BACHELOR OF TECHNOLOGY

CURRICULA & SYLLABI

Civil Engineering Department

ABOUT THE DEPARTMENT

The Civil Engineering was established in 1962, since the inception of erstwhile Madan Mohan Malaviya Engineering College, Gorakhpur. The department has, over the years, established its status as a centre for imparting high quality technical education to Undergraduate and Postgraduate students and extending consultancy services to industries and various government departments located in Eastern UP. Besides Undergraduate course of B.Tech. (Civil Engineering), the department offers 4 regular M.Tech. courses in Civil Engineering respectively in Hill Area Development Engineering, Environmental Engineering, Structural Engineering, and Seismic Design and Earthquake Engineering domains. The facilities of doctoral research are also available in the department under QIP/ TEQIP/ University schemes.

The department has experienced and highly qualified faculty members. Further, the strength of the department also lies in the strong linkages, it has with its alumni and various governments/private organizations located in the region. The alumni of the department are well placed in various government/ private organizations and are in close contact with the department. The department is continuously interacting with the various government and private organization in the form of consultancy work, expert advice, design projects, etc.

VISION

To become a premier centre of learning and research in Civil Engineering, nurturing sustainable development by the year 2025.

MISSION

1. To provide the quality education in the area of Civil Engineering to transform students into graduates with high professional values.
2. To share and disseminate expertise for use in the solution of problems faced by Civil engineering industry and by society.
3. To ensure the continuous improvement in the quality of life of people in the society.
4. To conduct need based research projects giving priority to the needs of industry.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO) OF B.TECH. PROGRAMME

A To enrich the students with state of the art knowledge in the field of Civil Engineering.

B To keep abreast the students with the use of modern tools, equipments and software and inculcating the habit of life-long learning.

C To foster team work and professional ethics among students towards devising feasible solutions to problems and project work.

PROGRAM OUTCOMES (POs) of B.Tech. PROGRAMME

(a) Broadening the horizon of the students in the field of Civil Engineering, increasing their ability to apply knowledge of mathematics, science and engineering to solve real world problems.

(b) Increasing the ability of students to identify, formulate and solve problems in a systematic way by appropriate collection, analysis, and interpretation of data,

(c) Increasing their ability to design a system, component or process to meet the desired needs in an environment friendly and socially acceptable way.

(d) Enhancing their skills to analyse complex Civil Engineering problems and obtain the solution by synthesizing simple components

(e) Increasing their ability to use the techniques, skills and modern engineering and Information Technology based tools (such as web-based applications and open source software etc.) to increase the creativity of students.

(f) Enhancing awareness of students about the impact of engineering projects in a global and societal context (social, economic, legal and/or environmental implications),

(g) Enhancing their ability to practice environmental concerns and related sustainable measures and be capable of carrying out environmental impact of a civil engineering project

(h) Informing students about engineering ethics and professional responsibilities

(i) Increasing their decision-making skills and innovative capability not only individually but also in a multi-disciplinary team.

(j) Increasing the ability to communicate effectively by enhancing their drawing and report writing skills and oral presentation skills

(k) Increasing awareness of students about cost, time and quality issues in construction helping them to develop social and leadership skills,

(l) Providing the students with knowledge on contemporary issues in the field of civil engineering and recognizing the need for an ability to engage in continuous and life-long learning.

Credit Structure for B.Tech. (Civil Engineering)

(For newly admitted students from Session 2014-2015)

Category Semester	I	II	III	IV	V	VI	VII	VIII	Total
Basic Science & Maths (BSM)	9	14	9	5	-	-	-	-	**37**
Engineering Fundamentals (EF)	12	7	7	-	-	-	-	-	**26**
Departmental Core (DC)	-	-	10	19	20	24	9	5	**87**
Management (M)	-	-	-	3	3	-	-	-	**6**
Humanities & Social Science Core (HSSSC)	4	-	-	-	-	-	-	-	**4**
Project (P)	-	-	-	-	-	-	5	5	**10**
Programme Electives (PE)	-	-	-	-	-	-	8	8	**16**
Open Electives (OE)	-	-	-	-	-	-	-	4	**4**
Humanities & Social Science Electives (HSSE)	-	3	-	-	-	-	-	-	**3**
Total	**25**	**24**	**26**	**27**	**23**	**24**	**22**	**22**	**193**

Curriculum for B.Tech. (Civil Engineering)

Freshman Year, Semester-I

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	BSM	BAS-01	Engineering Mathematics-I	3	1	0	4
2.	BSM	BAS-02	Engineering Physics-I	3	1	2	5
3.	EF	BCE-01	Mechanics of Structures	3	1	2	5
4.	EF	BCS-01	Introduction to Computer Programming	3	1	2	5
5.	HSSC	BAS-03	Professional Communication	3	1	0	4
6.	EF	BCE-10	Engineering Graphics	0	0	4	2
7.	AC	BAS-05	Environment & Ecology	2	1	0	-
			Total	**15**	**5**	**10**	**25**

Freshman Year, Semester-II

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	BSM	BAS-07	Engineering Mathematics-II	3	1	0	4
2.	BSM	BAS-08	Engineering Physics-II	3	1	2	5
3.	BSM	BAS-09	Engineering Chemistry	3	1	2	5
4.	EF	BEE-01	Principles of Electrical Engineering	3	1	2	5
5.	HSSE	BAS-**	Humanities & Social Science Electives	2	1	0	3
6.	EF	BME- 10	Workshop Technology	0	0	4	2
7.	AC	BEC-01	Fundamentals of Electronics Engineering	3	1	2	-
			Total	**14**	**5**	**10**	**24**

Sophomore Year, Semester-III

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	BSM	BAS-07	Engineering Mathematics-III	3	1	0	4
2.	DC	BCE-11	Concrete & Concrete Structures	3	1	2	5
3.	EF	BCE-12	Basic Surveying	3	1	2	5
4.	BSM	BCE-13	Fluid Mechanics	3	1	2	5
5.	DC	BCE-14	Structural Mechanics-I	3	1	2	5
6.	EF	BCE-15	Engineering Geology & Building Material	0	0	4	2
7.	AC	BAS-22	Nano Technology	2	1	0	-
			Total	**15**	**5**	**12**	**26**

Sophomore Year, Semester-IV

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	BSM	BAS-29	Numerical Methods	3	1	2	5
2.	M	MBA-01	Industrial Management	2	1	0	3
3.	DC	BCE-16	Hydraulic and Hydraulic Machines	3	1	2	5
4.	DC	BCE-17	Structural Mechanics -II	3	1	0	4
5.	DC	BCE-18	Advanced Surveying	3	1	2	5
6.	DC	BCE-19	Building Construction and Planning Estimation and Costing	3	1	2	5
7.	AC	BAS-20	Communication Skills	0	0	4	-
			Total	**17**	**6**	**8**	**27**

Junior Year, Semester-V

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	M	MBA-02	Engineering and Managerial Economics	2	1	0	3
2.	DC	BCE-26	Environmental Engineering-I	3	1	2	5
3.	DC	BCE-27	Geotechnical Engineering -I	3	1	2	5
4.	DC	BCE-28	Transportation Engineering- I	3	1	2	5
5.	DC	BCE-29	Design of Concrete Structures	3	1	2	5
6.	AC	BCS-73	Neural Network & Fuzzy Systems	3	1	0	-
			Total	**14**	**5**	**8**	**23**

Junior Year, Semester-VI

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	DC	BCE-31	Geotechnical Engineering -II	3	1	2	5
2.	DC	BCE-32	Environmental Engineering -II	3	1	0	4
3.	DC	BCE-33	Steel Structures	3	1	0	4
4.	DC	BCE-34	Transportation Engineering- II	3	1	0	4
5.	DC	BCE-35	Construction Technology and Management	3	1	0	4

6.	DC	BCE-36	Survey Camp*	0	0	9	3
7.	AC	BCE-30	Seminar	0	0	6	-
			Total	**15**	**5**	**11**	**24**

* Survey camp will be held during Winter Break

Senior Year, Semester-VII

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	DC	BCE-41	Water Resources Engineering	3	1	0	4
2.	DC	BCE-42	Earthquake Resistant Design	3	1	2	5
3.	PE1	BCE-**	Programme Elective-1	3	1	0	4
4.	PE2	BCE-**	Programme Elective-2	3	1	0	4
5.	P	BCE-40	Project Part -I	0	0	10	5
6.	AC	BCE-45	Industrial /Practical Training	0	0	2	-
			Total	**12**	**4**	**12**	**22**

Senior Year, Semester-VIII

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1.	DC	BCE-43	Analysis and Design of Hydraulic Structures	3	1	2	5
2.	PE3	BCE-**	Programme Elective-3	3	1	0	4
3.	PE4	BCE-**	Programme Elective-4	3	1	0	4
4.	OE	BOE-**	Open Elective offered by other Department	3	1	0	4
5.	P	BCE-50	Project Part II	0	0	10	5
			Total	**12**	**4**	**12**	**22**

Engineering Fundamentals & Department Core (Civil Engineering)

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
		Year-I					
1.	BCE-01	Mechanics of Structures	-	3	1	2	5
2.	BCE-10	Engineering Graphics	-	0	0	4	2
		Year-II	-				
3.	BCE-11	Concrete and Concrete Structures	-	3	1	0	4
4.	BCE-12	Basic Surveying	-	3	1	2	5
5.	BCE-13	Engineering Geology & Building Materials	-	0	0	4	2
6.	BCE-14	Structural Mechanics-I	-	3	1	2	5
7.	BCE-15	Fluid Mechanics	-	3	1	2	5
8.	BCE-16	Hydraulic and Hydraulic Machines	BCE-15	3	1	2	5
9.	BCE-17	Structural Mechanics -II	BCE-14	3	1	0	4
10.	BCE-18	Advanced Surveying	BCE-12	3	1	2	5
11.	BCE-19	Building Construction and Planning Estimation and Costing	BCE-10	3	1	2	5
		Year-III					

12.	BCE-26	Environmental Engineering-I	-	3	1	2	5
13.	BCE-27	Geotechnical Engineering-I	-	3	1	2	5
14.	BCE-28	Transportation Engineering-I	-	3	1	2	5
15.	BCE-29	Design of Concrete Structures	BCE-11	3	1	2	5
16.	BCE-30	Seminar	-	0	0	6	3
17.	BCE-31	Geotechnical Engineering-II	BCE-27	3	1	2	5
18.	BCE-32	Environmental Engineering-II	BCE-26	3	1	0	4
19.	BCE-33	Steel Structures	BCE-14 BCE-17	3	1	0	4
20.	BCE-34	Transportation Engineering-II	BCE-28	3	1	0	4
21.	BCE-35	Construction Technology and Management	-	3	1	0	4
22.	BCE-36	Survey Camp* (*will be held during winter break*)	BCE-12	0	0	9	3
		Year-IV					
23.	BCE-40	Project Part-I	-	0	0	10	5
24.	BCE-41	Water Resources Engineering	BCE-15	3	1	0	4
25.	BCE-42	Earthquake Resistant Design	BCE-14 BCE-17	3	1	2	5
26.	BCE-43	Analysis and Design of Hydraulic Structures	BCE-41	3	1	2	5
27.	BCE-45	Industrial/Practical Training	-	0	0	2	1
28.	BCE-50	Project Part-II	BCE-40	0	0	10	5

Programme Electives (PE1)

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
1.	BCE-51	Solid Waste Management	-	3	1	0	4
2.	BCE-52	Environmental Impact Assessment	BCE-26 BCE-32	3	1	0	4
3.	BCE-53	Rock Mechanics	BCE-13	3	1	0	4
4.	BCE-54	Bridge Engineering	BCE-14 BCE-17 BCE-11	3	1	0	4
5.	BCE-55	Disaster Management	-	3	1	0	4
6.	BCE-56	Advanced Engineering Hydrology	-	3	1	0	4

Programme Electives (PE2)

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
1.	BCE-57	Geo-environmental Engineering	BCE-27 BCE-31 BCE-26 BCE-32	3	1	0	4

2.	BCE-58	Advanced Structural Engineering	BCE-14 BCE-17	3	1	0	4
3.	BCE-59	Principles of Remote Sensing	-	3	1	0	4
4.	BCE-60	Airport, Docks & Harbour Engineering	BCE-28 BCE-34	3	1	0	4
5.	BCE-61	Matrix Method of Analysis	BCE-14 BCE-17	3	1	0	4
6.	BCE-62	Open Channel Flow	BCE-15 BCE-16	3	1	0	4

Programme Electives (PE3)

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
1.	BCE-63	Advanced Foundation Engineering	BCE-27 BCE-31	3	1	0	4
2.	BCE-64	River Engineering	BCE-62	3	1	0	4
3.	BCE-65	Advance Concrete Design	BCE-29	3	1	0	4
4.	BCE-66	Water Resources Systems	BCE-41	3	1	0	4
5.	BCE-67	Principles of Geographic Information System	-	3	1	0	4
6.	BCE-68	Earth and Earth Retaining Structures	BCE-27 BCE-31	3	1	0	4
7.	BCE-69	Air and Noise Pollution control	BCE-26 BCE-32	3	1	0	4

Programme Electives (PE4)

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
1.	BCE-70	Ground Improvement Techniques	BCE-27 BCE-31	3	1	0	4
2.	BCE-71	Transportation System & Planning	BCE-28 BCE-34	3	1	0	4
3.	BCE-72	Industrial Pollution control and Environmental Audit	BCE-26 BCE-32	3	1	0	4
4.	BCE-73	Structural Dynamics	BCE-14 BCE-17	3	1	0	4
5.	BCE-74	Advanced Hydraulic Structures	BCE-41	3	1	0	4
6.	BCE-75	Environmental Quality Management	BCE-26 BCE-32	3	1	0	4

Subjects offered for other Departments

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
1.	BCE-02	Fire Hazards and Safety	-	3	1	0	4
2.	BCE-21	Environmental Impact Assessment & Management	-	3	1	0	4
3.	BOE-04	Principles of Remote Sensing	-	3	1	0	4
4.	BOE-05	Disaster Management	-	3	1	0	4
5.	BOE-06	Solid Waste Management	-	3	1	0	4

Humanities & Social Science Electives

S.N.	Paper Code	Subject	Prerequisite Subject	L	T	P	Credits
1.	BAS-11	Human Values & Professional Ethics	-	2	1	0	3
2.	BAS-12	Industrial Psychology	-	2	1	0	3
3.	BAS-13	Industrial Sociology	-	2	1	0	3

Civil Engineering Department

Subjects offered by the Department

S. N.	Paper Code	Subject	Prerequisite Subjects	L	T	P	Credits
1.	BCE-01	Mechanics of Structures	-	3	1	2	5
2.	BCE-02	Fire Hazards and Safety	-	3	1	0	4
3.	BCE-10	Engineering Graphics	-	0	0	4	2
4.	BCE-11	Concrete and Concrete Structures	-	3	1	0	4
5.	BCE-12	Basic Surveying	-	3	1	2	5
6.	BCE-13	Engineering Geology & Building Materials	-	0	0	4	2
7.	BCE-14	Structural Mechanics-I	-	3	1	2	5
8.	BCE-15	Fluid Mechanics	-	3	1	2	5
9.	BCE-16	Hydraulic and Hydraulic Machines	BCE-15	3	1	2	5
10.	BCE-17	Structural Mechanics -II	BCE-14	3	1	0	4
11.	BCE-18	Advanced Surveying	BCE-12	3	1	2	5
12.	BCE-19	Building Construction and Planning Estimation and Costing	BCE-10	3	1	2	5
13.	BCE-21	Environmental Impact Assessment & Management	-	3	1	0	4
14.	BCE-26	Environmental Engineering-I	-	3	1	2	5
15.	BCE-27	Geotechnical Engineering-I	-	3	1	2	5
16.	BCE-28	Transportation Engineering-I	-	3	1	2	5
17.	BCE-29	Design of Concrete Structures	BCE-11	3	1	2	5
18.	BCE-30	Seminar	-	0	0	6	3
19.	BCE-31	Geotechnical Engineering-II	BCE-27	3	1	2	5
20.	BCE-32	Environmental Engineering-II	BCE-26	3	1	0	4
21.	BCE-33	Steel Structures	BCE-14 BCE-17	3	1	0	4
22.	BCE-34	Transportation Engineering-II	BCE-28	3	1	0	4
23.	BCE-35	Construction Technology and Management	-	3	1	0	4
24.	BCE-36	Survey Camp	BCE-12	0	0	9	3
25.	BCE-40	Project Part-I	-	0	0	10	5
26.	BCE-41	Water Resources Engineering	BCE-15	3	1	0	4
27.	BCE-42	Earthquake Resistant Design	BCE-14 BCE-17	3	1	2	5
28.	BCE-43	Analysis and Design of Hydraulic	BCE-41	3	1	2	5

