Department of Civil Engineering
B.I.T. Sindri, Dhanbad

5th semester -Course Structure

Sl.no.	Course no.	Subject	L	T	P	Credit
1	CE5PC01	PC-I - SteelStructure& Design	4	1	0	4
2	CE5PC02	PC-II -Geotechnical Engineering-I	3	1	0	3
3	CE5PC03	PC-III - Environmental Engineering	3	1	0	3
4	CE5PE01()	PE-I -	3	1	0	3
5	CE5OE01()	OE-I -	3	1	0	3
Laboratory/Sessionals						
1	Lab-1	Sessional- SteelDesign Lab	0	0	3	1
2	Lab-2	Sessional- Geotechnical Engineering Lab	0	0	3	1
3	Lab-3	Sessional- Environmental EngineeringLab	0	0	3	1
4	Lab-4	Field Survey	0	0	3	1
5		General Proficiency/Seminar	0	0	2	2
TOTAL CREDIT						**22**

PROFESSIONAL ELECTIVE – I

[CE5PE01(A)] Water Resources Engineering-I
[CE5PE01(B)] Earthquake Engineering
[CE5PE01(C)] EnvironmentalGeo-technology
[CE5PE01(D)] Advance Surveying
[CE5PE01(E)] Water resources system
[CE5PE01(F)] IndustrialStructure
[CE5PE01(G)] DesignofStructural System

OPEN ELECTIVE – I

[CE5OE01(A)] EnvironmentalImpact Assessment
[CE5OE01(B)] Reliability Engineering
[CE5OE01(C)] Global Positioning System
[CE5OE01(D)] Disaster Management
[CE5OE01(E)] Environmental Management System
[CE5OE01(F)] Advanced Engineering System – MechanicalDepartment
[ ] Human ResourceDevelopmentandOrganisationalBehaviour – Humanities Department
[] Cyber Lawand Ethics – Humanities Department

PROFESSIONAL CORE – I

CE5PC01	**STEEL STRUCTURE &DESIGN**	**PC – I**	**4-1-0**	**4 Credits**

Pre-requisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Introduction to steel structures and IS 800-2007- Material specifications - Rolled sections – Section classifications - Design approach; design philosophy, i.e. loading load combination, factor of safety, permissible and working stress elastic method, limit state of design, plastic design, Elements of plastic theory:- Plastic hinge, shape factor, collapse load for beams & portal frame. Uniqueness, upper & lower bound theorem. Effect of axial force & shear in plastic moment ofsections.	**12**
2.	Connections: riveted, bolted and welded connections, strength and efficiency, Eccentric connection	**12**
3.	Tension member: rolled sections and built-up sections,	**8**
4	Compression members - Slenderness ratio – Design - Simple and built- up sections - lacings and battens - Tension members.	**10**
5.	Flexural members – Rolled sections - built-up beams - Design for strength and serviceability, web crippling, webyielding, bearing stiffeners,	**10**
6.	BEAM column: stability consideration, interaction formulae and Column bases: stability of base, gusseted base and grillage footing	**8**

Plate Girder, Gantry Girder,

Reading:

1. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi2008.

2. Dayaratnam P, Design of Steel Structures, S. Chand & Co., New Delhi,2003.

3. Arya, A.S and Ajmani, A.L., Design of Steel Structures, Nemchand and brothers, Roorkee, 1992..

4. Punmia, B.C., Ashok Kumar Jain and Arun Kumar Jain. Comprehensive Design of Steel Structures, Laxmi Publications Pvt. Ltd., New Delhi2000.

