SEVENTH SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/week	Credit	Full Marks
1.	Program Elective-2 (any one)	PE CE 701/1	Design of Hydraulic Structures	3	0	0	3	3	100
		PE CE 701/2	Bridge Engineering	3	0	0			
		PE CE 701/3	Geotechnical Design	3	0	0			
2.	Program Elective-3 (any one)	PE CE 702/1	Rural Water Supply and Sanitation Systems	2	0	0	2	2	100
		PE CE 702/2	Traffic Engineering and Management	2	0	0			
		PE CE 702/3	Building Construction Practice	2	0	0			
3.	Open Elective-1	OE 703	See in Annexure-I	3	0	0	3	3	100
4.	Open Elective-2	OE 704	See in Annexure-II	2	0	0	2	2	100
5.	Project - 2	PR CE 705	Project Work Intermediate	0	0	12	12	6	200
6.	Summer Internship-2	SI CE-706	Internship – II	0	0	0	0	1	100
7.	Seminar - 1	SE CE 707	Seminar on Contemporary Engineering Topics - I	0	0	2	2	1	100
			Total :	10	0	14	24	**18**	**800**

Design of Hydraulic Structures

Course Code	PE-CE 701/1
Course Title	Design of Hydraulic Structures
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Hydrology and Water Resources Engineering
Course Category	Program Elective (PE)
Number of classes	38 hours

Course Outcomes: After completion of the course students will be able to-

CO No	CO Description	K-level
CO-1	Analyse and design of Earthen dams.	K-4
CO-2	Analyse and design of Gravity dams.	K-5
CO-3	Design Ogee spillways, canal falls and cross drainage structures	K-6
CO-5	Understand the hydroelectric power development.	K-2

Module 1: **Embankment Dams** **(9 hours)**

Investigation Survey, Selection of dam Site, Selection of type of dam, Classification of dams. Earth and Rockfill Dam- Causes of failures and remedial measure, selection of earth dam, design considerations, Phreatic lines, Seepage loss through earth dams, Stability analysis, Control of seepage through earth dams, rockfill dams.

Module 2: **Gravity Dams** **(9 hours)**

Gravity Dams: Forces acting on gravity dam; modes of failures; load combination for design, elementary profile, practical profile, low and high gravity dam, stability analysis, Galleries in dam.

Module 3: **Spillways, Canal Fall and Diversion Head Works** **(10 hours)**

Spillways and energy dissipation systems: Types of spillways, Design of Ogee spillway, Design of stilling basins. Canal regulators, Types of canal falls, Design of Sarda type fall, Design of straight glacis fall, Diversion head works: Layout of a diversion head work, Types and components of Diversion headworks.

Module 4: **Cross Drainage works and Hydroelectric Power Development** **(10 hours)**

Types of cross drainage works, Design of canal fluming, Design of aqueduct/ syphon aqueduct.
Introduction to Hydroelectric power development, components of hydroelectric schemes development, selection of turbines.

References / Suggested Learning Resources:

1. Modi P.M, Irrigation Water Resources and Hydropower Engineering, Standard Publishing Company, New Delhi, 2000.
2. Arora K.L. Irrigation Water Resources Engineering, Standard Book Publishing Co., Delhi, 1996.
3. Asawa G.L., Irrigation and Engineering, New Age Publishing Co., Delhi, 1996.

4. Murthy C.S.N., Water Resources Engineering – Principles and Practice, New Age Publishing Company, Delhi, 2002.
5. Hydraulic Structures by Varshney.

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Bridge Engineering

Course Code	PE CE 701/2
Course Title	Bridge Engineering
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Nil
Course Category	Program Elective (PE)
Number of classes	38 hours

Course Outcomes: After completion of the course students will be able to-

CO No	CO Description	K-level
CO-1	Select alignment, survey, plan and selection the different types of bridge.	K-3, K-5
CO-2	Design, analysis and maintain the various types of bridge.	K-6
CO-3	Plan and design of substructure and superstructure of bridge.	K-6
CO-5	Design the steel bridges.	K-3, K-6

Course Contents:

Module 1: Introduction and Deck Slab of Bridge 9 Hours

Definition, types of bridges, components of bridges. Bridge site investigations, Hydraulic design, Loading standard, temporary bridges- movable bridges, economic spans, aesthetics, selection of suitable type of bridge, Design loads and their distribution-IRC loads, railway loading, analysis of deck slab and IRC loads, load distribution among longitudinal beams of a bridge.