		Structures					
29.	BCE-45	Industrial/Practical Training	-	0	0	2	1
30.	BCE-50	Project Part-II	BCE-40	0	0	10	5
31.	BCE-51	Solid Waste Management	-	3	1	0	4
32.	BCE-52	Environmental Impact Assessment	BCE-26 BCE-32	3	1	0	4
33.	BCE-53	Rock Mechanics	BCE-13	3	1	0	4
34.	BCE-54	Bridge Engineering	BCE-14 BCE-17 BCE-11	3	1	0	4
35.	BCE-55	Disaster Management	-	3	1	0	4
36.	BCE-56	Advanced Engineering Hydrology	-	3	1	0	4
37.	BCE-57	Geo-environmental Engineering	BCE-27 BCE-31 BCE-26 BCE-32	3	1	0	4
38.	BCE-58	Advanced Structural Engineering	BCE-14 BCE-17	3	1	0	4
39.	BCE-59	Principles of Remote Sensing	-	3	1	0	4
40.	BCE-60	Airport, Docks & Harbour Engineering	BCE-28 BCE-34	3	1	0	4
41.	BCE-61	Matrix Method of Analysis	BCE-14 BCE-17	3	1	0	4
42.	BCE-62	Open Channel Flow	BCE-15 BCE-16	3	1	0	4
43.	BCE-63	Advanced Foundation Engineering	BCE-27 BCE-31	3	1	0	4
44.	BCE-64	River Engineering	BCE-62	3	1	0	4
45.	BCE-65	Advance Concrete Design	BCE-29	3	1	0	4
46.	BCE-66	Water Resources Systems	BCE-41	3	1	0	4
47.	BCE-67	Principles of Geographic Information System	-	3	1	0	4
48.	BCE-68	Earth and Earth Retaining Structures	BCE-27 BCE-31	3	1	0	4
49.	BCE-69	Air and Noise Pollution control	BCE-26 BCE-32	3	1	0	4
50.	BCE-70	Ground Improvement Techniques	BCE-27 BCE-31	3	1	0	4
51.	BCE-71	Transportation System & Planning	BCE-28 BCE-34	3	1	0	4
52.	BCE-72	Industrial Pollution control and Environmental Audit	BCE-26 BCE-32	3	1	0	4
53.	BCE-73	Structural Dynamics	BCE-14 BCE-17	3	1	0	4

54.	BCE-74	Advanced Hydraulic Structures	BCE-41	3	1	0	4
55.	BCE-75	Environmental Quality Management	BCE-26 BCE-32	3	1	0	4

SYLLABI

BCE-01 MECHANICS OF STRUCTURES

Course category : Engineering Fundamentals (EF)
Pre-requisite Subject : NIL
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits : 5
Course Assessment methods : Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to compute the magnitude and direction of force and moment.
2. Know the conditions of equilibrium of rigid body and able to compute equivalent force
3. Able to compute the centroids and centre of gravity.
4. Know the moment of inertia of mass and area, and also how to compute it.
5. Understand the principle of virtual work and able apply them to find out forces and reactions.
6. Know the different mechanism of friction and computation of frictional forces.
7. Understand the Newton's second law and apply them on system of particles.
8. Develop ability to apply Newton's second law on rigid body.

Topics Covered

UNIT-I 9

Statics –Basics Concepts, Fundamental principles & concepts

Vector algebra, Newton's laws, gravitation, force (external and internal, transmissibility), couple, moment (about point and about axis), Varignon's theorem, Resultant of concurrent and non-concurrent coplanar forces, static equilibrium, free body diagram, reactions. Problem formulation concept; 2-D statics, two and three force members, alternate equilibrium equations, constraints and static determinacy; 3-D statics.

Analysis of structures- Trusses

Assumptions, rigid and non-rigid trusses; Simple truss (plane and space), analysis by method of joints. Analysis of simple truss by method of sections; Compound truss (statically determinate,

rigid, and completely constrained).Analysis of frames and machines.

UNIT-II 9

Friction

Coulomb dry friction laws, simple surface contact problems, friction angles, types of problems, wedges. Sliding friction and rolling resistance.

Moment of Inertia

First moment of mass and center of mass, centroids of lines, areas, volumes, composite bodies. Area moments- and products- of inertia, radius of gyration, transfer of axes, composite areas. Rotation of axes, principal area-moments-of-inertia, Mohr's circle, Second moment of mass, Mass moments- and products- of inertia, radius of gyration, transfer of axes, flat plates (relation between area- and mass- moments- and products of inertia), composite bodies, Rotation of axes, principal mass-moments-of-inertia.

UNIT-III 9

Virtual Work and Energy Method

Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom, Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium, Applications of energy method for equilibrium, Stability of equilibrium.

Review of particle dynamics

Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates), 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy, Impulse-momentum (linear, angular); Impact Direct and oblique).

UNIT-IV 9

Plane kinematics of rigid bodies- Rotation

Parametric motion, Relative velocity, instantaneous center of rotation, Relative acceleration, rotating reference frames. Rotating reference frames, 3-part velocity and 5-part acceleration relations, Coriolis acceleration. Applications of rotating reference frames.

Plane kinetics of rigid bodies

Plane kinetics of rigid bodies- Kinetics of system of particles and derivation of moment equation, Translation Fixed axis rotation; General planar motion, Work – kinetic energy, potential energy, power; Impulse-momentum, Impact; Combination problems.

EXPERIMENTS

Any 10 experiments are to be conducted from the following:

1. To verify the law of parallelogram of forces
2. To study the equilibrium of a body under three forces.
3. To determine the coefficient of friction of a flat surface.
4. Friction experiment on screw-jack.
5. Experiment based on analysis of truss.
6. To determine the mass moment of inertia of rotating disc.
7. To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for mild steel specimen.
8. To conduct the Impact (Izod/Charpy) on Impact-testing machine to find the impact Strength of specimen.
9. To determine the hardness of the given specimen using Vicker/Brinell/Rockwell hardness testing machine.
10. Simple & compound gear-train experiment.
11. Worm &Worm-wheel experiment for load lifting.
12. Belt-Pulley experiment.

Textbooks

1. Vector Mechanics for Engineers: Statics and Dynamics – Johnston. R.E., Beer. F., Eisenberg. E. R, & Mazurek. D., McGraw Hill
2. Engineering Mechanics: Statics and Dynamics- Hibbler. R.C., Prentice Hall

Reference books

1. Engineering Mechanics: Statics & Engineering Mechanics: Dynamics – Meriam, J.L., & Kraige, L.G., John Wiley & Sons
2. Engineering Mechanics- McLean, Schaum Series, McGraw Hill

BCE-02 FIRE HAZARDS AND SAFETY

Course category	:	For Other Department
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Define fire fighting strategy and tactics.
2. Describe the elements of fire fighter safety and survival.
3. Identify the laws, rules, codes, and other regulations relevant to fire prevention and the agencies or authority having jurisdiction.
4. Identify five different types of non-water based fire suppression systems and describe how these systems extinguish fire
5. Demonstrate proficiency in building occupany and code enforcement.

Topics Covered

UNIT-I

Fire : The social aspect. Science and technology, Smoke control and pressurization, Behaviour of materials and structures in fire, Major fires world wide — 9

UNIT-II

Special appliances, Fire protective clothing, Fire prevention, Ropes and lines, Bends and hitches — 9

UNIT-III

Fire fighting codes, Electrical fire hazards, Structures under fire. — 9

UNIT-IV

Fire safety in Buildings, Fixed fire fighting installations, Fluidic fixed fire extinguishing system, Portable fire extinguisher Automatic fire detection and alarm circuits — 9

Textbooks

1. Design of special hazard and fire alarm systems- Robert M. Gagnon
2. Industrial explosion prevention and protection-Frank T. Bodurtha

BCE-10 ENGINEERING GRAPHICS

Course category	:	Engineering Fundamentals (EF)
Pre-requisite Subjects	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 4
Number of Credits	:	2
Course Assessment methods	:	Continuous assessment through three Viva voce, Practical work/record, attendance and Major Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course:

1. How Engineering Drawing helps to sketch the imagination?
2. Able to effectively practice the different scales for drawings.
3. Effectively analyze the geometrical shapes and to be able to draw.
4. Know about out solids and discuss about their classification.
5. How to implement the different views for a solid placed in 3d space.
6. Construction of the object from different perspective.
7. Comparison and contrast between frustum and truncated solid.
8. Sketching of different sections for any 3D regular object.
9. Discussing the principles of Isometric Projection.
10. Sketching isometric projections for different geometrical shapes and solids.

Topics Covered

UNIT-I 6x4

Title: Conic Sections and Orthographic Projections

Introduction

Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Orthographic Projections

Orthographic Projections covering Principles of Orthographic Projections- Conventions- Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Plane

UNIT-II 3x4

Title: Projection of Regular Solids

Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views

UNIT-III 3x4

Title: Sections and Sectional Views of Right Angular Solids

Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone

UNIT-IV 3x4

Isometric Projections

Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions

Textbooks

1. Engineering Drawing - Bhat, N.D.& M. Panchal, Charotar Publishing House, 2008

Reference books

1. Engineering Drawing and Computer Graphics - Shah, M.B. & B.C. Rana, Pearson Education, 2008
2. A Text Book of Engineering Drawing - Dhawan, R.K., S. Chand Publications, 2007

3. Text book on Engineering Drawing - Narayana, K.L. & P Kannaiah, Scitech Publishers, 2008

BCE-11 CONCRETE & CONCRETE STRUCTURES

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to test all the concrete materials as per IS code design the concrete mix using IS code method.
2. Able to determine the properties of fresh and hardened of concrete design special concretes and their specific applications ensure quality control while testing/ sampling and acceptance criteria.
3. Understand limit state design philosophy.
4. Understand the behaviour of beam under flexure and shear.
5. Able to design beams using limit state method.
6. Able to design one way slab using limit state method.
7. Able to design column using limit state method.

Topics Covered

UNIT-I

Constituents of Concrete, Grades of concrete, Manufacturing of concrete, Importance of w/c ratio, Properties of fresh concrete, Workability, factors affecting workability, consistency, cohesiveness, bleeding, segregation 9

Properties of hardened concrete, compressive, tensile and flexural strength, Modulus of elasticity, Shrinkage and creep, Concreting in extreme weather conditions, under water concreting, Testing of concrete.

UNIT-II

Mix design for compressive strength by various methods, mix design for flexural strength, Admixtures used in cement concrete. Introduction to Various Design Philosophies, Design of Rectangular Singly and Doubly Reinforced Sections by Working Stress Method. Assumptions in 9

Limit State Design Method, Design of Rectangular Singly and Doubly Reinforced beams, T-beams, L-beams by Limit State Design Method.

UNIT-III

Behavior of RC beams in Shear, Shear Strength of beams with and without shear reinforcement, Minimum and Maximum shear reinforcement, design of beam in shear. 9

Introduction to development length, Anchorage bond, flexural bond. (Detailed Examples by Limit State Design Method), Failure of beam under shear, Concept of Equivalent Shear and Moments.

UNIT-IV

Design of one way and two way slabs by Limit State Design Method, Serviceability Limit States, Control of deflection, cracking and vibrations. Design of Footings and Staircases. 9

Design of Columns by Limit State Design Method- Effective height of columns, Assumptions, Minimum eccentricity, Short column under axial compression, requirements for reinforcement, Column with helical reinforcement, Short column under axial load and uniaxial bending, Design of columns under bi-axial loading by Design Charts.

EXPERIMENTS

1. Comparison of strength of cylinder and cube strength of concrete.
2. Modulus of rupture of concrete.
3. Study of admixtures and their effect on workability.
4. Study of effect of w/c ratio on strength of concrete.
5. Study of variation of strength of cement concrete and determination of standard deviation and gradation of concrete.
6. Study and draw compression test diagram of concrete.
7. To determine quality/ strength of concrete by using Rebound hammer/ Ultrasonic pulse velocity instruments

Textbooks

1. IS:456-2000 , IS:10262-2009
2. Concrete Structure – Limit State Design by A.K. Jain, Nem Chand & Bros.
3. Reinforced Concrete Design by S. Unnikrishna Pillai & D. Menon, Tata McGraw
4. Fundamentals of Reinforced Concrete by M L Gambhir, PHI.

Reference books

1. Plain and Reinforced Concrete Vol. I & II by O. P. Jain & Jai Krishna, Nem Chand & Bros.
2. Reinforced Concrete Structures by R. Park and Pauley.
3. Reinforced Concrete Design by P. Dayaratnam., Oxford & IBH

BCE-12 BASIC SURVEYING

Course category : Engineering Fundamentals (EF)
Pre-requisite Subject : NIL
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits : 5
Course Assessment : Continuous assessment through tutorials, attendance, home

methods		assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Collecting data with errors, students gain a better appreciation of data quality and how instruments and field techniques contribute to error.
2. Learn rules for handling systematic errors, random errors and blunders.
3. Learn elementary statistical methods to aid in error control.
4. Appreciate the concepts of accuracy and precision.
5. Understand how to meet client expectations in terms of data quality.
6. Develop an appreciation of how one set of surveying data relates to another.
7. Learn the importance of referencing their projects properly.
8. Students learn to work with others, respect the contributions of others, resolve difficulties, and understand responsibility.
9. Students will learn surveying techniques that will remain current for long periods of time.
10. Students understand the range of calculations that can be made with surveying data and understand the linkages between surveying data and engineering design.
11. Students learn how surveying data may be stored and retrieved for a variety of purposes.
12. Students develop proficiency in working with raw data. Students see applications of their previous education in mathematics.
13. Students understand the range of surveying instrumentation and the appropriate uses of each class of instrument.
14. Students learn how surveying data is clearly and ethically reported.

Topics Covered

UNIT-I 9

Principles of Surveying, Measurement of Distances with chain and Tape, Angular measurements with compass and traversing

Introduction

Introduction and Principles of surveying, Plane and Geodetic Surveying, Control Points, Classification of surveys, Measurement by chain and tape. Sources of errors and precautions, Corrections to tape measurements, Field problems Compass surveying, Instruments, Surveyors and Prismatic compass, Bearing of survey lines, systems and conversions, Local attraction,

Traversing, Latitude and departure, Traverse adjustment of closing errors. Computation of

coordinates.

UNIT-II 9

Levelling, and determination of Elevations

Different methods of determining elevation; Spirit levelling: Definition of terms, Principle, Construction, Temporary and permanent adjustments of levels. Automatic levels, Levelling staves, Methods of spirit levelling, Booking and reduction of fields notes, Curvature and refraction, Reciprocal leveling,

Trigonometric levelling-simple and reciprocal observations, Sources of errors and precision of levelling procedures. Methods of relief representations, Definition and characteristics of contours, Direct and Indirect methods of contouring, Use of contour maps, Digital Elevation Model.

UNIT-III 9

Theodolite and Tacheometer

Theodolite surveying, Vernier theodolite, Temporary adjustments, Measurement of horizontal and vertical angles, Methods of repetition and reiteration, errors in theodolite surveying, elimination of errors, permanent adjustments

Tacheometric surveying, Principles ,Methods – Stadia system –Fixed and Movable hair methods, Methods with staff held vertical and normal, Analytic lens, Subtense bar, Tangential method.

UNIT-IV 9

Plane Tabling and computation of areas and Volumes

Plane Table surveying, instruments and accessories, advantages and disadvantages of plane table surveying, methods – radiation, intersection, traversing, resection – Two and three point problems, errors in plane table surveying.

Area and volume computation, area from latitude and departure, Simpson's rule and Trapezoidal rule.