5. IS 800-2007, Code of practice for general construction in steel, Bureau of Indian Standards, NewDelhi.

PROFESSIONAL CORE – II

CE5PC02	Geotechnical Engineering-I	PC – II	3-1-0	3 Credits

Pre-requisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	**Engineering Properties and Classifications** Laboratory and field identification of soils: Determination of water content by oven drying– specific gravity using Pycnometer and specific gravity bottle – grain size analysis by sieveanalysis, hydrometer analysis and pipette analysis – Atterberg limit and indices, sensitivity &thixotropy field density by core cutter, sand replacement and wax coating methods.Permeability: Definition - Darcy's law - factors affecting permeability – laboratorydetermination – permeability of stratified soils. Classification of Soils: Necessity – Principles of classification – I.S. classification – plasticitychart.	10
2.	**Stress Distribution in Soils** Stress distribution: Boussinesque's and Westergaard's equations for vertical pressure due topoint loads and uniformly distributed loads - assumptions and limitations - pressure bulb – Newmarks` charts and their use	4
3.	**Compressibility of Soils** Consolidation: definition - concepts of coefficient of compressibility - coefficient of volumechange and compression index - e-log p curves - pre-consolidation pressure - Terzaghi'stheory of one-dimensional consolidation - determination of coefficient of consolidation -difference between consolidation and compaction Compaction: definition and objectives of compaction - proctor test and modified proctor test- concept of OMC and maximum dry density - zero air voids line - factors influencingcompaction - field compaction methods - Proctor needle for field control	12
4	**Shear Strength and Stability of Slopes:** Shear Strength: definition - Mohr's strength and stress circles - Mohr's envelope – MohrCoulomb strength theory - direct, triaxial and UCC tests - drainage conditions-UU, CU andCD tests - vane shear tests - total and effective stress - strength parameters Stability of slopes: slope failure, base failure and toe failure - Swedish circle method -friction circle method - Taylor's stability number - stability charts	8
5.	**Retaining Walls :** Retaining walls, Active, neutral and Passive earth pressures and their distributions, rigid and flexible retaining walls,	6

	Coulomb's and Rankine's earth pressure distribution, Tension cracks, depth of tension cracks, Critical depth of excavation	
6.	**Sub-surface Exploration :** Subsurface exploration and investigation: Preliminary and detailed investigation, Soil sampling and various terms such as clearance and recovery ratio, auguring and boring, Penetration tests such as SPT, CPT, SCPT	**4**

PROFESSIONAL CORE – III

CE5PC03	**ENVIROMENTAL ENGINEERING**	**PC – III**	**3-1-0**	**3 Credits**

Pre-requisites:None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Water demand: - Population- forecast, design period, factors affecting populations growth, water demand, factors affecting rate of demand, variations in rate of demand.	**8**
2.	Quality of water: - sources of impurities, common impurities in water and their effect, water analysis, physical, chemical and biological characteristics, water borne diseases, Indian andWHO drinking standard.	**8**
3.	Purification: Sedimentation, flocculation, coagulation, filtration, disinfection, water softening, aeration, miscellaneous treatment method.	**8**
4.	Distribution of water: - Introductions , Methods of distribution, pressure in distribution mains, system of water supply, storage and distribution reservoir, layout and design of distribution system and distribution reservoir.	**12**
5.	Waste water treatment: - Sewage characteristics. Sewerage system: - Type, design, construction and maintenance. Treatment :- Primary and secondary treatments, screens, grit chamber, sedimentation chamber, principle and design of activated sludge digestion, final disposal of sludge and effluents, Disposal of sewage by dilution, self-purification of streams, sewage disposal by irrigation, waste water reuse, solid waste collection, re-utilization/disposal, B.O.D, C.O.D.	**12**

Reference Books

1. G.B. Masters, Introduction to Environmental Engineering and Science, Pearson Education,2013.
2. Gerard Kiely, Environmental Engineering, McGraw Hill Education Pvt Ltd, Special Indian
   Edition, 2007.
3. W P Cunningham, M A Cunningham, Principles of Environmental Science, Inquiry and Applications, Tata McGraw Hill, Eighth Edition,2016.
4. M. Chandrasekhar, Environmental science, Hi Tech Publishers,2009

PROFESSIONAL ELLECTIVE – I

CE5PE01(A)	WATER RESOURCES ENGINEERING – I	PE – I	3-1-0	3 Credits

Prerequisite: Fluid Mechanics

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	**Introduction -** Hydrologic cycle, water-budget equation, history of hydrology,worldwaterbudget,WaterbudgetofIndia,Organization preserving hydrological data,	4
2.	**Precipitation –** types and forms of precipitation, different characteristics of rainfall and their representation, measurement of rainfall , rain gauge network, mean precipitation over an area, depth area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India	8
3.	**Abstractions from precipitation -** evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration,evapotranspiration equations, potential evapotranspiration, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, infiltration capacity curve, classification of infiltrationcapacities, infiltration indices	10
4.	**Runoff** –components ofrunoff Estimation of run off, SCS-CN method of estimating runoff, flow duration curve, flow-mass curve, Different types ofindices.	4
5.	**Hydrograph:** Elements of storm hydrograph, simple and complex storm hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph, Derivation of unit hydrograph from S- Curve technique, SUH and IUH.	10
6.	**Floods estimation and Flood Routing:** Estimation of peak discharge, rational method, SCS method and unit hydrograph method, Design flood, return period, flood frequency analysis, concepts of flow routing, Different methods of routing,PMF,SPF	8

Reading:

1. 1.KSubramanya, Engineering Hydrology, Mc-GrawHill.
2. K N Muthreja, Applied Hydrology, Tata Mc-GrawHill.
3. K Subramanya, Water Resources Engineering through Objective Questions, TataMc-
    a. GrawHill.