Module 2: Design of Superstructure of Bridge 10 Hours

Design of balanced cantilever concrete bridge, introduction to design of RC arch bridge, pre-stressed concrete and box Girder Bridge. Design of lattice girder railway bridge.

Module 3: Design of Substructure of Bridge 10 Hours

Different types of foundations, their choice and method of construction, design of well foundation, design of piers and abutments, various types of bearings and their design.

Module 4: Design of Steel Bridge 9 Hours

Different types of steel bridges with design. Large – span bridges. Bearings, joints and hand rails. Construction methods and maintenance-Erection of bridge superstructures, cantilever construction.

References / Suggested Learning Resources:

1. Victor D J, essentials of Bridge Engineering, Oxford & IBH
2. Raju N K, Design of Bridges, Oxford & IBH
3. Ponnuswamy S, Bridge Engineering, Tata McGraw Hill
4. Raina V K, Concrete Bridge Practice, Tata McGraw Hill

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Geotechnical Design

Course Code	PE CE 701/3
Course Title	Geotechnical Design
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Foundation Engineering
Course Category	Program Elective
Number of classes	38 hours

Course Outcome:

CO Number	CO Description	K-level
CO-1	To compute the subsurface investigation	K-3
CO-2	To analyze and design shallow foundations	K-4 & K-5
CO-3	To analyze and design of pile foundation and retaining structure	K-4 & K-5
CO-4	To analyze and design marine substructure, foundation in expensive soil and foundation of transmission line tower.	K-4 & K-5

Course Content:

Module 1: Subsurface investigation (09 hours)

Introduction- Substructure: Definition and purpose, Role of foundation engineer, general requirements of substructure.

Subsurface site evaluation: Introduction, open pits with sampling, methods of bring- auger boring, wash boring, percussion boring, rotary boring, amount of boring: depth of boreholes, spacing and number of boreholes; location of water table, soil sampling, sampling tools, types of samplers, standard penetration test (SPT), dynamic cone penetration test (DCPT), Static cone penetration test (SCPT), plate load test, field vane shear test, field permeability test; *geophysical methods*: Seismic Method, electrical resistivity method; planning of exploration program.

Module 2: Design of shallow foundation (09 hours)

Foundation design- General principles: types of foundation, basic requirements of a foundation, terminology: total overburden pressure, effective overburden pressure, total foundation pressure, net foundation pressure, ultimate bearing capacity, net ultimate bearing capacity, net safe bearing capacity, allowable bearing pressure, computation of load.

Design of shallow foundation- introduction: location and depth of foundation; bearing capacity of footings: modes of shear failure, general bearing capacity equation; footing on layered soils, settlement of footings, types of mat foundation, allowable bearing pressure for raft foundation, mat settlement, the coefficient of subgrade reaction, design of mat foundation by rigid and elastic plate method, uplift capacity of footings; *Structural Design*-Isolated footing, combined footing, foundation with strap beam, raft foundation.

Module 3: design of pile foundation and retaining wall (10 hours)

Design of pile foundation- ultimate bearing capacity of bord and cast-in-situ piles in cohesive soil, bearing capacity of pile from dynamic analysis, pile load test, coyle and reese (1966) method of estimating load settlement behavior of pile, negative skin friction, vertical pile subjected to lateral load, lateral load capacity of single pile, uplift capacity of piles, pile group- spacing of piles, efficiency of a pile group, bearing capacity of a pile group, settlement of pile group, negative skin friction in a pile group, uplift capacity of a pile group, ultimate lateral load resistance of pile group, lateral pile load test, proportioning and design of pile foundation,

Rigid retaining wall- types of retaining wall, concept under which Rankine and Coulomb formulas are applicable to retaining walls under active state, proportioning of retaining wall, stability of retaining wall, structural design of retaining wall.

Module 4: design of Marine substructure, foundation in expensive soil and foundation of transmission line tower (10 hours)

bridge substructures- elements of a bridge substructure, determination of the maximum depth of scour, depth of foundation, allowable bearing pressure, load to be considered, later stability of well foundation, design of pier cap, design of pier, types of well foundation, design of well cap, design of well steining, design of well curb, design of cutting edge, design of bottom plug, top plug and filling, sinking of wells, tilts and sifts.