BASIC SURVEY LAB/FIELD WORK

Minimum Eight experiments are to be conducted from the following:

1. To study instruments used in chain surveying and to measure distance between two points by ranging.
2. To determine the bearing of sides of a given traverse using Prismatic Compass, and plotting of the traverse.
3. To find out the reduced levels of given points using level. (Reduction by Height of Collimation method and Rise and Fall Method).
4. To determine and draw the longitudinal and cross-section profiles along a given route.
5. Practice for temporary adjustments of a Vernier Theodolite and taking Horizontal (by Reiteration method) and Vertical angular measurements.
6. Measurement of horizontal angles by Repetition method.
7. Determination of the Tacheometric constants of a given theodilite.
8. To plot details using radiation and intersection methods in plane tabling.
9. To solve three point problem in plane tabling

Textbooks

1. K.R. Arora, "Surveying" , Vol. II Standard Book House, Delhi
2. B.C Punmia,., "Surveying", Vol. III Laxmi Publications New Delhi
3. S.K. Duggal., Surveying Vol. III Tata McGraw Hill
4. Reddy, M. Anji, Remote sensing and Geographic Information System BS Publications

5. B. Bhatta, Remote Sensing and GIS, Oxford University Press

Reference books

1. W. Schofield Engineering Surveying Elsevier
2. Charles D Ghilani and Paul R Wolf Elementary Surveying Pearson
3. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman., Remote Sensing and Image Interpretation. Wiley
4. C.P. Lo and Albert K. W. Yeung, Concepts and Techniques of Geographical Information Systems, Prentice- Hall India

BCE-13 FLUID MECHANICS

Course category	:	Basic Science and Maths (BSM)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand how to make measurements of flow.
2. Understand the type and nature of flow.
3. Apply the principle of momentum, energy and mass conservation in various fluid flows
4. Explain and describe the difference between smooth and rough surface.
5. Figure out the problems in different pipe flows

Topics Covered

UNIT-I 9

Introduction: Fluids and continuum , Fluid Statics, Dimensional Analysis and Model Studies

Introduction: Fluids and continuum; Physical properties of fluids: Viscosity, Compressibility, Surface Tension, Capillarity, Vapour Pressure; Cavitations; Classification of fluids including rheological classification.

Fluid Statics: Pressure-density-height relationship; Measurement of pressure by Manometers and mechanical gauges; Pressure on plane and curved surfaces; The Hydrostatic law; Total Pressure and Centre of pressure; Buoyancy; Stability of immersed and floating bodies;

Dimensional Analysis: Units and Dimensions, Rayleigh's method, Buckingham's Π theorem, Important dimensionless numbers used in fluid mechanics and their significance. Hydraulic Similitude and Model Studies: Model and prototype; Similitude; Geometric, Kinematic and

Dynamic similarity; Model Laws; Un-distorted model studies..

UNIT-II 9

Fluid Kinematics and Fluid Dynamics-I

Fluid Kinematics: Description of Fluid flow: Lagrangian and Eulerian approach; Types of fluid Flows: Steady and unsteady, Uniform and non-uniform, Laminar and turbulent flows, 1, 2 and 3-D flows; Stream lines, Path lines and Streak lines; Stream tube; Acceleration of a fluid particle along a straight and curved path; Differential and Integral form of Continuity equation; Rotation, Vorticity and Circulation; Elementary explanation of Stream function and Velocity potential; Flow net characteristics, uses and experimental and graphical methods of drawing.

Fluid Dynamics-I: Concept of control volume and control surface, Reynolds Transport Theorem, Introduction to Navier-Stokes Equations, Euler's equation of motion along a streamline and its integration, Bernoulli's equation and its applications – Pitot tube, Flow through orifices, Mouthpieces, Nozzles, Notches, Weirs, Sluice gates under free and submerged flow conditions; Free and Forced vortex motion.

UNIT-III 9

Fluid Dynamics-II, Flow Through Pipes and Boundary Layer Analysis

Fluid Dynamics-II: Impulse-Momentum Principle; Moment of momentum equation; Momentum equation application to stationary and moving vanes, pipe bends, Problems related to, combined application of energy and momentum equations, flow measurements, determination of coefficients of discharge, velocity and contraction and energy loss.

Laminar Flow: Reynolds Experiment; Equation of motion for laminar flow through pipes; Flow between parallel plates; Kinetic energy and Momentum correction factors; Stokes law; Flow through porous media; Darcy's Law; Measurement of viscosity.

Turbulent Flow: Turbulence; Equation for turbulent flow; Reynolds stresses; Eddy viscosity; Mixing length concept and velocity distribution in turbulent flow;

Boundary Layer Analysis: Boundary layer thicknesses; Boundary layer over a flat plate; Laminar boundary layer; Application of Von-Karman Integral Momentum Equation; Turbulent boundary layer; Laminar sub-layer; Hydro-dynamically Smooth and rough boundaries; Local and average friction coefficient; Total drag; Boundary layer separation and its control.

UNIT-IV 9

Laminar Flow and Turbulent Flow

Flow Through Pipes: Nature of turbulent flow in pipes; Major and Minor energy losses; Hydraulic gradient and total energy lines; Flow in sudden expansion, contraction, bends, valves and siphons; Concept of equivalent length; Branched pipes; Pipes in series and parallel; Simple pipe networks.

Compressibility Effects in Pipe Flow: Transmission of pressure waves in rigid and elastic pipes; Water hammer; Analysis of simple surge tank excluding friction.

Flow Past Submerged Bodies: Drag and lift, Types of drag force, Drag on sphere, Cylinder and airfoil; Circulation and Lift on a cylinder and airfoil; Magnus effect.

EXPERIMENTS

1. To measure the surface tension of a liquid.
2. To determine the meta centric height of a ship model experimentally.
3. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
4. To determine the coefficients of velocity, contraction and discharge of an orifice (or a

5. mouthpiece) of a given shape. To plot the flow net for a given model using the concept of electrical analogy.
6. To calibrate an orifice meter and venturimeter and to study the variation of the coefficient of discharge with the Reynolds number.
7. To calibrate and to determine the coefficient of discharge for rectangular and triangular notches.
8. To verify Darcy's law and to find out the coefficient of permeability of the given medium.
9. To verify the momentum equation.
10. To determine the loss coefficients for the various pipe fittings.

Textbooks

1. R J Fox: Introduction to Fluid Mechanics
2. Hunter Rouse: Elementary Mechanics of Fluids, John Wiley and sons, Omc/ 1946.
3. L H Shames: Mechanics of Fluids, McGraw Hill, International student edition.
4. Garde, R J and A G Mirajgaonkar: Engineering Fluid Mechanics (including Hydraulic machines), second ed., Nemchand and Bros, Roorkee, 1983.
5. K L Kumar: Engineering Fluid Mechanics
6. Munson, Bruce R, Donald F Young and T H Okishi, Fundamentals of Fluid Mechanics, 2nd Ed, wiley Eastern.
7. V Gupta and S K Gupta, Fluid Mechanics and its Applications, Wiley eastern ltd.
8. Som and Biswas: Introduction to Fluid Mechanics and Machines, TMH.

Reference books

1. Hydraulics and Fluid Mechanics by Dr.P.N Modi and Dr. S.M Seth

BCE-14 STRUCTURAL MECHANICS – I

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Mechanics of Structures (BCE-01)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Know different methods for calculating the stress strain.
2. Able to apply hook's law.
3. Able to draw the Mohr's circle for calculating the stress and strain in different direction.
4. Understand how to calculate the reactions, bending moment and shear force, and also able to draw the bending moment and shear force diagram for different type of

structures.

5. Able to find out displacement using different methods.
6. Able to find out torsional moment in different type of section.
7. Know the buckling phenomena and able to calculate critical load in different type of end condition.

Topics Covered

UNIT-I

Simple Stress and Strain, Poisson's Ratio, Different Moduli of elasticity and their relations. 9

Compound stresses and strains: Introduction: normal stress and strain, shear stress and strain, stresses on inclined plane, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr's stress circle three dimensional state of stress & strain, equilibrium equation, generalized Hook's law, theories of failure.

UNIT-II

Bending Moment, Shear Force Diagram for beams and determinate frames. Stresses in Beam: Pure bending, and shear stresses in beam, composite beam. Curved Beams: Bending of beams with initial curvature. Unsymmetrical Bending. Shear Centre 9

UNIT-III

Deflection of beam: Equation of elastic curve, cantilever and simply supported beam, Macaulay's method, Moment Area method, Unit Load Method. Strain Energy Methods and Strain Energy theorems. 9

Torsion: Torsion, combined torsion and bending moment of solid & hollow shafts, torsion of thin walled tubes.

UNIT-IV

Combined bending and direct stress, middle third and quarter fourth rules. 9

Columns and struts: Buckling and Stability, slenderness ratio, Euler's Crippling Load, Buckling Loads for columns with various end conditions. Empirical formulae for evaluation of Buckling Load

EXPERIMENTS

Following experiments to be carried out:

1. Flexural Rigidity of Beam
2. Unsymmetrical Bending
3. Buckling Load of Struts
4. Deflection of curved members
5. Verification of Maxwell Betti's Reciprocal theorems

Textbooks

1. Mechanics of Structures by Hibler, Pearson
2. Strength of Materials by Timoshenko and Young, East West Press
3. Jain, O.P. and Jain, B.K., "Theory & Analysis of Structures. Vol. I & II Nem Chand.

Reference books

1. Coates, R.C., Coutie, M.G. & Kong, F.K., "Structural Analysis", English Language BookSociety& Nelson, 1980
2. Ghali, A. & Neville, M., "Structural Analysis", Chapman & Hall Publications, 1974.

3. Jain, A.K. "Advanced Structural Analysis", Nem Chand &Bors, Roorkee, India, 1996.

BCE-15 ENGINEEIRING GEOLOGY AND BUILDING MATERIAL

Course category	:	Engineering Fundamentals (EF)
Pre-requisite Subject	:	Mechanics of Structures (BCE-01)
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 4
Number of Credits	:	2
Course Assessment methods	:	Continuous assessment through three Viva voce, Practical work/record, attendance and Major Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understanding of rocks and their minerals
2. Understanding of properties of building materials like cement, aggregates, concrete, lime and bricks.
3. To perform several experiments to find out consistency, initial and final setting time of cement, workability of concrete, crushing strength of aggregates etc.

Topics Covered

1. Physical and mechanical properties of reinforcing steel.
2. Bricks
3. Lime
4. Fine Aggregate
5. Cement
6. Coarse Aggregate
7. Geology

1. Cement:

1. Normal Consistency of cement
2. Initial & final setting time of cement
3. Compressive strength of cement
4. Fineness of cement by air permeability and Le-chatalier's apparatus.
5. Soundness of cement.
6. Tensile strength.

II. Coarse Aggregate:

1. Crushing value of aggregate
2. Impact value of aggregate
3. Water absorption of aggregate
4. Sieve Analysis and Grading of aggregate
5. Specific gravity, bulk density

III. Fine Aggregate:

1. Sieve analysis of sand and Fineness Modulus
2. Silt content of sand
3. Bulking of sand

IV. Lime:

1. Fineness
2. Setting time and Soundness

V. Physical and mechanical properties of reinforcing steel.

VI. Bricks:

1. Water absorption
2. Dimension Tolerance
3. Compressive Strength
4. Efflorescence.

VII. Geology:

1. Megascopic study of minerals (physical properties and identification).
2. Determination of Specific Gravity of minerals.
3. Megascopic study of the following rocks with special reference to their suitability in Civil Engineering works –
   (a) Igneous rocks
   (b) Sedimentary rocks
   (c) Metamorphic rocks
4. Determination of strike and dip & completion of outcrop.
5. Preparation of geological section and study of geological maps with emphasis on the site selection for dams, tunnels and highways.

Textbooks

1. Prabin Singh: Engg. and General Geology, Katson Publishing House.
2. F G Bell: Fundamentals of Engineering Geology , B S Publication.

Reference books

1. Tony Waltham : Fundamentals of Engineering Geology ,SPON Press.
2. J.M. Treteth : Geology of Engineers, Princeton, Von. Nostrand.
3. K V G K Gokhale , Text Book of Engineering Geology , B S Publication.
4. Blyth F.G.M. : A Geology for Engineers, Arnold, London.
5. D.S. Arora : Geology for Engineers, Mohindra Capital Publishers, Chandigarh

BCE-16 HYDRAULIC AND HYDRAULIC MACHINES

Course category	:	Departmental Core (DC)
Pre-requisite Subject	:	Fluid Mechanics (BCE-15)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To identify the different types of flow in Open Channel
2. To understand the concept of Hydraulic Jump
3. To classify the various types of flow profiles
4. To study the characteristics of rotodynamic Pumps
5. To understand the working of Turbines

Topics Covered

UNIT-I

Difference between open channel flow and pipe flow, geometrical parameters of a channel, continuity equation. Critical depth, concepts of specific energy and specific force, application of specific energy principle for interpretation of open channel phenomena, flow through vertical and horizontal contractions. 9

Chezy's and Manning's equations for uniform flow in open channel, Velocity distribution, most efficient channel section

UNIT-II

Equation of gradually varied flow and its limitations, flow classification and surface profiles, integration of varied flow equation by analytical, graphical and numerical methods. 9

UNIT-III

Classical hydraulic jump, evaluation of the jump elements in rectangular and non-rectangular channels on horizontal and sloping beds, open channel surge, celerity of the gravity wave. 9

Rotodynamic pumps, classification on different basis, basic equations, Velocity triangles, manometric head, efficiencies, cavitation in pumps, characteristics curves.

UNIT-IV

Introduction, Rotodynamic Machines, Pelton Turbine, equations for jet and rotor size, efficiency, spear valve, reaction turbines, Francis and Kaplan type, Head on reaction turbine, unit quantities, similarity laws and specific speed, cavitation, characteristic curves 9

Experiments

1. To determine the Manning's coefficient of roughness 'n' for the bed of a given flume.
2. To study the flow characteristics over a hump placed in an open channel.
3. To study the flow through a horizontal contraction in a rectangular channel.
4. To calibrate a broad-crested weir.
5. To study the characteristics of free hydraulic jump.
6. To study rotodynamic pumps and their characteristics
7. To study characteristics of any two turbines (Francis/ Kaplan / Pelton)

Textbooks

1. Jain A.K., Fluid Mechanics including Hydraulic Machine, Khanna publisher, 8th edition.
2. Bansal R.K, Fluid Mechanics and Hydraulics machines, Laxmi publication, 9th edition

Reference books

1. Garde, R.J., " Fluid Mechanics through Problems", New Age International
2. Streeter, V.L. and White, E.B., "Fluid Mechanics", McGraw Hill, New York, 8th
3. Asawa, G.L., "Experimental Fluid Mechanics", Vol.1, NemChand and Bros.,
4. Ranga Raju, K.G., Flow through open channels, T.M.H. 2nd edition

5. Rajesh Srivastava , Flow through Open Channels , Oxford University Press
6. Subramanya, Flow through Open Channels , TMH
7. Vasandani, Hydraulic Machines

BCE-17 STRUCTURAL MECHANICS - II

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Structural Mechanics –I (BCE-14)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Analyze indeterminate structures by using different compatibility equations used in various methods.
2. Analyze the shear force, thrust and bending moment acting on two hinged arches.
3. Draw the influence line diagram for moving or rolling loads so as to determine maximum bending moment, shear force etc.
4. Find out the forces acting on two hinged and three hinged stiffening girders.
5. Draw the Influence line diagram for maximum bending moment and shear forces for stiffening girders.
6. Formulate matrices for computation of unknown member forces in high degree indeterminate structures.
7. Do plastic analysis and find out the ultimate strength.
8. To determine the collapse load of different structures.

Topics Covered

UNIT-I

Analysis of fixed beams, Continuous beams and simple frames with and without translation of joint, Method of Consistent Deformation, Slope-Deflection method, Moment Distribution method, Strain Energy method. 9

UNIT-II

Rolling loads, influence lines for beams and trusses, Absolute maximum bending moment Muller-Breslau's Principle and its applications for drawing influence lines for indeterminate beams, Influence line diagrams for maximum bending moment, Shear force and thrust. 9

UNIT-III

Analysis of Arches, Linear arch, Eddy's theorem, three hinged parabolic and circular arch, two hinged arch, spandrel braced arch, moving load & influence lines. 9

UNIT-IV

Basics of Plastic Analysis, Applications of Static and Kinematic theorem for Plastic Analysis of Beams and Frames. 9

Textbooks

1. Theory and Analysis of Structures, Vol. I & II - O. P. Jain & B. K. Jain, Nem Chand & Bros., Roorkee.
2. Theory of Structures - S. P. Timoshenko and D. Young, McGraw Hill Book Publishing Company Ltd., New Delhi
3. Analysis of Statically Indeterminate Structures - P. Dayaratnam, Affiliated East- West Press.
4. Indeterminate Structural Analysis - C. K. Wang.