CE5PE01(B)	EARTHQUAKE ENGINEERING	PE – I	3-1-0	3 Credits

Pre-requisites: NA

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Elements of Seismology ,Definitions of Magnitude, Intensity, Epicenter, etc. General features of tectonic of seismic regions, Seismographs. Theory of Vibrations	8
2.	Free vibrations of single degree, two degree and multiple degree freedom systems. Computation of dynamic response to time dependent forces. Vibration isolation. Vibration absorbers.	8
3.	Principles of Earthquake Resistant Design ,Response spectrum theory. Brief introduction to accelerographs and S.R.R.'s.	8
4.	Nature of dynamic loading resulting from earthquakes. Application of Response spectrum. Theory to a seismic design to structures. Resistance of structural elements and structures for dynamic loads, design criteria-strength and deflection. Ductility and absorption of energy.	8
5.	Dynamic Properties of Soils, Remedial measures and management of earthquake disaster , Introduction to Indian Standard Codes IS : 1893 – 1984 and IS: 4326 – 1993	8

CE5PE01(C)	ENVIRONMENTAL GEO-TECHNOLOGY	PE – I	3-1-0	3 Credits

Pre-requisites:None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	A consideration of technical and scientific aspects of key geo-societal issues.	8
2.	Case studies and analysis of current and historic databases will be used to illustrate topics including impact of climate change, energy resources, water and soil pollution, and health risks posed by heavy metals and emerging pollutants.	16

3.	Influence of disposal of industrial and construction waste on the Geo-environment	**12**
4.	Effect and impact of effluent from chemical and mining industries on ground water, Design of clay liners	**8**

Reference Books

1. Introduction to Environmental Geotechnology by Hsai – YangFang
2. CDEEP, IITB video lectures on course CE 488 and CE 641 by Prof. D. N.Singh

CE5PE01(D)	**ADVANCE SURVEYING**	**PE – I**	**3-1-0**	**3 Credits**

Pre-requisites: Surveying &Geomatics

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	**Field Astronomy**: Introduction, purposes, astronomical terms, Astronomical coordinate system, astronomical triangle, determination of azimuth, declination & hour angle, different types of time, LMT, ST & GMT and interdependencies. Equation of time,	**12**
2.	**Aerial photogrammetry**: Introduction, Principle, Uses, Aerial & terrestrial photographs, Scale of vertical and tilted photograph, photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics,map substitutes.	**10**
3.	**Remote Sensing And Geographical Information System**: Introduction, Electromagnetic spectrum, Principles of energy interaction in atmosphere and earth surface, Image interpretation techniques, digital satellite data; Global Positioning system: Definition of GIS, Key Components of GIS, Functions of GIS, Spatial data, spatial information system, Geospatial analysis, Integration of Remote sensing & GIS and Applications in Civil Engineering	**12**
4.	**Hydrographic surveying**: Introduction, shoreline survey, sounding method of locating sounding, Three pointproblem.	**10**

Reading:

1. Surveying Vol. II and III by Dr. B.C. Punamia, Laxmi Publishers. NewDelhi
2. Surveying Vol. II and III by Dr. K.R. Arora, Standard Book House. NewDelhi
3. Advanced Surveying by R. Agor, Khanna Publishers, NewDelhi

4. Remote Sensing and GIS by B Bhatia, Oxford University Press, NewDelhi.
5. Remote sensing and Image interpretation by T.M Lillesand,. R.W Kiefer,. and J.W Chipman, 5th edition, John Wiley and SonsIndia

CE5PE01(E)	WATER RESOURCE SYSTEM	PE – I	3-1-0	3 Credits

Pre-requisites: Fluid Mechanics & Hydrology

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	**Introduction and Basic Concepts**: Introduction, System Components, Planning and management, Concept of a system, Advantages and limitations of systems approach, Modeling of Water Resources Systems, Simulation andoptimization, Economics in water resources, Challenges in water sector	6
2.	**Linear Programming and Applications**: General form of LP, Standard and Canonical forms of LP, Elementary transformations, Graphical method, Feasible and infeasible solutions, Simplex method, Dual and sensitivity analysis, LP problem formulation, Reservoir sizing and Reservoir operation using LP	8
3.	**Simulation:** Introduction, River basin simulation, Reservoir operation simulation, Performance evaluation - Reliability, Resiliency and Vulnerability, Some simulation models	4
4.	**Water Resources Systems Modeling:** River basin planning and management, Water distribution systems, Groundwater systems, Water quality modeling, Floodplain management, Urban storm water management	8