Foundation in expensive soil- introduction, mineral structure, identification of expensive soil, swell potential and swelling pressure, expansion index, swell index, traditional Indian practice of foundation on expansive soil, drilled pier foundation, belled piers foundation, replacement of soils and 'CNS' concept, remedial measure for cracked building.

Foundation of transmission line towers- introduction, forces on tower foundation, general design criteria, chose and type of foundation, design of foundation of transmission line towers.

References / Suggested Learning Resources:

1. Analysis and design of substructures, by S. Saran, Oxford and IBH Publishing company Ltd.
2. Foundation analysis and design by J.E. Bowles , McGraw-Hill Companies.
3. B.M. Das, Principles of Foundation Engineering, 5th Ed., Thomson Asia, Singapore, 2003.
4. N. Som, Theory and Practice of Foundation Design, Prentice Hall, New Delhi, 2003.
5. Relevant Indian Standard Specifications and Codes.

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Rural Water Supply and Sanitation

Course Code	PE CE 702/1
Course Title	Rural Water Supply and Sanitation
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Environmental Engineering
Course Category	Program Elective
Number of classes	26 hours

Course Outcome:

CO Number	CO Description	K-level
CO-1	Explain water quality, hygiene and sanitation.	K-2
CO-2	Develop water resources.	K-3
CO-3	Explain community sanitation.	K-2
CO-4	Explain the concept of biogas.	K-2

Course Content:

Module 4: General (7 hours)

Attributes of water supply systems, drinking water quality.Relationships between diseases and water quality, hygiene and sanitation. Need for water treatment. Point of use water treatment systems, filters, bio-sand filters, disinfection systems for rural areas, chlorination, Solar disinfection systems, removal of arsenic, fluoride and iron. Onsite sanitation systems: Nexus between water quality and sanitation. Importance of hydrogeology on selection of onsite sanitation systems, Design of Septic tanks, single pit and double pit toilets. Small bore systems, bio digesters, reed beds, constructed wetlands, sludge/septage management systems.
Concept and scope of Environmental sanitation in rural areas, magnitude and problems of water supply and sanitation in rural areas in India, National Policy.

Module 4: Water Supply Schemes (7 hours)

Quality aspects: specific impurities ad their significance, Design population, Demand and variations, Planning of water supply schemes in rural areas: individual village and group schemes, Sources of water supply: springs, wells, infiltration wells, radial wells, infiltration galleries and surface water intake, Treatment of water for rural water supply, compact system: multi bottom settler, slow sand filter, diatomaceous earth filter, cloth filter, chlorine diffusion cartridges, pumps, pipe, materials, appurtenances and improvised device for use in rural water supply schemes, Distribution systems for rural water supply, Iron removal plant, Rain water harvesting, Ground water recharging.

Module 4: Disposal of Night soil and wastewater (6 hours)

Various methods of collection and disposal of night soil: Sanitary latrines, community latrines, Privies of a

conservancy system of sanitation, septic tanks, soakage system, anaerobic filter, Imhoff tank, Plumbing system, Compact and simple wastewater treatment units: Stabilization ponds, revolving biological surface, Garbage, ash, rubbish, collection methods, transportation, disposal, Hauled container and stationary container system, Impact on improper disposal of solid wastes on human health and environment.

Module 4: Biogas Plants and Waste Management (6 hours)

Quantity of cow dung, Required capacity and design, Disposal of Solid Wastes, sanitary land fill, Indore process, Bangalore process, Composting, land filling, Incineration, Pyrolysis, Strategies for reducing pollution and improving the environment, Pollution related diseases, Sustainable consumption, Need and challenges for sustainable development, Sources and classification of waste, Impact of waste accumulation, Waste management – need and practice, Participation in waste management.

References / Suggested Learning Resources:

1. Water supply for Rural areas and small communities, Wagner, E.G and Lanoix, J.N.
2. Rural Water Supply and Sanitation, Wright, F.B.,.
3. Excreta Disposal for Rural Areas Wagner and Small Communities E.G., Lanoix, J.N.
4. Water supply and sanitary S.C.Rangawala, Engineering K.S.RangawalaCharotar publishing P.S.Rangawala housing
5. Water supply and sanitryG.S.Birdie& J.S. Birdie DhanpatRai Engineering publishing Company, New Delhi.