Reference books

1. Introduction to Matrix Methods of Structural Analysis by H. C. Martin, McGraw Hill Book Publishing Company Ltd.
2. Matrix Analysis of Framed Structures - Weaver and Gere.
3. Theory of Structures Vol. II - Vazirani & Ratwani.
4. Influence Line Diagrams - Dhavilkar.

BCE-18 ADVANCED SURVEYING

Course category	:	Departmental Core (DC)
Pre-requisite Subject	:	Basic Surveying (BCE-12)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understanding the method of triangulation and working of Total Station
2. Importance of precision and accuracy in taking observations.
3. The different types of curves and methods to set them out.
4. Figure out the fundamentals of photo interpretation

Topics Covered

UNIT-I

Triangulation, different networks, orders and accuracies, intervisibility and height of stations, 9

signals and towers, Baseline measurement, instruments and accessories, extension of baseline, satellite stations, Reduction to centre.

Electromagnetic distance measurement (EDM) – Principle, Types, Total station, Trilateration

UNIT-II

Errors, Precision and Accuracy, Types of errors, Theory of least squares, weighted observations, most probable value, computations of indirectly observed quantities – method of normal equations, conditioned quantities, method of correlates, adjustment of simple triangle and quadrilateral network with and without central station. 9

UNIT-III

Curve setting – Horizontal curves - Elements of simple and compound curves – Methods of setting out – Reverse curve – Transition curve – Length of curve – Elements of cubic parabola, true spiral and cubic spiral – Vertical curve – parabola – Setting out of buildings – culverts – tunnels. 9

UNIT-IV

Photogrammetry – Terrestrial and Aerial Photogrammetry, Geometry and scale of vertical photographs, Stereoscopy and elevation of a point – Flight Planning for vertical photographs Relief displacement – Planimetric mapping from vertical photos — Fundamentals of aerial photo-interpretation 9

Experiments

1. Demonstration and working on Total Station
2. To layout a precise traverse in a given area and to compute the adjusted coordinates of
3. survey stations
4. Demonstration and working with Mirror stereoscopes, Parallax bar and Aerial photographs. Aerial Photo interpretation
5. Visual Interpretation using IRS false colour composite
6. Demonstration and practice work with hand held GPS.

Textbooks

1. K.R. Arora, "Surveying" , Vol. I & II Standard Book House, Delhi,
2. B.C Punmia, "Surveying", Vol. I, II & III Laxmi Publications New Delhi,
3. S.K. Duggal., Surveying Vol. I & II Tata McGraw Hill
4. A.M. Chandra., "Plane Surveying", New Age International Publishers, Delhi
5. R. Subramanian Surveying and Levelling Oxford University Press

Reference books

1. W. Schofield Engineering Surveying Elsevier
2. Charles D Ghilani and Paul R Wolf Elementary Surveying Pearson

BCE-19 BUILDING CONSTRUCTION AND PLANNING, ESTIMATION AND COSTING

Course category : Department Core (DC)
Pre-requisite Subject : Engineering Graphics (BCE-10)
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits : 5

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Identify quantities of the various materials involved in the project.
2. Create summaries and detailed quantity surveying reports quickly and easily.
3. Count and quantify all of your project design data more quickly and easily.
4. Generate quantities linked to specific objects.
5. Perform interactive examination of 3D models for material cost estimating purposes.
6. Compile, update, and interact with quantity-related project data.

Topics Covered

UNIT-I

Classification of construction materials, study of properties of materials (physical, chemical, biological and other like durability, reliability, compatibility) and economic characteristics, Binder materials: lime cement, plaster of paris, Mortar physical properties and manufacturing processes 9

Components of building area considerations, Construction Principle and Methods for layout, Damp proofing, anti-termite treatment, Vertical circulation means staircases ramp design and construction. Different types of floors, and flooring materials (Ground floor and upper floors).

UNIT-II

Classification and bonding of stone, brick and concrete blocks, masonry finishes- pointing, plastering and painting. 9

Doors, Windows and Ventilations, Construction details types and relative advantages & disadvantages. Roofs type, Lintels and Chhajja Functional efficiency of Buildings.

Natural Ventilation, Water Supply and Sanitary fittings (Plumbing), Electricity. Heating, Ventilation & Air conditioning, Mechanical Lifts and Escalators, Fire Fighting, Acoustics.

UNIT-III

Importance of estimation, different types of estimates, specifications: general and detailed. Methods of estimation, Estimates of RC works, Estimates of Buildings 9

UNIT-IV

Analysis of rates, Prime cost, Work charge establishment, Quantity of materials per unit of work for major Civil Engineering items, Resource planning through analysis of rates, Market rates, P.W.D. schedule of rates and cost indices for building material and labor. Introduction to Valuation. 9

EXPERIMENTS

Following experiments to be carried out:

1. Identify activities for implementation of a building project work.
2. Identify activities for execution of roads construction project work.
3. Building Planning related experiments
4. Draw Marshall Diagram for Earthwork associated with road/rail/airport etc.
5. To verify the consumption of the materials for any one of the following items of work:
   i. Cement Mortar
   ii. Cement Concrete

Textbooks

1. Estimating and Costing - B. N. Dutta.
2. PERT and CPM Principles and Application - L. S. Shrinath.

Reference books

1. Estimating, Costing and Valuation in Civil Engineering - M. Chakraborty.
2. Construction, Planning, Equipment and Methods - R. L. Peurify
3. Network Analysis Techniques - S. K. Bhatnagar.
4. Construction Planning and Management - U. K. Srivastava.

BCE-21 ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

Course category	:	For other Departments
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the importance of Environmental Impact Assessment (EIA) and key issues involved in EIA.
2. Identify the environmental attributes for EIA study.
3. Identify methodology & prepare EIA report.
4. Identify methods for prediction of impacts.
5. Formulate Environmental Management Plan (EMP).
6. Understand the role of Environmental Audit (EA) and the methodology of EA.

Topics Covered

UNIT-I 9

Environmental Impact Assessment, Historical Background, Global Environment Policy, Need for EIA

UNIT-II 9

Definition, Aims and Methodology of EIA, Role of EIA as a Planning tool

UNIT-III 9

Environmental Impact Assessment, Projects, Recent case histories, Management and Audit Traditional Approach

UNIT-IV 9

Management through legislation, Management through awareness, Environmental Education and Incentives, Environmental Audit- Definition and Role of EA, Methodology of EA, Current Status of EA

Textbooks

1. Environmental Impact Assessment by Canter

Reference books

1. Environmental Impact Assessment-Training Resource Manual, UNEP
2. EIA Notification, MOEF, Govt. of India
3. Environmental Science and Ecological Studies-S.K. Garg, Rajeshwari Garg and Ranjini Garg

BCE-26 ENVIRONMENTAL ENGINEERING-I

Course category	:	Departmental Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Discuss water demand, sources of water and intake structures.
2. Understand transmission of water.
3. Discuss various types of conduits, laying and testing of water supply pipe lines and related issues.
4. Describe storage and distribution of water, design of water distribution system and plumbing systems in buildings.
5. Describe systems of sanitation and waste water collection.
6. Estimate waste water flows and variations.
7. Design sewers.
8. Discuss types, materials and construction of sewers.
9. Explain the concept of shall bore sewer systems.
10. Do planning of sewerage systems

Topics Covered

UNIT-I 9

Water supply: Water demands and domestic use, variation in demands; population forecasting by various methods using logistic curve method; per capita supply, basic needs and factors affecting consumption; design period.

Sources of water: Kinds of water sources and their characteristics, collection of surface and ground water; factors governing the selection of a source of water supply; intakes and their design for lakes, streams and rivers.

UNIT-II 9

Transmission of water: Various types of conduits, capacity and sizes including economical sizes of rising main, structural requirements; laying and testing of water supply pipelines; pipe materials, joints, appurtenances and valves; leakages and control

UNIT-III 9

Storage and distribution of water: Methods of distribution, pressure and gravity distribution systems, concept of service and balancing reservoirs, capacity of distribution reservoirs; general design guidelines for distribution system, Hardy - Cross method, Equivalent pipe method of pipe network analysis.

Water supply, plumbing systems in buildings and houses: water connections, different cocks and pipe fittings.

UNIT-IV 9

Wastewater collection: Systems of sanitation and wastewater collection, estimation of wastewater flows and variations in wastewater flows. Storm water: Collection and estimation of storm water by different formulae.

Flow in sewers: Flow in full and partially full sewers and design of sewers; types of sewers, materials and construction of sewers, joints and sewer appurtenances, layout and construction of sewer lines; small bore sewer systems. Planning of sewerage systems.

Environmental Engineering Lab

EXPERIMENTS

1. Determination of turbidity, colour, and conductivity.
2. Determination of pH, alkalinity and acidity.
3. Determination of hardness and chlorides.
4. Determination of dissolved oxygen.
5. Determination of most probable number of coliforms.
6. Measurement of air pollutants with high volume sampler.
7. Measurement of sound level with sound level meter.
8. Determination of BOD of sample.
9. Determination of COD of sample.

Textbooks

1. Peavy, Rowe and Tchobanoglous: Environmental Engineering
2. Metcalf and Eddy Inc.: Wastewater Engineering
3. Garg: Water Supply Engineering (Environmental Engineering Vol. – I)
4. Garg: Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol. II).
5. Sawyer, McCarty and Parkin: Chemistry for Environmental Engineering
6. Mathur: Water and Wastewater Testing.

Reference books

1. Manual on Water Supply and Treatment, C.P.H.E.E.O., Ministry of Urban Development, Government of India, New Delhi
2. Manual on Sewerage and Sewage Treatment, C.P.H.E.E.O., Ministry of Urban Development, Government of India, New Delhi
3. Steel and McGhee: Water Supply and Sewerage
4. Fair and Geyer: Water Supply and Wastewater Disposal
5. Standard Methods for the Examination of Water and Wastewater, A. P. H. A.,New York
6. W. H. O.: Selected Methods of Measuring Air Pollutants
7. Cunniff: Environmental Noise Pollution.

BCE-27 GEOTECHNICAL ENGINEERING

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes.

1. Describe the fundamental differences in engineering behavior between cohesive and cohesionless soils.

2. Compute the groundwater seepage and distribution of groundwater pressure.
3. Compute the applied stress beneath the ground surface.
4. Demonstrate the fundamental difference in the strength and deformation characteristics of cohesive and cohesionless soils.
5. Analyze field and laboratory data to determine the strength and deformation properties of cohesive and cohesionless soils.
6. Compute settlements due to consolidation of soil.
7. Prepare soil investigation report based on the result of various field tests.
8. Design a shallow foundation.

Topics Covered

UNIT-I

Preview of Geotechnical field problems in Civil Engineering, Soil formation, transport and deposit, Soil composition, Basic definitions, Clay minerals, Index properties, Particle size analysis, Soil classification. 9

UNIT-II

Soil-water systems, capillarity-flow, Darcy's law, permeability, field and lab tests, piping, quick sand condition, seepage, flow nets, flow through dams, filters. 9

Soil compaction, water content – dry unit weight relationships, OMC, field compaction control, Proctor needle method.

UNIT-III

Effective stress principle, Stresses due to applied loads, Boussinesq and Westergaard equations, Compressibility and consolidation characteristics, Rate of consolidation, Terzaghi's one dimensional theory of consolidation and its applications, Over Consolidation Ratio, determination of coefficient of consolidation and secondary consolidation (creep). 9

UNIT-IV

Shear strength - direct & triaxial shear tests, Mohr – Coulomb strength criterion, drained, consolidated, undrained and unconsolidated tests, strength of loose and dense sands, Normally Consolidated and Over Consolidated soils, dilation, pore pressure, Skempton's coefficient. Stability of slopes with or without pore pressure, limit equilibrium methods, methods of slices and simplified Bishop method, factor of safety. 9

Geotechnical Engineering Lab

EXPERIMENTS

1. Sieve Analysis
2. Hydrometer Analysis
3. Specific Gravity
4. Liquid & Plastic Limit Tests
5. Shrinkage Limit Test
6. Proctor Compaction Test
7. Relative Density
8. In Situ Density – Core cutter & Sand Replacement
9. Permeability Test- Falling Head & Constant Head

Textbooks

1. Alam Singh – Modern Geotechnical Engineering, Asia Publishing House, New, Delhi
2. Gopal Ranjan and A.S.R. Rao – Basic and Applied Soil Mechanics, New Age Intl(P) Ltd.

Reference books

1. Brij Mohan Das – Geotechnical Engineering , CENGAGE Learning
2. I.H. Khan – Text Book of Geotechnical Engineering. Prentice-Hall of India Ltd., New Delhi
3. C. Venkataramaiah – Geotechnical Engineering, New Age Intl(P) Ltd., New Delhi
4. Shashi Gulati & ManojDatta – Geotechnical Engineering, Tata McGraw Hill, New Delhi
5. J. E. Bowles- Foundation Analysis & Design, McGraw Hills, New Delhi
6. K. R. Arora – Soil Mechanics & Foundation Engg. Standard Publishers & Distributors, Delhi
7. V.N.S. Murthy – Soil Mechanics and Foundation Engineering (Fifth Edition)
8. http://ascelibrary.org/journal/jggefk
9. www.dfi.org
10. www.nptel.ac.in

BCE-28 TRANSPORTATION ENGINEERING-I

Course category	:	Departmental Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understanding the types of pavements and their components.

2. Materials used for highway construction.
3. Methods of design of flexible and rigid pavement including IRC method.
4. Construction and maintenance of different types of pavements
5. Basic concept about highway engineering
6. Various types of intersection and their suitability.
7. Different types of traffic control system

Topics Covered

UNIT-I 9

Introduction: Role of transportation, Mode of transportation, History of road development, Nagpur road plan, Bombay road plan & 3rd 20 Year Old Road Plan, Road Types and Pattern.

Geometric design: cross sectional elements, camber, shoulder, slight distance, horizontal curves, super elevation, extra widening, transition curves and gradient, vehicle curves, summit and valley curves.

UNIT-II 9

Traffic Engineering: Traffic characteristic, volume studies, speed study, capacity, density, traffic control devices, signs, signals, design of signals, Island, Intersection at grade and grade separated intersections, design of rotary intersection.

UNIT-III 9

Design of Highway Pavement: Types of pavements, Design factors, Design of flexible pavements by CBR method (IRC: 37-2001 and 2012), Design of rigid pavement, Westergaard theory, load and temperature stresses, joints, IRC method of rigid pavement design. (IRC 58-2002).

UNIT-IV 9

Road Construction Methods: WBM, WMM, Surface Dressing, Bituminous carpeting, Bituminous Bound Macadam and Asphaltic Concrete, Cement Concrete road construction.

EXPERIMENTS

1. Crushing Value Test of Aggregate
2. Impact value test of Aggregate
3. Los Angeles Abrasion Value for Aggregate.
4. Shape test (Flakiness, Index, Elongation Index) of Aggregate.
5. Penetration test of Bituminous Sample
6. Softening point test of Bituminous sample.
7. Stripping test of Bituminous Sample.
8. Ductility test of Bituminous Sample.
9. Flash and Fire Test of Bituminous Sample.
10. Classified Both directional Traffic Volume study.
11. Traffic speed study (using radar speedometer).

Textbooks

1. Highway Engineering by S. K. Khanna and C.E.G. Justo, Nem Chand & brothers, Roorkee.
2. Traffic Engineering by L. R. Kadiyali, Khanna Publishers, New Delhi .

3. Principles of Transportation and Highway Engineering by G.V. Rao, Tata McGraw Hill, New Delhi.
4. Highway and Traffic Engineering by Subhash C. Saxena, CSB Publishers and Distributers Ltd. New Delhi

Reference books

1. Transportation Engineering by James S. Banks Tata McGraw Hill, New Delhi.
2. Transportation Engg. by Papakosta and P.D. Prevedouros , Prentice Hall India, New Delhi.
3. Principles of Transportation Engineering by P. Chakraborti and A. Das, Prentice Hall India, New Delhi
4. Highway Material Testing S.K. Khanna and C.E.G. Justo.
5. Highway Material Testing by A.K. Duggal.