Reading:

1. Loucks D.P, Stedinger J.R and Haith D.A, 'Water Resources Systems Planning and Analysis', Prentice Hall, USA, 1981.

CE5PE01(F)	INDUSTRIAL STRUCTURES	PE – I	3-1-0	3 Credits

Pre-requisites: Steel Structure

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Industrial steel building frames: Types of frames, bracing, crane girders and columns, workshop sheds, trussed bents	6
2.	Transmission and Communication towers: Types and configuration, Analysis and design; Chimneys; Loads and stresses in chimney shaft, Earthquake and wind effect, Stresses due to temperature difference, combined effect of loads and Temperature	10
3.	Silos and Bunkers; Jassen's theory, Airy's theory, Shallow and deep bins, Rectangular bunkers with slopping bottom, Rectangular bunkers with high side walls, Steel stacks; introduction, force acting on a steel stack, design consideration, design example of stacks	12
4	Concrete Shell Structures: Folded plate and cylindrical shell structures; Introduction, structural behaviour of long and short shells, beam and arch action, analysis and design of cylindrical shell structures	10
5.	Machine foundations; introduction, machine vibration, structural design of foundation to rotary machines, impact machines, vibration characteristics, design consideration of foundation to impact machine, grillage, pile and raft foundation.	10

Reading:

1. 1.Design of Steel Structures, Arya and Azmani, Nem Chand Brothers, Roorkee,2004
2. Punmia B.C, Ashok Kr. Jain, Arun Kr. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers,2006.
3. Ramachandra, Design of Steel Structures, 12th Edition, Standard Publishers,2009.

CE5PE01(G)	DESIGN OF STRUCTURAL SYSTEMS	PE – I	3-1-0	3 Credits

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Classification of structural systems, Loads, assumptions and Idealizations	10
2.	The whole structural design process including definition of functional requirements, selection of structural scheme	18
3.	Formulation of design criteria, preliminary and computer- aided proportioning, and analysis of response, cost, and value.	18

Reading:

1. Structural Stability - Theory and Implementation by W.F.Chen and E.M.Lui byElsevier.
2. Reeve,D., Chadwick, A. and Fleming, C. Coastal Engineering-Processes, theory and design practice, Spon Press, Taylor & Francis Group, London &Paris,2004.

OPEN ELLECTIVE – I

CE5OE01(A)	**ENVIRONMENT IMPACT ASSESSMENT**	**OE – I**	**3-1-0**	**3 Credits**

Prerequisites: Environmental Engineering

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Evolution of EIA: Concepts ofEIA methodologies, Screening and scoping;	**8**
2.	Rapid EIA and Comprehensive EIA; GeneralFramework for Environmental Impact Assessment, Characterization and site assessment.Environmental Risk Analysis	**8**
3.	Definition of Risk, Matrix Method. Checklist method, Faulttree analysis, Consequence Analysis; Socioeconomic aspects, measures of effectiveness of pollution control activities	**12**
4	Environmental Legislation; Introduction to EnvironmentalManagement Systems; Environmental Statement - procedures; Environmental Audit: CostBenefit Analysis; Life Cycle Assessment; Resource Balance, Energy Balance &ManagementReview; Operational Control;	**14**
5	Case Studies on EIA.	**2**

CE5OE01(B)	RELIABILITY ENGINEERING	OE – I	3-1-0	3 Credits

Pre-requisites: NA

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Introduction: Definitions and concepts, Reliability , Probability, Impossible and certain events. Failure-data and its Analysis, Hazard rate and Failure density, Reliability in terms of hazard rate, Failure density in other situations.	10
2.	Hazard Models : Type of distribution and standard deviation and variance, Expectations , Conditional probabilities.	8
3.	System Reliability : Series, Parallel and mixed configurations. Methods of solving Complex systems.	8
4.	Reliability improvement : Types of redundancies, Reliability allocation for a series of system, Optimization Reliability- cost trade-off.	8

CE5OE01(C)	GLOBAL POSITIONING SYSTEM	OE – I	3-1-0	3 Credits

Pre-requisites: NA

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Overview of GPS – Development of Global Surveying Techniques, History of GPS, New Satellite Navigations constellations, Basic concept of GPS, Space, Control and User segments.	8
2.	GPS Observables – Structure of GPS Signal, Frequency, P Code, C/A code and data format, Generation of C/A code, Navigation data bits Pseudo range measurements, Phase measurements, system accuracy characteristics, DOP, Data format.	8
3.	Surveying with GPS–Planning a GPS Survey, Positioning methods – point positioning, relative positioning, Static, Fast static, RTK, Differential Positioning, Post processing, real-time processing,	8
4	Accuracy measures, software modules, Network adjustments, Dilution of Precision.	8
5	Applications of GPS – General Uses of GPS, Attitude determination, Interoperability of GPS. Future of GPS – Modernization plans of navigational satellites, Hardware and software improvements.	8