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Traffic Engineering and Management

Course Code	PE CE 702/2
Course Title	Traffic Engineering and Management
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Transportation Engineering-I
Course Category	Program Elective (PE)
Number of classes	26 hours

Course Outcome: After completion of this course the students will be able to:

CO Number	CO Description	K-level
CO-1	Explain and apply fundamental relation of traffic flow with its parameters.	K-2 & K-3
CO-2	Design the signalized and unsignalized intersections	K-6
CO-3	Develop a clear idea on traffic operation and management, demand relationships	K-3
CO-4	Elaborate parking study, shockwaves, headway distribution.	K-6

Course Contents:-

Module- 1: Traffic flow theory and traffic studies (6 hours)

Driver behavior, traffic information and control systems, traffic studies- volume, speed and delay studies, elements of traffic flow theory, characteristics of uninterrupted traffic, capacity and LOS of Uninterrupted facilities, Highway capacity: Passenger's car units, level of service, factor affecting capacity and level of service, influence of mixed traffic.

Module- 2: Unsignalized and signalized intersections (6 hours)

Hours Characteristics of interrupted traffic, traffic characteristics at un-signalised intersections, design of signalized intersections, types of traffic signals, advantages, determination of optimal cycle time and signal setting for an intersection with fixed time signals, actuated signal control, signal coordination, Rotary design.

Module- 3: **Traffic operation and management, design hourly volume, demand relationships (7 hours)**

Traffic Operation and Management- Various measures and their scope, relative merits and demerits Traffic congestion, circulation, Planning, control devices, Speed change Lane- Different type of speed change lane, Design of speed change lane, Advantages and Disadvantages of one way lane and reversible lane. Street lighting. Design Hourly Volume For Varying Demand Conditions: Concept of Design vehicle units and determination of PCU under mixed traffic conditions, Price-volume relationships, demand functions & relationships.

Module- 4: Parking studies, gap acceptance, shockwaves, headway distribution (7 hours)

Parking- On street parking, parallel parking and angle parking, Off street parking,Advantages and Disadvantages of on street and off street parking,Accident- Spot map, Collision Map, Condition diagram, Introduction to intelligent transportation systems, Introduction to advanced computational techniques for transportation planning. Shock waves; Queuing theory and applications, Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, application of simulation techniques in traffic engineering

References / Suggested learning Resources:-

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2. L R Kadiyali, N B Lal, Principles and practice of highway engineering, Khanna Publications, 2005
3. Principles of Transportation Engineering, Partha Chakraborty, PHI Learning, 1st edition
4. Principles of Highway Engineering and Traffic Analysis, 4th Edition, Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski, John Wiley
5. Morlok, E.R., An Introduction to Transportation Engineering and Planning, McGraw Hill, NY, 1970
6. Hay W.W., Introduction to transportation Engineering, John Wiley & Sons, NY, 1988.
7. Papacostas C.S., Fundamentals of transportation Engineering, Prentice Hall of India, 1987.
8. Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.

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Building Construction Practice

Course Code	PE CE 702/3
Course Title	Building Construction Practice
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	Materials, Testing and Evaluation
Course Category	Professional elective courses (PEC)
Number of classes	26 hours

Course Outcomes: After completion of the course students will be able to-

CO No	CO Description	K-level
CO-1	Explain different components and classification of building	I
CO-2	Illustrate sequence of activities of building construction	II
CO-3	Demonstrate different Sub Structure Construction	IV
CO-4	Design Green Buildings	VI

Course contents:-

Module 1: **- Introduction to Building Construction Practice (7 hours)**

Types of buildings, components of a building , details and sequence of activities and construction co-ordination – Site Clearance – Marking – Earthwork - masonry – stone masonry –Brick masonry- Bond in masonry - concrete hollow block masonry – flooring – damp proof courses –cavity walls-partition walls-construction joints – movement and expansion joints.

Module 2: **- Parts of Building Construction (7 hours)**

Building foundations-types – basements – temporary shed – centering and shuttering – slip forms – scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – frames – braced domes – laying brick — weather and water proof – roof and roof coverings, finishes.

Module 3: **- Sub Structure Construction (6 hours)**

Sub Structure Construction- Techniques of Box jacking – Pipe Jacking –under water construction of diaphragm walls and basement-Tunneling techniques – Piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting-driving diaphragm walls, sheet piles - shoring for deep cutting - well points –Dewatering.

Module 4: **- Green Buildings (6 hours)**

Importance, Sustainable Site planning: wind/sun path, water management, material use, landscape, topography. Climate responsive architecture: orientation, solar-wind, Building envelope. Arrangement of mechanical and natural ventilation, Sustainable development and it's features, Sanitation. Ratting system: Leadership in energy and environmental design (LEED), green globes, LEED India energy conservation, GRIHA.