BCE-29 DESIGN OF CONCRETE STRUCTURES

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Concrete and Concrete Structures (BCE-11)
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical:2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand various philosophies for design of reinforced concrete.
2. Understand Limit state method of design.
3. Understand the provisions of IS 456:2000 for design of one way and two way slab.
4. Design one way and two way slab by limit state method.
5. Understand the behavior of R.C.C. column and various types of end connections.
6. Understand the provisions of IS 456:2000 for design of R.C.C. Columns with and without eccentricity.
7. To use Design Chart for design of columns subjected to uni-axial biaxial bending
8. Know the method of pre-stressing, their advantages and losses in pre-stress.
9. Able to analyse pre-stressed rectangular and T-section.

Topics Covered

UNIT-I

Nature of Stresses in flat slabs with and without drops, coefficient for design of flat slabs, 9

reinforcement in flat slabs. (IS Code Method). Structural behaviour of footings, design of footing for a wall and a single column, combined rectangular and trapezoidal footings, Design of strap footing.

UNIT-II

Structural behaviour of retaining wall, stability of retaining wall against overturning and sliding, Design of T-shaped retaining wall, Concept of Counter fort retaining wall. Loads, forces and I.R.C. bridge loadings, Design of R.C. slab culvert. 9

UNIT-III

Design criteria, material specifications and permissible stresses for tanks, design concept of circular and rectangular tanks situated on the ground / underground, design of overhead tanks. 9

UNIT-IV

Advantages of pre-stressing, methods of pre-stressing, losses in pre-stress, analysis of simple pre-stressed rectangular and T-section 9

EXPERIMENTS

1. Compressive Strength of Concrete.
2. Workability by Compaction Factor, Slump Test.
3. Determination of Constituents of Hardened Mortar.
4. Mix Design by IS Code Method.

Textbooks

1. IS: 456 – 2000.
2. Reinforced Concrete – Limit State Design by A. K. Jain, Nem Chand & Bros., Roorkee
3. Reinforced Concrete Design by P. Dayaratnam.

Reference books

1. Plain and Reinforced Concrete Vol.I & II by O. P. Jain & Jai Krishna, Nem Chand & Bros.
2. Reinforced Concrete Structures by R. Park and Pauley.
3. Reinforced Concrete Design by S. Unnikrishna Pillai & D. Menon, Tata McGraw Hill Book Publishing Company Limited, New Delhi.

BCE-30 SEMINAR

Course category	:	Audit Course (AC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 6
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through quality of material, presentation, quality & extent of external response of question asked and participation in other seminars (attendance)
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Develop and support a relevant and informed thesis, or point of view, that is appropriate for its
2. audience
3. Identify, understand and discuss current, real-world issues.
4. Improve oral and written communication skills.
5. Distinguish and integrate differing forms of knowledge and academic disciplinary approaches

BCE-31 GEOTECHNICAL ENGINEERING-II

Course category	:	Departmental Core (DC)
Pre-requisite Subject	:	Geotechnical Engineering-I (BCE-27)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The basic knowledge of soil mechanics
2. Good scientific details of site investigations and insitu tests
3. Practical knowledge of sub soil investigation report
4. The earth pressure theories and Coloumb and Rankine approaches for soils
5. Knowledge of retaining structures
6. The basic and deep knowledge about foundations and bearing capacity determination of soil
7. The basic knowledge of pile foundation, their design and construction
8. The knowledge of well and machine foundation

Topics Covered

UNIT-I

Review of principles of soil mechanics. Characterization of ground, site investigations, groundwater level, methods of drilling, sampling, in situ test, SPT, CPT, DCPT, Pressure meter test, geophysical exploration, Components of Sub-soil investigation report. 9

UNIT-II

Earth pressure theories, Coulomb and Rankine approaches for c-φ soils, smooth and rough walls, inclined backfill, depth of tension crack, graphical solutions and types of retaining structures. 9

UNIT-III

Types of foundations – shallow / deep, isolated, combined, mat, etc., Definitions, Bearing capacity of shallow foundations (Terzaghi analysis), general, local and punching shear failures, corrections for size, shape, depth, water table, Bearing capacity by consolidation method, insitu bearing capacity determination, Provisions of IS code of practice, eccentrically loaded footings. 9

UNIT-IV

Classifications of piles, loading capacity of single pile in clay, silt and sand by static methods. Pile groups, under-reamed piles – their design and construction, negative skin friction, pile load test, Well foundations – various parts, Scour Depth, Grip length, forces acting on well. Introduction to Machine foundation. Barken's method 9

EXPERIMENTS

1. Direct Shear Test
2. Unconfined compression test
3. Vane Shear Test
4. Consolidation Test
5. Standard Penetration Test
6. Static Cone Penetration Test
7. Dynamic Cone Penetration Test.
8. CBR Test
9. Model Pile load Test
10. Visit to sub-surface exploration site.
11. Tri-axial Shear Test (Study only)

Textbooks

1. Singh, A – Modern Geotechnical Engineering
2. Ranjan, G and. Rao, A.S.R – Basic and Applied Soil Mechanics

Reference books

1. Ventatramaiah, C. "Goetechnical Engineering" , New Age International Ltd.
2. Poulos, H.G. and Davis E.H. (1980) "Pile Foundation Analysis and Design" Wiley.
3. Purushottam Raj "Geotechnical Engineering", Tata McGraw Hill.
4. S.K. Gulhati & Manoj Dutta "Geotechnical Engineering", Tata McGraw Hill
5. Bowles J.E. "Foundation Analysis and Design", 5TH Edition McGraw-Hill.

BCE-32 ENVIRONMENTAL ENGINEERING-II

Course category : Departmental Core (DC)
Pre-requisite Subject : Environmental Engineering-I (BCE-26)
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits : 4

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Discuss beneficial uses of water, quality requirements and standards.
2. Understand water borne diseases and their prevention and control.
3. Discuss objectives of water and waste water treatment, unit operations and processes and flow sheets.
4. Understand settling phenomena, coagulation and flocculation.
5. Design primary and secondary settling tanks, flocculators and clariflocculators.
6. Understand theory of filtration and various types of filters, disinfection process and water softening along with dosing requirements.
7. Understand preliminary, primary, secondary and tertiary treatment of waste water.
8. Design primary and secondary waste water treatment processes.
9. Discuss anaerobic digestion of sludge and the basic concept of emerging technologies for waste water treatment

Topics Covered

UNIT-I

Introduction: Beneficial uses of water and quality requirements, standards. Concepts of water and wastewater quality: physical, chemical and bacteriological examination of water and wastewater. Water borne diseases and their control. 9

Wastewater characteristics: Temperature, pH, colour and odour, solids, nitrogen and phosphorus, chlorides, toxic metals and compounds, BOD, COD etc.

Objectives of treatment: Water and wastewater treatment, unit operations and processes and flow sheets.

Sedimentation: Determination of settling velocity, efficiency of ideal sedimentation tank, short circuiting; different classes of settling; design of primary and secondary settling tanks

UNIT-II

Calculating removal efficiency for discrete and flocculent settling. Coagulation: Mechanisms of coagulation, coagulants and their reactions, coagulant aids; design of flocculators and clariflocculators. 9

Filtration: Theory of filtration; hydraulics of filtration; Carmen - Kozeny and other equations; slow sand, rapid sand and pressure filters, backwashing; brief introduction to other filters; design of filters. Disinfection: Requirements of an ideal disinfectant; kinetics of disinfection, various disinfectants, chlorination and practices of chlorination.

Water softening and ion exchange: calculation of dose of chemicals. Adsorption.

UNIT-III

Wastewater Treatment: Preliminary, primary, secondary and tertiary treatment processes. Primary Treatment: Screens, grit chamber and their design, sedimentation and chemical treatment to be given. Secondary Treatment: Theory of organic matter removal; activated sludge process, design of different units and modifications, extended aeration systems; trickling filters; aerated lagoons, waste stabilization ponds, oxidation ditches, R.B. C. etc. 9

UNIT-IV

Anaerobic digestion of sludge: Design of low and high rate anaerobic digesters and septic tank. Basic concept of anaerobic contact process, anaerobic filter, anaerobic fixed film reactor, fluidized bed and expanded bed reactors and up-flow anaerobic sludge blanket (UASB) reactor. Disposal of wastewater on land and in water bodies. Introduction to Duckweed pond, vermiculture and root zone technologies and other emerging technologies for wastewater treatment. 9

Textbooks

1. Peavy, Rowe and Tchobanoglous: Environmental Engineering
2. Metcalf and Eddy Inc.: Wastewater Engineering
3. Garg: Water Supply Engineering (Environmental Engineering Vol. – I)
4. Garg: Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol. – II).

Reference books

1. Manual on Water Supply and Treatment, C. P. H. E. E. O., Ministry of Urban Development, Government of India, New Delhi
2. Manual on Sewerage and Sewage Treatment, C. P. H. E. E. O., Ministry of Urban Development, Government of India, New Delhi
3. Steel and McGhee: Water Supply and Sewerage
4. Fair and Geyer: Water Supply and Wastewater Disposal
5. Arceivala: Wastewater Treatment for Pollution Control
6. Hammer and Hammer Jr.: Water and Wastewater Technology
7. Raju: Water Supply and Wastewater Engineering
8. Sincero and Sincero: Environmental Engineering: A Design Approach
9. Pandey and Carney: Environmental Engineering
10. Rao: Textbook of Environmental Engineering
11. Davis and Cornwell: Introduction to Environmental Engineering
12. Kshirsagar: Water Supply and Treatment and Sewage Treatment Vol. I and II
13. Punmia: Water Supply and Wastewater Engineering Vol. I and II
14. Birdie: Water Supply and Sanitary Engineering
15. Ramalho: Introduction to Wastewater Treatment Processes
16. Parker: Wastewater Systems Engineering
17. Mara: Sewage Treatment in Hot climates

BCE-33 STEEL STRUCTURES

Course category : Department Core (DC)
Pre-requisite Subjects : Structural Mechanics-I (BCE-14)
Structural Mechanics-II (BCE-17)
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 0

Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To understand concepts of strength and stiffness considerations.
2. Analyze, and design the riveted and bolted connections.
3. To undertake design problems on the basis of strength and serviceability concepts taught.
4. Able to design tension and compression members.
5. Able to design beam and flexural members.

Topics Covered

UNIT-I

Introduction to rolled steel sections, loads, factor of safety, permissible and working stresses. Riveted, welded and bolted connections, strength, efficiency and design of joints. 9

UNIT-II

Compression members- Effective length, Slenderness ratio, Strength of Compression members, Design of Struts, Columns, Built-up Columns, Design of eccentrically loaded columns. Tension members – Net and Gross sectional areas, Strength of members and their design. Design of slab and Gusset bases, Design of Grillage footing. 9

UNIT-III

Beams – web crippling and web buckling, design of laterally supported beam, design of laterally unsupported beam, Purlins, Design of Plate Girders. 9

UNIT-IV

Loads on Structures, Design of Roof Trusses, Design of Industrial Buildings. 9

Textbooks

1. Design of Steel Structures by N. Subramaniam, Oxford Publication
2. Design of Steel Structures by S. K. Duggal, Tata Mc-Graw-Hill Publishing Company

Reference books

1. Design of Steel Structures by A. S. Arya & J. L. Ajmani, Nem Chand & Bros., Roorkee.
2. Design of Steel Structures by Gaylord & Gaylord.
3. IS : 800 – 2007.

BCE-34 TRANSPORTATION ENGINEERING-II

Course category : Departmental Core (DC)

Pre-requisite Subject	:	Transportation Engineering-I (BCE-28)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the knowledge of various systems of railway, airport and water transportation.
2. Understand the components of railway tracks, components and types of aircrafts etc.
3. Understand the design concept of railway track, runway, taxiway etc.
4. Apply the concept of geometric design of railway, runway, taxiway, docks & harbours etc.
5. Apply the knowledge of various signaling system for railway engineering, air traffic control, navigational aids, etc

Topics Covered

UNIT-I

Indian Railways: Development and organization of Indian Railways. Permanent way: Sub-grade formation, embankment and cutting, track damage. Rails: Rail gauges, types of rails, defects in rails, rail failure, creep of rail. 9

Rail Fastenings: Fish plates, spikes, chairs, keys, bearing plates. Sleepers: Timber, steel, cast iron, concrete and pre-stressed concrete sleepers, manufacturing of concrete sleepers, sleeper density. Ballast: Ballast materials, size of ballast, screening of ballast, specification of ballast, tests on ballast.

UNIT-II

Railway Track Geometry: Gradients, horizontal curves, super elevation, safe speed on curves, cant deficiency, negative super elevation, compensation for curvature on gradients, track resistance and tractive power. Points and Crossings: Elements of simple turn-out, details of switch, details of crossings, number and angle of crossings, design of turn-out. Introduction to High Speed Trains. 9

UNIT-III

Stations & Yards: Site section for a railway station, layout of different types of stations, classification of stations, types of railway yard, functioning of Marshalling yards. Signaling and Interlocking: Classification of signals, methods of train working, absolute block system, mechanical interlocking of two line railway stations. 9

UNIT-IV

Airport Engineering: Air craft characteristics, types of airports, layout of airports, airport planning and design, runway orientation, wind-rose diagram, estimation of runway length and correction. Harbors, Layout and port facilities; inland waterways; inland water operation. 9

Textbooks

1. A Text Book of Railway Engineering by S. P. Arora & S. C. Saxena.
2. Airport Planning and Design by S. K. Khanna, M. G. Arora

Reference books

1. Railway Engineering - M.M. Aggarwal.
2. Railway Engineering - Vasvani.
3. Railway Engineering - B.L. Gupta and Amit Gupta.

BCE-35 CONSTRUCTION TECHNOLOGY AND MANAGEMENT

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to understand how to control project schedule, cost, quality and risk.
2. Develop the ability to analyze the risk and feasibility of real estate projects throughout their life cycle.
3. Students will be able to know the different types of equipment to be used in the construction projects.
4. Students will be able to know the different types of contracts in construction arbitration and legal aspects and its provision.
5. Students will be able to know various construction safety concepts.

Topics Covered

UNIT-I

Elements of Management: Project cycle, Organisation, planning, scheduling monitoring updating and management system in construction. 9

Network Techniques: Bar charts, milestone charts, work break down structure and preparation of networks. Application of network Techniques like PERT, GERT, CPM AON and AOA in construction management. Project monitoring, cost planning, resource allocation through network techniques. Line of balance technique.

UNIT-II

Engineering Economics: Time value of money, Present economy studies, Equivalence concept, financing of projects, economic comparison present worth method Equivalent annual cost method, 9

discounted cash flow method, analytical criteria for postponing of investment retirement and replacement of asset. Depreciation and break even cost analysis.

UNIT-III

Contract Management: Legal aspects of contraction, laws related to contracts, land acquisition, labour safety and welfare. Different types of contracts, their relative advantages and disadvantages. Elements of tender preparation, process of tendering pre-qualification of contracts, Evaluation of tenders, contract negotiation and award of work, monitoring of contract extra items, settlements of disputes, arbitration and commissioning of project. 9

UNIT-IV

Equipment Management: Productivity, operational cost, owning and hiring cost and the work motion study. Simulation techniques for resource scheduling. Construction Equipments for earth moving , Hauling Equipments, Hoisting Equipments , Conveying Equipments , Concrete Production Equipments 9

Textbooks

1. "Construction Planning", Equipment and Methods.: R.L. Peurify. T.M.H., International Book Company.
2. Construction Technology by Sarkar , Oxford

Reference books

1. "PERT & CPM Principles and Applications" L.S. Shrinath, E.W.P. Ltd., New Delhi.
2. "Network Analysis Techniques" S.K. Bhatnagar, Willey Eastern Ltd

BCE-36 SURVEY CAMP *

Course category	:	Departmental Core (DC)
Pre-requisite Subject	:	Basic Surveying (BCE-12)
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 9
Number of Credits	:	3
Course Assessment methods	:	This is carried out during Winter Break with the help of Total Station and Differential GPS
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Be able to conduct topographical survey of a given area.
2. Be able to prepare topographical maps of an area.
3. Knowledge of practical implementation of different survey works

Topics Covered

Ten days survey camp using GPS, Theodolite, levelling Instrument and staff, tapes, and plane table. The camp must involve work on a large area and map should be at least 1:5000 or smaller. At the end of the camp, each student shall have mapped and contoured the area. The camp record shall include all original field observations, calculations and plots. Control Points should be plotted using Computer

Aided Drawings. Students should also be exposed to modern Survey Equipment and practices, like Total Station

Experiments

7 days survey camp during break of winter after V^{th} semester

BCE-40 PROJECT PART-I

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 10
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through three viva voce/presentation, preliminary project report, effort and regularity and end semester presentation
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
2. To communicate effectively and to present ideas clearly and coherently
3. To learn on their own, reflect on their learning and take appropriate actions to improve it.
4. Students will acquire collaborative skills through working in a team to achieve common goals.