Reading:
1. Bradford W. Parkinson, James Spilker, Global Positioning System: Theory and Applications, Vol. I, 1996.
2. Gunter Seeber, Satellite Geodesy Foundations, Methods and Applications, Walter de Gruyter Pub., 2003.
3. Hofmann W.B, Lichtenegger, H, Collins, J Global Positioning System – Theory and Practice, Springer-VerlagWein, 2001.

CE5OE01(D)	DISASTER MANAGEMENT	OE – I	3-1-0	3 Credits

Pre-requisites: NA

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Understanding Disaster:Concept of Disaster – Different approaches- Concept of Risk – Levels of Disasters – Disaster Phenomena and Events (Global, national and regional) Hazards and Vulnerabilities: Natural and man-made hazards; response time, frequency and forewarning levels of different hazards – Characteristics and damage potential or natural hazards; hazard assessment – Dimensions of vulnerability factors; vulnerability assessment – Vulnerability and disaster risk – Vulnerabilities to flood and earthquake hazards	8
2.	Disaster Management Mechanism:Concepts of risk management and crisis managements – Disaster Management Cycle – Response and Recovery – Development, Prevention, Mitigation and Preparedness – Planning for Relief	8
3.	Capacity Building:Capacity Building: Concept – Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk – Counter-Disaster Resources and their utility in Disaster Management – Legislative Support at the state and national levels	8
4	Coping with Disaster:Coping Strategies; alternative adjustment processes – Changing Concepts of disaster management – Industrial Safety Plan; Safety norms and survival kits Mass media and disaster management	8
5	Planning for disaster management:Strategies for disaster management planning – Steps for formulating a disaster risk reduction plan – Disaster management Act and Policy in India – Organizational structure for disaster management in India – Preparation of state and district disaster management plans	8

TEXT BOOKS:
Manual on Disaster Management, National Disaster Management, Agency Govt of India.
Disaster Management by MrinaliniPandey Wiley 2014.
Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

CE5OE01(E)	ENVIRONMENTAL MANAGEMENT SYSTEM	OE – I	3-1-0	3 Credits

Pre-requisites: NA

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Environmental Management System in Industry : Quality of environment. ISO 14000 Environment standards, EMS model. Policy planning process, implementation and operation in industry.	8
2.	Environmental Pollution & Control Techniques: Definition of pollution, pollutant and significance of pollution of pollution control. Types of environment pollution: air, water and land pollution and control.	8
3.	Hazardous waste management system : landfill as incineration, environment problems and solution Concept of Restoration Ecology and Reclamation of degraded land.	8
4	Environment Impact Assessment and Audits : Basic concept of EIA, Needs for EIA and Methods. Introduction and Significance of Environment Audit. Audit regulations, standards and protocols. Setting up EIA and Audit Division in Industry.	8
5	Disasters and their management: Introduction of disasters, Classification and sub types of disasters. Industrial disasters and related case studies. Precautions of SHE in disaster management. Role of SHE in disaster management	8

CE5OE01(F)	ADVANCE ENGINEERING SYSTEMS	OE – I	3-1-0	3 Credits

Pre-requisites: NA

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Equations of motion for simple physical system. mechanical, electrical and eectromechanical systems	10
2.	Equations of motion for simple heat, conduction and fluid system. Analogies. Equations of motion for mechanical system in two and three dimension. Dynamic response of first orderand second order systems	12
3.	Forced oscillations of elementary systems. Dynamic stability of compound system. Total response of compound system. Fundamentals of compound systemanalysis.	12

*** Human Resource Development and Organizational Behavior (syllabus prepared and taught by Training and placement Cell, BIT, Sindri)**

*** Cyber Law and Ethics (syllabus prepared and taught by CSE & IT Department)**

Department of Civil Engineering
B.I.T. Sindri, Dhanbad

6th semester -Course Structure

Sl.no.	Course no.	Subject	L	T	P	Credit
1	CE6PC01	PC-I - Concrete Structure-II	4	1	0	4
2	CE6PC02	PC-II - Structural Analysis-II	3	1	0	3
3	CE6PC03	PC-III - Highway Engineering	3	1	0	3
4	CE6PE01()	PE-I -	3	1	0	3
5	CE6OE01()	OE-I -	3	1	0	3
Laboratory/Sessionals						
1	Lab-1	Sessional- ConcreteDesign Lab	0	0	3	1
2	Lab-2	Sessional- Transportation Engineering Lab	0	0	3	1
3	Lab-3	Sessional- Structural EngineeringLab	0	0	3	1
4	Lab-4	C.S.Q.A.	0	0	3	1
5	IN601	Tour&Training/Internship	0	0	2	2
TOTAL CREDIT						**22**