References / Suggested learning Resources:-

1. Rangwala, Engineering Materials, Charotar Publishing House Pvt. Ltd.

2. Ashok Kumar Jain, Dr. B.C. Punmia, Arun Kumar Jain, Building Construction, Laxmi Publications Pvt. Ltd.
3. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth- Heinemann
4. S.K.Duggal, Building Materials, 3rd Edition, New Age International Publishers.
5. Sushil Kumar, Building Construction, Standard Publishers Distributors.
6. M.S.Shetty, Concrete Technology: Theory and Practice, S. Chand Publishers.

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Project Work Intermediate

Course Code	PR CE 705
Course Title	Project Work Intermediate
Number of Credits	6 (L: 0, T: 0, P: 12)
Prerequisites	Nil
Course Category	Project (PR)
Number of classes	130 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Demonstrate a sound technical knowledge of their selected project topic	K-2
CO-2	Develop the skill of working in a Team	K-3
CO-3	Design engineering solutions to complex problems utilizing a systematic approach	K-6
CO-4	Design the solution of an engineering project involving latest tools and techniques	K-6
CO-5	Develop the skill of effective communication with engineers and the community at large in written an oral forms	K-3
CO-6	Demonstrate the knowledge, skills and attitudes of a professional engineer	K-2

Course Content:-

The project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Develop sound knowledge about the domain of the project work.
2) Perform detailed study about various components of a project.
3) Learn to be an important member of a team for successful execution of a project work.
4) Study about methodologies and professional way of documentation and communication related to project work.
5) Develop idea about problem formulation, finding the solution of a complex engineering problem.

6) Develop project report as per the suggested format to communicate the findings of the project work.
7) Acquire the skill of effective oral communication to the fellow engineers and people in the society at large.
8) Develop knowledge of how to organize, scope, plan, do and act within a project thesis.
9) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.
10) Demonstrate the implementation of a project work.

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Industry Internship – II

Course Code	SI CE 706
Course Title	Industry Internship – II
Number of Credits	1 (L: 0, T: 0, P: 0)
Prerequisites	Nil
Course Category	Summer Internship (SI)
Number of classes	-

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Solve real life challenges in the workplace by analysing work environment and conditions, and selecting appropriate skill sets acquired from the course of study	K-3
CO-2	Develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting	K-3
CO-3	Demonstrate the skill to communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means	K-2
CO-4	Show professional ethics by displaying positive disposition during internship	K-2
CO-5	Decide career options by considering opportunities in company, sector, industry, professional and educational advancement	K-5

Course Content:-

The industry internship aims to provide the student with:

1. A practice-oriented and 'hands-on' working experience in the real world or industry, and to enhance the student's learning experience.

2. An opportunity to develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting.

3. An opportunity to further develop and enhance operational, customer service and other life-long knowledge and skills in a real world work environment.

4. Pre-employment training opportunities and an opportunity for the company or organisation to assess the performance of the student and to offer the student an employment opportunity after his/her graduation, if it deems fit.

Each student shall

1) Identify an internship program of relevance in his/her branch of engineering to undergo during summer break between 6th and 7th semester,
2) Get approval of the concerned HOD,
3) Undergo the industry internship program for minimum 4 weeks duration
4) Prepare their own report
5) Present in the class among fellow students and faculty members / deliver viva voce.
6) Submit the report and participation/course completion certificate.

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Seminar on Contemporary Engineering Topics – I

Course Code	SE CE 707
Course Title	Seminar on Contemporary Engineering Topics – I
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Nil
Course Category	Seminar (SE)
Number of classes	24 hours

Course Outcome:-

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

CO Number	CO Description	K-level
CO-1	Identify contemporary topics in respective branch of engineering	K-3
CO-2	Survey literature to understand insight of the selected topic	K-4
CO-3	Develop report writing and presentation making skill	K-3
CO-4	Present the topic so prepared among audience using suitable aid	K-3

Course Content:-

Each student shall

1) Identify a topic of current relevance in his/her branch of engineering,
2) Get approval of the faculty concerned/HOD,
3) Collect sufficient literature on the selected topic, study it thoroughly (literature survey),
4) Prepare their own report and presentation slides and
5) Present in the class among fellow students and faculty members.

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