BCE-41 WATER RESOURCES ENGINEERING

Course category	:	Departmental Core (DC)
Pre-requisite Subject	:	Fluid Mechanics (BCE-15)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Design of water management systems utilizing the basic principles of the hydrologic cycle.
2. Apply knowledge for efficient design methods for rapid conveyance of water with lesser loss in irrigation canals.
3. To demonstrate a knowledge of the multi-disciplinary nature of water resources engineering.
4. Realize the importance of optimal water use for growing the crops, and apply methods for saving land from water-logging.
5. To demonstrate technique involved in making design problems of canal and related structures to be safe and cost effective.
6. Apply the knowledge in the design of hydraulic structures to be constructed for conveyance of irrigation water.
7. Apply the silt control devices in canals and natural channels for long life of irrigation schemes.
8. Formulate irrigation networks across the country to make itself self reliant in food grain production.
9. Enumerate the need of water resource conservation and management to overcome the natural calamities such as drought and flood and its protection measures.
10. Design of water management systems utilizing the basic principles of the hydrologic cycle.

Topics Covered

UNIT-I 9

Introduction– irrigation, water resources in India, need of irrigation in India, development of irrigation in India, impact of irrigation on human environment, irrigation systems: minor and major, command area development.

Hydrology– hydrologic cycle, rainfall- runoff process, factors affecting runoff, runoff hydrograph, runoff computations, flood discharge calculations, unit hydrograph method, S-hydrograph.

UNIT-II 9

Water requirement of crops- Crops and crop seasons in India, cropping pattern, duty and delta; Quality of irrigation water; Soil-water relationships- soil characteristics significant from irrigation considerations, root-zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle/drip irrigation types.

UNIT-III 9

Sediment Transportation: Suspended, Bed load and Total load and its estimation.

Irrigation channels: Types: sediment threshold, lined and unlined.

Silt Theories: Kennedy's and Lacey's Design procedure for irrigation channels, Longitudinal cross section, Schedule of area statistics and channel dimensions, use of Garret's Diagrams in channel design, cross sections of an Irrigation channel, Computer programs for design of channels, Lining of Irrigation Canals: Advantages and types, factors for selection of a particular type, design of

lined channels, cross section of lined channels, Economics of canal lining.
Water- logging: Definition, effects, causes and anti-water logging measures, Drainage of water logged land, Types of drains open and closed, spacing of closed drains.

UNIT-IV 9

Regulation and control of canal system: Purpose, Types of canal regulation works and their functional aspects.
Irrigation Outlets: Requirements, types, non-modular, semi-module and rigid module, selection criterion.
River Training: Objective and need, classification of rivers, and river training works, meandering, stages, methods of river training, bank protection, Methods for measurement of discharge.

Textbooks

1. Irrigation Engg. and Hydraulic Structures -.K. Garg, Khanna Publishers.
2. Irrigation and water Power engineering - B.C. Punmia, Laxmi Publications.
3. Engineering Hydrology - K. Subramanya, TMH.
4. Irrigation Water Power and Water Resource Engg. - K.R. Arora.

Reference books

1. Water Resources Engg. - Larry W. Mays, John Wiley India.
2. Water resources Engg. - Wurbs and James, John Wiley India.
3. Water Resources Engg. - R. K. Linsley, McGraw Hill.
4. Irrigation and water Resources Engg. - G L Asawa, New age International Publishers.
5. Irrigation Theory and practices - A.M. Michel.

BCE-42 EARTHQUAKE RESISTANT DESIGN

Course category	:	Departmental Core (DC)
Pre-requisite Subjects	:	Structural Mechanics-I (BCE-14) Structural Mechanics-II (BCE-17)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To introduce nature and characteristics of various dynamics loads.
2. To have considerable knowledge of theory of vibrations including multi-degree of freedom systems.
3. To assess of structural failure due to earthquakes.
4. To analyze and design structures subjected to seismic loading as per IS codes.
5. To introduce ductile detailing of structures, concept of soft story and design of shear walls as per IS code.

Topics Covered

UNIT-I 9

Introduction - Origin of Earthquakes, magnitude, intensity, ground motions, sensors, Strong motion characteristics.

Concepts of Earthquake Resistant Design of Reinforced Concrete Buildings – Earthquake and vibration effects on structure, identification of seismic damages in R.C. buildings, Effect of structural irregularities on the performance of R.C. buildings during earthquakes and seismo-resistant building architecture

UNIT-II 9

Single Degree of Freedom Systems- Equation of motion, free and forced vibrations, damping, Response spectrum

Multi Degree of Freedom Systems.- Two degree and multi-degree freedom systems.

UNIT-III 9

Seismic Analysis and Modeling of R.C. Buildings- Codal procedure for determination of design lateral loads, in-fill walls, seismic analysis of R.C. building as per IS: 1893 (Part 1)-2002

UNIT-IV 9

Earthquake Resistant Design of Buildings- Ductility considerations, IS 13920 - 2002, E.R.D. of R.C. building, Design of load bearing buildings, Design of shear wall

EXPERIMENTS

To study and sketch the earthquake resistant IS code provisions for Earthquake Resistant Detailing of the following:

1. Brick masonry structures
2. RCC structures
3. Steel structures
4. Timber and other structures
5. Non-Engineered Building Construction

Textbooks

1. Earthquake Resistant Design of Structures - P. Agarwal & M. Shrikhande
2. Structural Dynamics – Theory & Computation - Mario Paz
3. Dynamics of Structures Theory and Applications to Earthquake Engineering - Anil K. Chopra

Reference books

1. Introduction to Structural Dynamics - J.M. Biggs
2. Elements of Earthquake Engineering - Jai Krishna and A.R. Chandrasekharan

3. Fundamental of Earthquake Engineering - N.M. Neumarks and E. Rosenblueth
4. Engineering Vibrations - L.S. Jacobsen & R.S. Ayre
5. Structural Dynamics - R. Roy Craig Jr.
6. Dynamics of Structures - R.W. Clough & J. Penjien

IS Codes

1. IS: 1893 (Part –1) – 2002
2. IS: 1893 (Part –4) – 2005
3. IS: 13920 – 1993
4. IS: 4326 – 2002

BCE-43 ANALYSIS AND DESIGN OF HYDRAULIC STRUCTURES

Course category	:	Departmental Core (DC)
Pre-requisite Subject	:	Water Resources Engineering (BCE-41)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Use and integrate the fundamental and basic studied towards the goal of selecting, analyzing and designing of hydraulic structures.
2. Cope with decision making and satisfy competing objectives.
3. Design, analyse and proof that the hydraulic structures is safe and economical.
4. Work in team and learn successful group interaction for a project.
5. Deliver an oral presentation for the project.
6. Perform studies of various hydraulic structures such as weir/barrages and cross-drainage works.
7. Classify the dams and spillways and know the functioning of each type.

Topics Covered

UNIT-I

9

Types of Head works: Component parts of a diversion headwork, Failure of hydraulic structures founded on permeable foundations, Principles of design; Bligh's theory, Khosla's theory for determination of pressure and exit gradient.

Regulation Works: Falls, Classification, Introduction to design principle of falls, Design of Sarda type and straight glacis tall. Principle and design of Distributory head-regulator and cross-regulator, canal escape, Bed bars.

UNIT-II

Canal head works: Functions, Location, Layout of head works. Weir and Barrage, Canal head-regulator, Introduction to the design principles of Weirs on permeable foundations, Design of vertical drop and sloping glacis weir. 9

Cross drainage works: Necessity and types. Aqueduct, Siphon Aqueduct, supper passage, canal siphon, level crossing, Introduction to design principles of cross-drainage works.

UNIT-III

Flood routing: Types, methods of reservoir routing, channel routing by Muskingham Method. 9
Investigation and planning of dams and Reservoirs: Zones of storage, Estimation of storage capacity, Reservoir losses, Reservoir sedimentation and its control, life of a reservoir.

Dams: classification and selection criteria.

Earth Dams: Classification, causes of failure Phreatic line, and its determination Introduction to stability analysis.

UNIT-IV

Gravity dams: Forces method of analysis, modes of failure and factor of safety, Elementary profile, stability analysis, galleries, joints, control of cracks. 9

Spillways: Spillway capacity, types of spillways, Design of ogee spillway, Energy dissipation below spillway, Design criteria for Hydraulic Jump type stilling basins with horizontal and sloping aprons, spillway gates.

EXPERIMENTS

1. Study of cross-drainage models.
2. Study of flow over spillway.
3. Study of river meandering.
4. Model Study of river-training work.
5. Study of different characteristics of river resistance.

Textbooks

1. Water Resources Engg. - Larry W Mays, John Wiley India
2. Water resources Engg. - Wurbs and James, John Wiley India
3. Water Resources Engg. - R.K. Linsley, McGraw Hill 29
4. Irrigation and Water Resources Engg. - G L Asawa, New age International Publishers

Reference books

1. Irrigation Engg. And Hydraulic Structures - S. K. Garg, Khanna Publishers
2. Irrigation and Water Power Engineering - B. C. Punamia & Pande B.B. Lal

BCE-45 INDUSTRIAL / PRACTICAL TRAINING

Course category : Audit Course (AC)
Pre-requisite Subject : NIL
Contact hours/week : Lecture : 0, Tutorial : 0 , Practical: 2

Number of Credits	:	1
Course Assessment methods	:	Continuous assessment through technical quality of the work, attendance, discipline, involvement and interest, project work, viva voce, project report and presentation
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Work in a team.
2. Take initiatives.
3. Effectively communicate solution to the problems.
4. Gain practical knowledge in the field of Engineering.
5. Identify the hazards and safety measures.

BCE-50 PROJECT PART-II

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Project Part-I (BCE-40)
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 10
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through three viva voce/presentation, final project report, contribution made to literary world and Major examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
2. To communicate effectively and to present ideas clearly and coherently
3. To learn on their own, reflect on their learning and take appropriate actions to improve it.
4. Students will acquire collaborative skills through working in a team to achieve common goals.

BCE-51 SOLID WASTE MANAGEMENT

Course category	:	Programme Elective-1 (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Illustrate the waste generation in a technological society and analyze the waste generation trends.
2. Discuss the essential elements for solid waste management.
3. Propose a mathematical approach for handling waste on-site and off-site.
4. Calculate the efficiencies of each collection system.
5. Measure the actual volume of waste produced and reduced in terms of volume estimation.
6. Calculate the actual amount of energy that can be recovered from waste.
7. Designing an engineered landfill for waste produced from society.
8. Illustrate the chemical processes involved during degradation of waste in landfill.
9. Categorizing the various design parameters to be fulfilled while adopting composting process for waste treatment.
10. Figure out the present situation of solid waste and its management.

Topics Covered

UNIT-I

Solid waste: Public health and ecological impacts. Sources and types of solid wastes, material flow and waste generation in a technological society, factors affecting the generation rates, future challenges and opportunities. Functional elements: Waste generation, storage collection, transfer and transport, processing and recovery disposal. 8

UNIT-II

Physical and chemical composition of municipal solid waste, integrated solid waste management, hierarchy of waste management options. Storage: movable bins, fixed bins. Collection: home to home collection, community bin system. Theory and design of hauled container system, stationary container system. 10

UNIT-III

Transportation: Different vehicles used and layout of routes. Engineering system for on-site handling and processing of solid waste. Waste reduction and segregation equipment and methods. Landfilling: Site selection criteria, landfill layout, landfill sections. Occurrence of gases and leachate landfills, control of leachates and different phases. 9

UNIT-IV

Composting, types of composting, process description, design and operational consideration of aerobic and anaerobic composting. Thermal technologies: Incineration and pyrolysis system, energy recovery system. Electronic waste and Bio-Medical Waste. Overview of Solid waste management practices in India. 9

Textbooks

1. Tchobanoglous, G., Theisen, H. & Vigil, S.A; Integrated Solid Waste Management: McGraw Hill, New York

Reference books

1. Tchobanoglous, G., Kreith, F; Handbook of solid waste management: McGraw Hill, New York
2. Solid Waste Engineering, Principle & Management issues by VenTe Chow.
3. Bhide, A.D., B.B. Sundaresan, Solid Waste Management in developing Countries.
4. Manual on Municipal solid waste management, CPHEEO, Govt. of India.
5. Guidelines for Management and Handling of Hazardous wastes MOEF(1991), Govt. of India.
6. Datta, M; Waste Disposal in Engineered Landfills, Narosa Publishers, Delhi

BCE-52 ENVIRONMENTAL IMPACT ASSESSMENT

Course category	:	Programme Elective-1 (PE)
Pre-requisite Subjects	:	Environmental Engineering-I (BCE-26) Environmental Engineering-II (BCE-32)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Discuss and illustrate the importance of EIA for various processes of decision making in various projects
2. Categorize the different assessment methodology for various fields of concern air, water, noise and wildlife
3. Defend the different stages of EIS production
4. Illustrate the difference among various case studies
5. Figure out the Environmental Management plan to be adopted for various programmes

Topics Covered

UNIT-I

Environmental impact assessment, concept, Brief history of EIA, Significance of EIA, Role of EIA in planning and decision making process, objective of EIA, Provisions of various environmental acts of India. 9

UNIT-II

Environmental assessment process, Assessment methodology, Socioeconomic impact assessment, Air quality impact analysis, Noise impact analysis, Water quality impact analysis, Vegetation and wild life impact analysis, Ecological impact assessment. 9

UNIT-III

Environmental Impact statement, Basic concept behind EIS, Stages in EIS production: Screening, scoping, prediction, evaluation, reducing impact, monitoring, conclusions, typical EIS outline. Recent case studies 9

UNIT-IV

Environmental Management Plan, Preparation, implementation and review-Mitigation and rehabilitation plans-Policy and guideline for planning and monitoring programmes. 9

Post audit-Ethical and Quality aspects of Environmental Impact Assessment.

Textbooks

1. Environmental Impact Assessment: Harry W. Conter, McGraw Hill, New York

Reference books

1. Corporate Environmental Management: Welphort R, University Press
2. Environmental Impact Assessment: Canter L. W. McGraw Hill, New York
3. Environmental Impact Assessment: Handbook: John G. Rau and DC Wooren McGraw Hill,
4. EIA Notification-MOEF, Govt. of India 2014

BCE-53 ROCK MECHANICS

Course category	:	Programme Elective-1 (PE1)
Pre-requisite Subject	:	Engineering Geology and Building Materials (BCE-13)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To identify the different types of rocks.
2. To classify the rocks on the basis of their index properties.
3. To determine the strength of the rock by various failure criteria
4. To study the stress strain behavior of rockmass
5. To analyse the stability of rockslopes, foundation and dams
6. To study the application of rockmass in underground structures

Topics Covered

UNIT-I 9

Introduction, Rock materials, Index properties and Rock Mass classifications, Terzaghi, RQD, RSR, RMR and Q classifications, Rating, Applications. Strength behaviour in uniaxial compression, tension and tri-axial state. Laboratory testing methods. Stress-strain relationships

UNIT-II 9

Factors influencing strength, failure mechanism. Anistropy. Failure criteria for rock and rock masses. Coulomb, Mohr's, Griffiths and Modified Griffiths criteria and Empirical criteria. Brittle-ductile transition, Post failure behaviour. Insitu stress, various methods of stress measurement, Hydrofracturing technique, Flat jack technique, Overcoring technique.