PROFESSIONAL ELECTIVE – I

[CE6PE01(A)] Water Resources Engineering-II
[CE6PE01(B)] Pavement Design
[CE6PE01(C)] Bridge engineering
[CE6PE01(D)] Structural Dynamics
[CE6PE01(E)] System Engineering &Economics
[CE6PE01(F)] Masonry Structure

OPEN ELECTIVE – I

[CE6OE01(A)] IndustrialWaste Treatment
[CE6OE01(B)] Composite Material
[CE6OE01(C)] Environmental Laws and Policy
[CE6OE01(D)] Operational Research Technique
[CE6OE01(E)] Value and Ethics in engineering
[CE6OE01(F)] Decision and Risk Analysis

PROFESSIONAL CORE – I

CE6PC01	CONCRETE STRUCTURE-II	PC-I	4-1-0	4 Credits

Pre-requisites: Strength of Materials

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Design of Residential Buildings: fundamentals of multi-storey buildings, analysis of various loads: gravity, wind, earthquake loads., method of substitute frames, design examples, bending moments in columns, analysis of multistory frames subjected to horizontal loads.	**12**
2.	Design of RCC water tanks: Uncracked structures and determination of basic parameters, Revision of working stress design philosophies. Introduction to water tanks and their classifications, Important IS codes and its provisions, Analysis and design of Circular water tanks with flexible base and restrained base. Analysis and design of Rectangular water tanks, Analysis of Overhead tanks, Intze tank- basic geometrical configurations; analysis methods; design of top domes, cylindrical walls, ring beam.	**12**
3.	Design of Silos and Bunkers: Introduction, difference between bunker and silo, design of square or rectangular bunkers, design of circular bunkers, design examples, silos for storage of cement, design examples.	**10**
4.	Design of Simple Bridges: Bridges – basic definition, importance, classification., Site investigations for design of a bridge, Various loads and their combinations, Relevant IRC codes and its provisions, Introduction to RC bridge-, design of Culvertand T-beam bridge,.	**12**

PROFESSIONAL CORE – II

CE6PC02	**STRUCTURAL ANALYSIS II**	**PC-II**	**3-1-0**	**3 Credits**

Prereq uisites: Structural Analysis I

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Analysis of fixed beams, continuous beam, simple frames and redundant frames with and without translation of points. Method of consistent deformation, Strain energy method, Slope deflection method, Moment distribution method.	**12**
2.	Analysis of two hinged arches. Suspension bridges with two hinged stiffening girder.	**10**
3.	Structural theorems:-Linearity principle of superposition,virtualwork,energy theorems, reciprocal theorems, Muller's Breslau's principles.	**6**
4.	Basics of force and displacement matrix methods for beams,plane frame (rigid and pin-pointed)	**10**
5.	Influence lines:-Influence lines for propped cantilevers,continuous beams and two hinged arches	**10**

PROFESSIONAL CORE – III

CE6PC03	**HIGHWAY ENGINEERING**	**PC-III**	**3-1-0**	**3 Credits**

Prerequisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Highway development and planning-Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.	**6**
2.	Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal and vertical alignment; Grade compensation	**12**
3.	Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; Design of signals, design of road intersections; design of parking facilities; highway lighting; problems	**10**
4.	Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems	**12**

5.	Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems	**8**

PROFESSIONAL ELLECTIVE – I

CE6PE01(A)	**WATER RESOURCE ENGINEERING II**	**PE – I**	**3-1-0**	**3 Credits**

Prerequisites: Water Resources Engineering I

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Irrigation Principles and planning Definition of Irrigation, development of irrigation in India. Benefits and ill effects of Irrigation. Types of method of irrigation system. quality of irrigation water, water requirements and irrigation scheduling, duty and data & base periods and their relationship, improvements of duty.	**10**
2.	Canal design and layouts , types of canal Canal alignment – Canal design – Kennedy's Silt theory method, Laceyes regime theory. RangaRaju and Misri Method. Basak Method, Tractive shear approach ,layout of canals. Conveyance losses.	**10**
3.	Diversion head Works, Layout of diversion head works, Components of head works, Bligh's and lane's theories, Khosla theory, Design of weir& Barrage	**8**
4.	Canal Regulation Works: Different types of regulation works, Types and Design of falls. Types and design of regulators, Cross regulator, head regulator, canal escapes, canal modulus etc.	**8**
5	Cross – Drainage Works Types of cross-drainage works and design of aqueducts. River Training Works Meandering of rivers, cut off, spurs, guide banks ,marginal embankment. Channel Improvements	**6**

