Classes- A, B, C, D and E classes. Introduction to classless addressing.

Unit 4

LAN interconnecting devices: Repeater, Hubs, Switches, Bridges, Routers, Gateways.

Internet and E-mail: Concept of Internet, Advantages of Internet, Security issues in using internet. Application of Internet in various fields: Scientific, Business, Research, Sports, Medicine & Health Care, Engineering, Teaching. HTTP and FTP

Email :concept, Protocols: SMTP, POP, IMAP.

Text Book:

1.Andrew S Tanenbaum, Computer Networks, 5th Edition, Pearson publications, 2010.

2. Forouzan, Data Communication and networking ,5th Edition, Tata McGrawHill, 2012.

3. William Stalling, Data & Computer Communication 6th edition, LPE Pearson Education, 2013.

Reference Books:

Data Communications, Computer Networks and Open Systems (4th edition), Halsall Fred, 2000, Addison Wesley, Low Price Edition.

Computer Networks – A System Approach, Larry L. Peterson & Bruce S. Davie, 2 Edition

Computer Networking – ED Tittel, 2002, T.M.H.

Learning Outcomes: By the end of the course the students will be able to:

1. Independently understand basic computer network technology.

2. Understand and explain Data Communications System and its components.

3. Identify the different types of network topologies and protocols.

4. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.

5. Identify the different types of network devices and their functions within a network

Course code	S-CE-418 G				
Category	Seminar				
Course title	**SEMINAR**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	0	**0**	**2**	**1**	
External marks:	25 Marks				
Internal marks:	25Marks				
Total	50Marks				
Duration of Exam	3 Hours				

COURSE CONTENT

During the semester, the students have to:

- Select a topic relevant to analysis, design, implementation, experimental and management of a civil engineering system.
- Undertake a critical review of the literature on the chosen topic.
- Prepare and present a technical report.
- Preparing a review paper forpresentation/Publication in national conference/ International conference/ Journals, if possible.

Course code	**MC-317-G**				
Category	Mandatory courses (non-credit)				
Course title	**Constitution of India**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	2	**0**	0	**0**	
Class work	-				
Exam	-				
Total	-				
Duration of Exam	-				

Course Objectives:
Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rightsperspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional roleand entitlement to civil and economic rights as well as the emergence of nationhood in the earlyyears of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in1917 and its impact on the initial drafting of the Indian Constitution.

*__Note: 1. MC-317G__ is a mandatory non-credit course in which the students will be awarded grades A, B, C, F as per their performance. A: Excellent, B: Good, C: Satisfactory, F: Not Satisfactory. A student who is awarded 'F' grade is required to repeat course**.**

COURSE CONTENT

Module– I
Philosophy of Indian Constitution: Salient features of Indian Constitution, Preamble, and Nature ofIndian Constitution, Procedure for amendment of the Constitution.

Module – II
Federal structure and distribution of legislative and financial powers between the Union and the States.

Module – III
Organs of Governance: President – Qualification and Powers of the President,Governor Qualification and Powers of Governor, Parliament: Composition, Qualifications andDisqualifications, Judiciary: Appointment, Tenure and Removal of Judges.

Module – IV
Fundamental Rights: Origin and development of Fundamental rights, Need for fundamental rights, Introduction to Right to equality, Right to freedom, Right against exploitation, Right to freedom ofreligion, Cultural and Education rights and Fundamental duties.

Course Outcomes: Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrivalof Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptutilizationof social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] underthe leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct electionsthrough adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S.N. Busi, Dr. B.R. Ambedkar framing of Indian Constitution, latest Edition
3. M.P. Jain, Indian Constitution Law, Lexis Nexis, latest edition
4. D.D. Basu, Introduction to Constitution of India, Lexis Nexis, latest edition.

Course code	**PROJ- CE-420 G**				
Category	Project				
Course title	**Project Work –II**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 8th**
	0	**0**	8	**4**	
Class work	75Marks				
Exam	75Marks				
Total	150 Marks				
Duration of Exam	3 Hours				

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under Project work-I or a new topic, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under Project work -I.
2. Review and finalization of the Approach to the Problem relating to the assigned topic.
3. Preparing an Action Plan for conducting the investigation, including team work.
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed.
5. Final development of product/process, testing, results, conclusions and future directions.
6. Preparing a paper for Conference presentation/Publication in Journals, if possible.
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.