UNIT-III 9

Strength and deformation behaviour of discontinuities. Rock mass behaviour, Shear strength of jointed rocks, roughness, peak and residual strengths. Strength criteria for rock mass. . Creep and cyclic loading. Weathered rocks, Flow through intact and fissured rocks. Dynamic properties

UNIT-IV 9

Applications of Rock Mechanics to Underground Structures, Stability of rock slopes, Foundation on rocks, Methods to improve rock mass responses, Grouting in Rocks, Rock bolting, Rock Anchors.

Textbooks

1 Goodman, R.E. (1980). Introduction to Rock Mechanics. Wiley.

Reference books

1. Ramamurthy, T. (2007). Engineering in Rocks for Slopes, Foundations and Tunnels. Prentice-Hall of India Private Limited.
2. Vutukuri, V.S., Lama, R.D. and Saluja, S.S. (1974). Handbook on Mechanical Properties of Rocks. Vol. 1, Trans Tech. Publications.
3. Zhang Lianyang (2005). Engineering Properties of Rocks. Elsevier.
4. Jaeger, J.C. (1979). Fundamentals of Rock Mechanics. Chapman & Hall.
5. Jaeger, J.C. and Cook, N.G.W. (1979). Fundamentals of Rock Mechanics. Chapman & Hall.
6. Bieniawski, Z.T. (1989). Engineering Rock Mass Classifications. John Wiley & Sons.
7. Bieniawski, Z.T. (1984). Rock Mechanics Design in Mining and Tunnelling. Balkema.
8. Hudson, J.A. & Harrison, J.P. (1997). Engineering Rock Mechanics: An Introduction to the Principles. Pergamon.

BCE-54 BRIDGE ENGINEERING

Course category	:	Programme Elective-1(PE1)
Pre-requisite Subjects	:	Structural Engineering-I (BCE-14) Structural Engineering-II (BCE-17) Concrete Structures (BCE-11)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To discuss basic definitions, types, and components of bridges.
2. To discuss sub-surface investigations required for bridge construction.
3. To understand standard specification for bride design.
4. To perform design of various slab type reinforced concrete bridges.
5. To perform design of bridges sub-structures, bearings and joints.

Topics Covered

UNIT-I 9

Site selection, various types of bridges and their suitability, loads, forces and IRC bridge loading and permissible stresses, Design of RC bridges under concentrated loads using effective width and Pigeauds Method, Courbon's method of load distribution.

UNIT-II 9

Detail design of slab culvert, T-beam bridge, box culverts

UNIT-III 9

Design and detailing of plate girder and steel Truss type bridges

UNIT-IV 9

Design of piers and pier caps. Abutments and Bearings

Textbooks

1. Essentials of Bridge Engineering by D J Victor
2. Limit State Design of Steel Structures by S K Duggal
3. Design of steel Structures by Ramchandra

Reference books

1. Design of Bridges by N. Krishna Raju
2. Bridge Engineering by S Ponnuswamy
3. Design of Bridge Structure by T. R. Jagadees.

BCE-55 DISASTER MANAGEMENT

Course category	:	Programme Elective-1 (PE1)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Discuss the various modes of disaster arising in different areas
2. Identify the roles of NDRF and SDRF in disaster management
3. Illustrate the various trends of disaster management in Indian context
4. Recommend the various disaster prevention techniques for different context
5. Define the role of engineers in Disaster mitigation

Topics Covered

UNIT-I 9

Type of disasters, Accent on land slides, earthquakes, flashflood, avalanches, snow blizzards. Causes, consequences and mitigation techniques, Flashfloods their management and relief, Contingency planning for dam failures

UNIT-II 9

Characteristics of glaciers and protection of important monuments from glacial flow, Management of snow avalanche, Disaster management planning, Roles of NDRF and SDRF in Disaster Management

UNIT-III 9

Landslides, their classification, causes, & preventive measures. Concept, growth presents trends status in India and concept of contingency planning and systems approach of disaster management. Sociology of disasters, Human and media response and role.

UNIT-IV 9

Disaster prevention techniques, Disaster legislation, Disaster prone area building codes, Vulnerability analysis, Health and sanitation aspects, Relief administration in India and role of engineers in disaster mitigation

Textbooks

1. Disaster Management and Strategies by Ashu Pasricha, Kiyanoush Ghalav and Jai Narain Sharma

Reference books

1. Disaster Management and Preparedness - Larry R. Collins, CRC Press.

2. Disaster Management Handbook - Jack Pinkowski, CRC Press

BCE-56 ADVANCED ENGINEERING HYDROLOGY

Course category	:	Programme Elective-1 (PE1)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To demonstrate about the knowledge of Hydrological cycle
2. To know the different form of precipitation and measurement of precipitation
3. To prepare the hydrograph and different types of hydrograph
4. To predict the flood and design flood
5. To calculate flood by different flood routing method
6. To have a knowledge of groundwater hydrology
7. To demonstrate about the knowledge of surface and groundwater hydrology
8. To have a full attitude of hydrologic engineering, i.e., surface and groundwater hydrology.

Topics Covered

UNIT-I 9

Introduction: hydrologic cycle, water budget equations, world water balance, application in engineering. Precipitation: Forms of precipitation, measurement, depth-area-duration & intensity-duration- frequency relationships, probable maximum precipitation. Abstraction from Precipitation: Evaporation – process, measurement and estimation; Evapotranspiration-measurement and estimation; Initial Losses- Interception & Depression storage; Infiltration- process, capacities, indices, measurement & estimation

UNIT-II 9

Runoff and Hydrographs : Hydrograph, runoff characteristics of stream, Yield, Rainfall-runoff correlations, flow duration curve, mass curve, droughts and floods. Factors affecting flood hydrographs, unit hydrograph and its analysis, s-curve hydrograph, synthetic and instantaneous unit hydrographs.

UNIT-III 9

Flood: Rational method, empirical formulae, unit hydrograph method, flood frequency studies, statistical analysis, regional flood frequency analysis, design storm & design flood, risk/reliability and safety factor; Flood Routing: Basic equation, hydrologic storage routing & attenuation, hydrologic channel routing, flood forecasting & control, hydraulic method of flood routing.

UNIT-IV 9

Groundwater: introduction, forms of subsurface water, aquifers & its properties, Compressibility of aquifers, flow equations for confined and unconfined aquifers, well hydraulics- steady and unsteady flow to a well in confined aquifer, well losses, specific capacity, ground water irrigation, rain water harvesting

Textbooks

1. 'Engineering Hydrology' by K. Subramanyam

Reference books

1. 'Hydrology for Engineers' by Linsley R. K., Kohler M. A. and Paulhus J. L. H.
2. 'Hydrology: Principles. Analysis. Design' by Raghunath H. M.
3. 'Handbook of Applied Hydrology' by Chow V. T.
4. 'Irrigation: Theory & Practice' by Michael A. M.
5. 'Hydrology for Engineers' by Linsley R. K., Kohler M. A. and Paulhus J. L. H.

BCE-57 GEO-ENVIRONMENTAL ENGINEERING

Course category	:	Programme Elective-2 (PE2)
Pre-requisite Subjects	:	Geotechnical Engineering-I (BCE-27) Geotechnical Engineering-II BCE-31) Environmental Engineering-I (BCE-26) Environmental Engineering-II (BCE-32)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Student will aware the development of geo-environmental engineering
2. Understand the environmental cycle and their interaction with geotechnology
3. Student will acquire the knowledge of waste characterization, solid waste interaction and hazardous waste
4. Student will understand how the contaminants are transported into the soils

5. Student will acquire knowledge about the stabilization and treatment of sludge
6. Understand the geosynthesis
7. Will get the knowledge about geotechnical reuse of waste
8. Student will acquire knowledge of design of landfills
9. Student will analyze the stability and settlement including seismic stability and liquefaction
10. Student will understand the grouting and injection process

Topics Covered

UNIT-I 9

Introduction, Development of Geo-environmental Engg, Aims, Environmental Cycle and their interaction with geo-technology, Waste characterization and solid waste interaction: Composition of municipal and industrial wastes, hazardous waste at municipal landfill sites, chemical and bio-chemical reactions, Solid waste interaction, engineering properties of wastes.

UNIT-II 9

Contaminant transport in soil: Contaminant migration, diffusion and monitoring, Sludge solidification and stabilization: Regulation, physical and chemical tests, treatment method and solidification / stabilization methods, quality control. Vertical barriers: Slurry walls, soil-slurry interaction, permeability compatibility.

UNIT-III 9

Geo-synthetics: Type, function and application in geo-environmental projects, Ash Pond and Mine Tailing Impoundments, Geotechnical re-use of waste materials and fills.

UNIT-IV 9

Design of linear system for landfills, Leachate collection and removal system, Stability and settlement analysis including seismic stability and liquefaction,

Grouting and injection process: Grout used for controlling hazardous wastes, SinkholeBearing capacity of foundation on sanitary landfills. Special topics

Textbooks

1. Sharma, H. D. and Sangeeta, P.L. - waste containment systems, waste stabilization and landfills: design and evaluation

Reference books

1. Fang, H. – Introduction to Environmental Geotechnology.
2. Koerner, R. M. - Designing with Geosynthetics

BCE-58 ADVANCED STRUCTURAL ENGINEERING

Course category : Programme Elective-2 (PE2)
Pre-requisite Subjects : Structural Mechanics-I (BCE-14)
Structural Mechanics-II (BCE-17)
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 0

Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To understand how to represent real structures by idealized structural systems.
2. To understand the classification of structures, static indeterminacy, kinematic indeterminacy.
3. To understand the stain energy and complimentary strain energy of the structures.
4. To understand the concept of flexibility method and be able to apply it for analysis of statically indeterminate structures.
5. To understand the concept of stiffness method and be able to apply stiffness methods for analysis of statically indeterminate structures.
6. To understand the equilibrium of forces for cable bridges and analysis of suspended cable bridges.

Topics Covered

UNIT-I 9

Classification of Structures, stress resultants, degrees of freedom, Strain Energy and Complimentary Strain Energy. Introduction to various methods of structural analysis

UNIT-II 9

Force Method of analysis: Application to beams and frames, Construction and Use of Flexibility Matrix for analyzing rigid jointed and pin jointed structures.

UNIT-III 9

Displacement Method of analysis: Application to beams and frames, Construction and Use of Stiffness Matrix for analyzing rigid jointed and pin jointed structures.

UNIT-IV 9

Equilibrium of light cable, General Cable theorem, uniformly loaded cable, anchor cables, temperature stresses in suspension cables, three hinged stiffening girder, two hinged stiffening girder, temperature stresses in two hinged girder.

Textbooks

1. Advanced Structural Analysis by A. K. Jain, Nem Chand & Bros., Roorkee.
2. Structural Analysis by C. S. Reddy, Tata Mc Graw Hill Publishing Company Limited, New Delhi.
3. Theory of Structures Vol 1 & 2 by Gupta & Gupta , TMH

Reference books

1. Reddy, C.S., “Basic Structural Analysis”, Tata McGraw Hill.
2. Coates, R.C., Coutie, M.G. & Kong, F.K., “Structural Analysis”, English Language Book Society & Nelson, 1980.

3. Ghali, A. & Neville, M., "Structural Analysis", Chapman & Hall Publications, 1974.
4. Jain, A.K. "Advanced Structural Analysis", Nem Chand & Bors, Roorkee, India, 1996.
5. Jain, O.P. & Arya A.S., "Theory of Structure", Vol. II, Nem Chand Bros., Roorkee , 1976.
6. Kinney, J.S., "Intermediate Structural Analysis", McGraw Hill Book Company, 1957.
7. Wang, C.K. "Intermediate Structural Analysis", McGraw Hill Book Company, 1983.
8. Nautiyal, B.D., "Introduction to Structural Analysis", New Age International, 2001

BCE-59 PRINCIPLES OF REMOTE SENSING

Course category	:	Programme Elective-2 (PE2)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the way in which electromagnetic radiation interacts with the earth's atmosphere, the earth's surface and the remote sensing system.
2. Develop some skills in image interpretation and analysis.
3. Be familiar with different types of sensors and remote sensing space missions that are used to detect and record certain parts of the electromagnetic spectrum.
4. Understand simple image enhancement , filtering operations over digital images
5. To carry out corrections of geometric distortions in digital images
6. Aware of some applications of remotely sensed images
7. Develop a knowledge and understanding of spectral classification of images for feature extraction
8. Understand the concepts and principles of global positioning system
9. Understand the sources of errors in a GPS, and tackling them.

Topics Covered

UNIT-I 9

Remote sensing system and its components, Electromagnetic spectrum, definition of emissivity, reflectance, absorbance and transmittance. Spectral signature, atmospheric window, active and passive remote sensing systems, Interaction of electromagnetic energy with atmosphere and earth features, factors affecting the reflectance.

UNIT-II 9

Airborne and space platforms, Advantages and disadvantages of each, principle and functioning of multi-spectral, thermal & line scanners, Multi concept of remote sensing, Different satellite and sensor combinations: LANDSAT, SPOT, IRS series of satellites and sensors. Their important characteristics such as flight altitude, IFOV, spatial resolution, swath, spectral bands, and repetivity.

UNIT-III 9

Introduction to Digital Image Processing, digital image representation, and characterization, Concept of color, Color composites, histograms and scatter plot, image enhancement, contrast stretching, radiometric processing including correction of atmospheric corrections; geometric corrections, Image Transformations such as subtraction, rationing, NDVI and PCA

UNIT-IV 9

Ground truth, Geographic and Radiometric, Principles of Global Positioning Systems and its role to remote sensing data, Digital terrain models. Thematic classification and clustering to include unsupervised and supervised classification based on parallelepiped, minimum distance and maximum likelihood classification; accuracy assessment of classification. Applications of remote sensing

Textbooks

1. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman., Remote Sensing and Image Interpretation. Wiley

Reference books

1. Curran, Paul J., Principles of Remote sensing Longman
2. Campbell, J.B., Introduction of Remote Sensing Taylor and Francis,
3. Sabins, F.F., Remote Sensing: Principles and Interpretations Worth Publishers
4. Reddy, M. Anji, Remote sensing and Geographic Information System BS Publications
5. B. Bhatta, Remote Sensing and GIS, Oxford University Press

BCE-60 AIRPORT, DOCKS & HARBOUR ENGINEERING

Course category	:	Programme Elective-2 (PE2)
Pre-requisite Subjects	:	Transportation Engineering-I (BCE-28) Transportation Engineering-II (BCE-34)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the components of aircrafts & different types of aircrafts.
2. Carryout the survey for airports, docks & harbours.
3. Perform geometric design for the airports, docks & harbour.
4. Plan and layout of different types of terminals.
5. Understand the various methods of design of runways.

Topics Covered

UNIT-I 9

Introduction, Aircraft Characteristics and Airport Selection: Air transport development in India, national and international organizations in air transport, aircraft characteristics and their impact on planning of airport, selection of site for an airport, airport obstruction, imaginary surfaces, runway orientation clam period and wind coverage.

UNIT-II 9

Geometric Designs: Runway and taxiway geometric designs, exit taxiway, its design and fillet curves, runway configuration, separation clearance, design of apron and their layouts.

Airport Traffic Control Aids: Visual aids, marking and lightning of runway and apron area, wind and landing direction indicator

UNIT-III 9

Planning and Layout of Docks and Harbours: Harbour planning principles, terminology, layout of a harbour, classification of harbour. Docks: Classification of Docks, transit sheds and Warehouses.

UNIT-IV 9

Construction and Maintenance of Docks and Harbours: Introduction, Construction of Quay walls, Construction of Breakwaters, Tides and Tidal Data Analysis, Types of tides, Tidal theories, Tidal data Analysis, Applications of Tidal data Analysis, Dredging, Maintenance of Ports and Harbours

Textbooks

1. A Text Book of Harbour and Docks Engineering by S. C. Rangwala.
2. Airport Planning and Design by S. K. Khanna, M. G. Arora

Reference books

1. Transportation Engineering by V.N Vazirani and S. P. Chandola. .
2. Airport Engineering by S.C. Saxena
3. Planning and design of airports by Horonjeff , Robert and McKelvey

BCE-61 MATRIX METHOD OF ANALYSIS

Course category	:	Programme Elective-2 (PE2)
Pre-requisite Subjects	:	Structural Mechanics-I (BCE-14) Structural Mechanics-II (BCE-17)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To understand the basic concepts of structural analysis and matrix algebra.
2. To understand the matrix methods can be applied to plane and space trusses; beams and grids; plane and space frames.
3. To identify a suitable system of releases (flexibility method) or an appropriate set of degrees of freedom (stiffness method).
4. To formulate and solve the equilibrium equations (stiffness method) or boundary conditions (flexibility method).
5. Ability to use modern structural analysis software

Topics Covered

UNIT-I 9

Introduction to Flexibility and stiffness method. Hand computation of problems on beam.