CE6PE01(B)	**PAVEMENT DESIGN**	**PE – I**	**3-1-0**	**3 Credits**

Prerequite: Highway Engineering

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Introduction: Types and component parts of pavements,	**6**

	Factors affecting design and performance of pavements. Highway and airport pavements.	
2.	Stresses and Deflection sin Flexible Pavements: Stresses and deflection sin homogeneous masses. Burmister's two layer theory, three layer and multi-layer theories; wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels. Repeated loads and EWL factors; sustained loads. Pavement behaviour under transient traffic loads.	**10**
3.	Flexible Pavement Design Methods For Highways and Airports: Empirical, semi-empirical and theoretical approaches, development, principle, design steps, advantages; design of flexible pavements as per IRC; Stresses in Rigid Pavements: Types of stresses and causes, factors in fluencing the stresses; general considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses.	**10**
4.	Rigid Pavement Design: Types of joint sin cement concrete pavements and their functions, joint spacings; design of CC pavement for roads and run ways as per IRC, design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design by stress ratio method.	**10**
5	Design of continuously reinforced concrete pavements; Maintenance, repair and rehabilitation of pavements including design of bituminous and concrete over lays as per IRC	**8**

CE6PE01(C)	**BRIDGE ENGINEERING**	**PE – I**	**3-1-0**	**3 Credits**

Prerequisites: Highway Engineering

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	General; classification of bridges, site selection, geometric and hydraulic design consideration	**6**
2.	Loading standards for highway and railway bridges, general design consideration; optimum spans; Concrete bridges: culverts; Slab, T-beam, box girder bridges, balanced cantilever bridge, cable stayed bridge, extrados bridges; arch bridge;	**12**
3.	Special requirements for Prestressed Concrete bridges; Steel bridges: plate girder bridge, truss bridge, suspension cable	**12**

	bridge, cable stayed bridge; Substructures: design of piers and abutments, pile and well foundations, bearings and expansion joints, special wearing coats	
4.	seismic design considerations; Aerodynamic stability considerations; special durability measures; provisions for inspection and maintenance;	**10**

CE6PE01(D)	**STRUCTURAL DYNAMICS**	**PE – I**	**3-1-0**	**3 Credits**

Prerequisites: Structural Engineering I

Detailed Syllabus:

MODULE	**CONTENTS**	**Hrs**
1.	THEORY OF VIBRATIONS Difference between static loading and dynamic loading – Degree of freedom – idealisation of structure as single degree of freedom, – Formulation of Equations of motion of SDOF system – D'Alemberts principles – effect of damping – free and forced vibration of damped and undamped structures – Response to harmonic and periodic forces.	**9**
2.	Two degree of freedom system – modes of vibrations – formulation of equations of motion of multi degree of freedom (MDOF) system – Eigen values and Eigen vectors – Response to free and forced vibrations – damped and undamped MDOF system – Modal superposition methods.	**9**
3.	Elements of Engineering Seismology – Causes of Earthquake – Plate Tectonic theory – Elastic rebound Theory – Characteristic of earthquake – Estimation of earthquake parameters – Magnitude and intensity of earthquakes – Spectral Acceleration.	**9**
4.	Effect of earthquake on different type of structures – Behaviour of Reinforced Cement Concrete, Steel and Prestressed Concrete Structure under earthquake loading – Pinching effect – Bouchinger Effects – Evaluation of earthquake forces as per IS:1893 – 2002 – Response Spectra – Lessons learnt from past earthquakes.	**9**
5	Causes of damage – Planning considerations / Architectural concepts as per IS:4326 – 1993 – Guidelines for Earthquake resistant design – Earthquake resistant design for masonry and Reinforced Cement Concrete buildings – Lateral load analysis – Design and detailing as per IS:13920 – 1993.	**9**

CE6PE01(E)	SYSTEM ENGINEERING AND ECONOMICS	PE – I	3-1-0	3 Credits

Prerequisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Introduction to the formulation and solution of civilengineeringproblems.Engineering economy, mathematical modeling, andoptimization.	12
2.	Techniques, including classical optimization, linear and nonlinearprogramming, network theory, critical path methods, simulation, decision theory	14
3.	Dynamic programming applied to a variety of civil engineering problems.	12

CE6PE01(F)	MASONRY STRUCTURES	PE – I	3-1-0	3 Credits

Prerequisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Introduction to analysis, design and construction of masonrystructures.	8
2.	Mechanical properties of clay and concrete masonry units, mortar, and grout	8
3.	Compressive, tensile, flexural, and shear behavior of masonry structural components.	8
4	Strength and behavior of unreinforced bearing walls. Detailed design of reinforced masonry beams, columns, structural walls with and without openings	8
5	Complete lateral-forceresisting building systems.	8

OPEN ELLECTIVE – I

CE6OE01(A)	INDUSTRIAL WASTE TREATMENT	OE – I	3-1-0	3 Credits

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	INTRODUCTION Types of industries and industrial pollution – Characteristics of industrial wastes – Population equivalent – Bioassay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health Environmental legislations related to prevention and control of industrial effluents and hazardous wastes	8
2.	CLEANER PRODUCTION Waste management Approach – Waste Audit – Volume and strength reduction – Material and process modifications – Recycle, reuse and byproduct recovery – Applications.	8
3.	POLLUTION FROM MAJOR INDUSTRIES Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants – Wastewater reclamation concepts	9
4.	TREATMENT TECHNOLOGIES Equalisation – Neutralisation – Removal of suspended and dissolved organic solids – Chemical oxidation – Adsorption – Removal of dissolved inorganics – Combined treatment of industrial and municipal wastes – Residue management – Dewatering – Disposal	11

CE6OE01(B)	COMPOSITE MATERIALS	OE – I	3-1-0	3 Credits

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	**Introduction:** Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc. Types of Reinforcements/Fibers: Role and Selection or reinforcement materials, Types of fibres, Glass fibers, Carbon fibers, Aramid fibers , Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc., Mechanical properties of fibres.	14

2.	**<u>Various types of composites:</u>** Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites.	**10**
3.	**<u>Fabrication methods: Processing of Composite Materials:</u>** Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression molding, resin-transplant method, pultrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films.	**8**
4.	Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.	**8**

CE6OE01(C)	**ENVIRONMENTAL LAWS AND POLICY**	**OE – I**	**3-1-0**	**3 Credits**

Prerequisites: Environmental Engineering

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Overview of environment, nature and eco system, Concept of laws and policies, Origin of environmental law,	**14**
2.	Introduction to environmental laws and policies, Environment and Governance, sustainable development and environment, understanding climate change, carbon crediting, carbon foot print etc.,	**12**
3.	Introduction to trade and environment. International environmental laws, Right to Environment as Human Right International Humanitarian Law and Environment, environment and conflicts management, Famous international protocols like Kyoto.	**14**

CE6OE01(D)	OPERATIONAL RESEARCH TECHNIQUE	OE – I	3-1-0	3 Credits

Prerequisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Introduction: History of operation research, nature and scope of operations research, allocation.	10
2.	Linear programming: Mathematical formulations of the problem, Graphical solution methods, mathematical solution of L-P problems, matrix formulation of general linear programming.	10
3.	Simplex Method: Algorithm and computational procedures, Two phase Simplex method, Problems of degeneracy, Principles of duality in simplex method, Sensitivity analysis, Transportation problem.	10
4	Game Theory: Introduction, Two persons zero sum games, the maxmini and minimax principles. Integer Programming: Formulation and solution of integer programming problems	10

Suggested Reading

1. Taha,H A, "Operations Research - An Introduction", Sixth Edition, Prentice Hall of India Private Limited, N. Delhi, 2004.
2. Hillier, F S, "Operations Research", First Indian Edition, CBS Publishers & Distributors, Delhi, 1994.

CE6OE01(E)	VALUES AND ETHICS IN ENGINEERING	OE – I	3-1-0	3 Credits

Prerequisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Human Values:Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty –	10

	Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.	
2.	Engineering Ethics: Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories	**10**
3.	ENGINEERING AS SOCIAL EXPERIMENTATION Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.	**10**
4	SAFETY, RESPONSIBILITIES AND RIGHTS Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination	**10**
5	GLOBAL ISSUES Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility	**8**

CE6OE01(F)	**DECISION AND RISK ANALYSIS**	**OE – I**	**3-1-0**	**3 Credits**

Prerequisites: None

Detailed Syllabus:

MODULE	CONTENTS	Hrs
1.	Development of modern statistical decision theory and	**10**

	riskanalysis, and application of these concepts in civil engineering design and decision making;	
2.	Bayesian statistical decision theory, decision tree, utility concepts, and multi-objectivedecision problems;	**8**
3.	Modelling and analysis of uncertainties, practical risk evaluation, andformulation of risk-based design criteria,	**12**
4	Risk benefit trade-offs, and optimal decisions.	**10**