UNIT-II 9

Hand computation of problems on trusses, frames and grids

UNIT-III 9

Generalized computer oriented treatment of stiffness method, Method of assembling the stiffness matrix, substructure technique for solving very large structures.

UNIT-IV 9

Analysis for imposed deformation, temperature, support settlement, etc.

Transfer matrix method of analyzing framed structure

Textbooks

1. H.C. Matrix, Introduction to Matrix Methods, of structural Analysis, McGraw Hill, New York.

Reference books

1. Weaver & Gere, Matrix Analysis of Framed structures.

BCE-62 OPEN CHANNEL FLOW

Course category	:	Programme Elective-2
Pre-requisite Subjects	:	Fluid Mechanics (BCE-15) Hydraulic & Hydraulic Machines (BCE-16)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To explain the terms of the open channel flow equations and explain the interaction among the terms.
2. To develop the open channel flow equations from the basic conservation equations.
3. To solve open channel flow problems through the selection and use of appropriate equations.
4. To explain the physical mechanisms and mathematical relationships for hydraulic jumps, surges, and critical, uniform, and gradually-varying flows as well as spatially varied flow.
5. Analysis and design of open channel controls, upstream and downstream controls, & spatially varied flow.
6. Analysis and design of open channel transition, functions, and energy dissipaters

Topics Covered

UNIT-I 9

Introduction: Basic concepts of free surface flows, velocity and pressure distribution, Mass, energy and momentum principle for prismatic and non-prismatic channels, Review of Uniform flow: Standard equations, hydraulically efficient channel sections, compound sections.

Energy-depth relations: Concept of specific energy, specific force, critical flow, critical depth, hydraulic exponents, and channel transitions.

UNIT-II 9

Gradually Varied Flow (GVF):Equation of gradually varied flow and its limitations, flow classification and surface profiles, Control sections, Computation methods and analysis, Integration of varied flow equation by analytical, graphical and advanced numerical methods, Transitions of subcritical and supercritical flow, flow in curved channels.

UNIT-III 9

Rapidly Varied Flow (RVF): Characteristics of rapidly varied flow, Classical hydraulic jump, Evaluation of the jump elements in rectangular and non-rectangular channels on horizontal and sloping beds, Hydraulic jump in gradually and suddenly expanding channels, submerged hydraulic jump, rolling and sky jump, use of jump as an energy dissipater.

Flow measurement: by sharp crested and broad crested weirs, critical depth flumes, sluice gate, Free-overfall. Rapidly varied unsteady flow: Equation of motion for unsteady flow, "Celerity" of the gravity wave, deep and shallow water waves, open channel-positive and negative surge.

UNIT-IV 9

Spatially Varied Flow (SVF): Basic principles, Differential SVF equations for increasing and decreasing discharge, Classifications and solutions, Numerical methods for profile computation, Flow over side-weir and bottom-rack.

Textbooks

1. Chow, V.T., Open channel Hydraulics, McGraw Hill International.

Reference books

1. Henderson, F.M., Open Channel Flow, McGraw Hill International.
2. Subramanya, K., Flow in Open Channels, Tata McGraw Hill.
3. Ranga Raju, K.G., Flow through open channels, T.M.H.
4. M. Hanif Chaudhry, Open Channel Flow, PHI.
5. French, R.H., Open channel Hydraulics, McGraw Hill International.

BCE-63 ADVANCED FOUNDATION ENGINEERING

Course category	:	Programme Elective-3 (PE3)
Pre-requisite Subjects	:	Geotechnical Engineering-I (BCE-27) Geotechnical Engineering-II (BCE-31)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand foundation design in relation to ground movement
2. Design shallow foundations, piled foundations, well foundation constructions, machine foundation and soil stability.
3. Evaluate deformations in the soil due to foundation works

Topics Covered

UNIT-I 9

Bearing capacity and settlement analysis of shallow foundation, Terzaghi, Meyerhof & Hansen methods, Floating foundation, allowable, total & differential settlement, soil pressure under un-symmetric foundation. Recent Advances.

UNIT-II 9

Settlement & safe load Carrying capacity of pile foundations, laterally loaded and battered piles, group action of piles, pile cum raft foundation; Foundations on expansive soils.

UNIT-III 9

Drilled piers and caissons, Elements of well foundations, shapes, depth of scour, well sinking, tilts, shift and their prevention, Sheet Piles, Bulkhead

UNIT-IV 9

Drilled Shaft: Construction Procedure, load carrying capacity, Types of coffer dams, Design of cellular coffer dams.

Textbooks

1. K.R. Arora – Soil Mechanics & Foundation Engineering
2. Alam Singh – Modern Geotechnical Engineering
3. Gopal Ranjan and A.S.R. Rao – Basic and Applied Soil Mechanics

Reference books

1. J.E. Bowles – Analysis & Design of Foundation (Fourth Edition)
2. V.N.S. Murthy – Soil Mechanics and Foundation Engineering (Fifth Edition)
3. C. Venkataramaiah – Geotechnical Engineering
4. Brij Mohan Das – Geotechnical Engineering

BCE-64 RIVER ENGINEERING

Course category	:	Programme Elective-3 (PE3)
Pre-requisite Subject	:	Open Channel Flow (BCE-62)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. An ability to apply knowledge of mathematics, science, and engineering.
2. An ability to design a system, component, or process to meet desired needs with realistic constrains.
3. An ability to identify, formulate and solve engineering problems.
4. An ability to articulate professional ideas clearly and precisely, prepare written materials, and make oral and written presentations.
5. An ability to design the river training structures as per area specific requirements

Topics Covered

UNIT-I 9

Elements of River Geomorphology: Introduction, origin and properties of sediments classification of Rivers, Mechanics of alluvial rivers including channel and flood plain features, Sediment transport and budgets, River morphology and various classification schemes.

Hydraulics of Alluvial Streams: Introduction, Incipient motion, modes of sediments transport, River Channel patterns, Straight river channels, causes, characteristics and shapes of meanders and control, cut-off, Braided Rivers, Bed forms, Instability of rivers, Hydraulic geometry, resistance to flow in alluvial rivers, Delta formation and control.

UNIT-II 9

River Geometry and Plan Forms: Rivers and restoration structures, Socio-cultural influences and

ethics of stream restoration. Stable channels and their geometry, flow around river.

Gravel Bed Rivers: Hydraulic geometry of gravel bed rivers, armouring, bed forms and geometry, and resistance to flow in gravel bed rivers.

UNIT-III 9

Bed level variations in streams: Degradation, local scour, aggradations, reservoir sedimentation, mathematical modeling for river bed variations.

Rivers and Environments: Environmental effects of hydraulic structures, river pollution and river action plans.

UNIT-IV 9

River Training and Protection Works: Introduction, Classification of River Training, Types of training works, Protection for Bridges with reduced waterway, Design of Guide Bund, Embankment and spurs/dampners and other river/flood protection works.

Textbooks

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 Mechanics, Cambridge University Press, By P.Y. Julien

Reference books

1. Mechanics of sediment Transportation and Alluvial Stream Problems, Wiley Eastern Ltd., R.J. Garde and K.G. Ranga Raju.
2. Fluvial Processes in River Engineering, Wiley Interscience, By H.H. Chang.

BCE-65 ADVANCE CONCRETE DESIGN

Course category	:	Programme Elective-3 (PE3)
Pre-requisite Subjects	:	Design of Concrete Structures (BCE-29)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Introduction to the various member components of Flat slab floor system.
2. Analyse and design a Flat slab floor system for serviceability and limit state loads.
3. Analyse and design retaining walls, counter fort retaining walls and culverts.
4. To undertake design problems on design of water tanks.
5. Explain the effects of prestress on the behavior of concrete beams and slabs and identify situations when prestress is needed.

6. To determine the combined stresses induced by prestress and applied loads using basic concepts of analysis, equivalent load method and load balancing approach.
7. To define and determine the different types of losses of pre-stressed concrete.

Topics Covered

UNIT-I 9

Nature of Stresses in flat slabs with and without drops, coefficient for design of flat slabs, reinforcement in flat slabs. (IS Code Method).

Analysis and design of beam curved in plan. Structural behaviour of footings, design of footing for a wall and a single column, combined rectangular and trapezoidal footings, Design of strap footing.

UNIT-II 9

Structural behaviour of retaining wall, stability of retaining wall against overturning and sliding, Design of T-shaped retaining wall, Concept of Counter fort retaining wall. Loads, forces and I.R.C. bridge loadings, Design of R.C. slab culvert.

UNIT-III 9

Design criteria, material specifications and permissible stresses for tanks, design concept of circular and rectangular tanks situated on the ground / underground, design of overhead tanks.

UNIT-IV 9

Advantages of prestressing, methods of prestressing, losses in prestress, analysis of simple prestressed rectangular and T-section.

Textbooks

1. IS : 456 – 2000.
2. Reinforced Concrete – Limit State Design by A. K. Jain, Nem Chand & Bros., Roorkee.

Reference books

1. Plain and Reinforced Concrete Vol. I & II by O. P. Jain & Jai Krishna, Nem Chand & Bros.
2. Reinforced Concrete Structures by R. Park and Pauley.
3. Reinforced Concrete Design by P. Dayaratnam.

BCE-66 WATER RESOURCE SYSTEMS

Course category	:	Programme Elective-3 (PE3)
Pre-requisite Subject	:	Water Resources Engineering (BCE-41)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To develop system approach about water resources system development
2. Having a knowledge about application of system engineering in reservoir operation and optimal crop water allocation
3. Having an attitude of solving problems related with water resources

Topics Covered

UNIT-I 9

Concept of system and system analysis: Definition and types of system, System Approach and analysis, Basic Problems in System Analysis. Planning and management. Concept of a system, Advantages and limitations of system approach.

System Technique in Water resources: Optimization using calculus, Linear Programming, Dynamic programming and Simulation, Combination of Simulation and Optimization. Modeling of water Resources Systems.

UNIT-II 9

Economical Considerations in Water Resources Systems: Basics of Engineering economics, Economic analysis, Conditions of project optimality, Benefit-cost Analysis.

UNIT-III 9

Multi-objective Planning: Non-inferior solutions, Plan Formulation and Plan selection.

UNIT-IV 9

Applications of Linear Programming: Irrigation water allocation for single and multiple crops, Multi-reservoir system for irrigation Planning Reservoir operation for Irrigation and Hydro-power Optimization

Applications of Dynamic Programming: Optimal crop water allocation, Steady State, Reservoir Operation policy for Irrigation.

Textbooks

1. Ossenbruggen, P.J.- System Analysis for Civil Engineering, John Wiley, New York.
2. Taha, H.- Operational Research- An Introduction, Vth Edn, Prentice Hall.
3. Loucks, D. P., Stedenger, and Haith, D.A.- Water Resources system Planning & Analysis, Prentice Hall.

Reference books

1. Jain, S. K. and Singh, V.P.- Water Resources systems Planning & Management, Elesvier, Amsterdam.
2. Rao, S.S. "Engineering optimization, theory and Practice" New Age International, New Delhi.
3. Chaturvedi, M.C., "Water Resources System Planning and Management", Tata McGraw-Hill India.

BCE-67 PRINCIPLES OF GEOGRAPHIC INFORMATION SYSTEM

Course category : Programme Elective-3 (PE3)
Pre-requisite Subject : NIL
Contact hours/week : Lecture : 3, Tutorial : 1 , Practical: 0

Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. develop a knowledge and understanding of spectral classification of images for feature extraction
2. Define what GIS is and know different types of spatial and non spatial data
3. Know what are the questions that GIS can answer
4. Differentiate between Raster and Vector Models
5. Create maps and overlay features/raster data for basic analyses
6. Understand the applications of GIS in the fields of environmental, geotechnical, transportation and water resources engineering

Topics Covered

UNIT-I 9

Definition of GIS, Cartography and GIS, GIS database: spatial and attribute data; Spatial models: Semantics, spatial information, temporal information, conceptual models of spatial information, representation of geographic information: point, line and area features, topology.

UNIT-II 9

Raster and vector data, raster to vector data conversion, map projection, analytical transformation, rubber sheet transformation, manual digitizing and semi-automatic line following digitizer; Remote sensing data as an input to GIS data.

UNIT-III 9

GIS database Concepts and management systems, Types of Database management Systems, hierarchical, network, relational models,

GIS functionality; data storage and data retrieval through query, generalization, classification, containment search within a spatial region.

UNIT-IV 9

Overlay: arithmetical, logical and conditional overlay, buffers, inter visibility, aggregation; Network analysis;

Applications of GIS in planning and management of utility lines and in the field of environmental engineering, geotechnical engineering, transportation engineering and water resources engineering.

Textbooks

1 Stan Arnoff Geographic Information Systems: A Management Perspective, WDL Publications.

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Reference books

1. Robert Laurini and Derek Thompson Fundamentals of Spatial Information Systems, Academic

Press.
2. Tor Bernhardsen Geographic Information Systems: An Introduction, Wiley
3. Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, Oxford Publication
4. Michael N. DeMers, Fundamentals of Geographic Information Systems, Wiley
5. C.P. Lo and Albert K. W. Yeung, Concepts and Techniques of Geographical Information Systems, Prentice- Hall India
6. Reddy, M. Anji, Remote sensing and Geographic Information System BS Publications Hyderabad
7. B. Bhatta, Remote Sensing and GIS, Oxford University Press

BCE-68 EARTH AND EARTH RETAINING STRUCTURES

Course category	:	Programme Elective-3
Pre-requisite Subjects	:	Geotechnical Engineering-I (BCE-27) Geotechnical Engineering-II (BCE-31)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To design the Earth retaining walls
2. To study the various types of ground improvement techniques
3. To analyse the bearing capacity of soil

Topics Covered

UNIT-I 9

Mechanically Stabilized Earth retaining walls: General considerations, backfill and reinforced materials, construction details, design method, stability.

UNIT-II 9

Soil nailing: applications, advantages, limitations, methods of soil nailing, case histories, analysis and design.

UNIT-III 9

Reinforced Soil: Introduction, basic components, strength characteristics, soil-reinforcement interface friction, Reinforced Earth wall: Stability analysis, construction procedure, drainage, design procedure

UNIT-IV 9

Foundation on Reinforced Soil Bed: Pressure ratio, analysis of strip, isolated, square and rectangular footing on reinforced soil bed, Ultimate bearing capacity of footing on reinforced earth slab. Fiber reinforced soil.

Textbooks

1. V N S Murthy – Soil Mechanics and Foundation Engineering
2. Swami Saran – Reinforced Soil and its Engineering Application

Reference books

1. J. E. Bowles – Analysis and Design of Foundation

BCE-69 AIR AND NOOISE POLLUTION CONTROL

Course category	:	Programme Elective-3 (PE3)
Pre-requisites	:	Environmental Engineering-I (BCE-26) Environmental Engineering-II (BCE-32)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Identify the types and modes of air pollution in different areas.
2. Discuss upon the air quality standards and measurement of pollutants pertaining to air quality as AQI.
3. Recommend the control devices for Particulate and Gaseous emissions.
4. Discuss the concepts used in air quality modelling.
5. Explain the impacts of noise on others and explain the mathematical ways to quantify same.

Topics Covered

UNIT-I 9

Introduction, Classification, Sources, Effects, Air Quality Standards, Air Quality Index, Role of Meteorology and Natural Purification Processes.

UNIT-II 9

Sampling, Measurement and Analysis, Control Devices for Particulate and Gaseous contaminants.

UNIT-III 9

Urban Air Pollution, Industrial and Vehicular Pollution, Indoor Air Pollution, Introduction to air quality modeling

UNIT-IV 9

Physics of Sound, Noise-sources and standards, Impacts of noise, measurement and Control of Noise Pollution.

Textbooks

1. Peavy, H.S., Rowe, D.R., Tchobanoglous, G. Environmental Engineering, McGraw Hills, New York 1985.
2. Patrick D. Cunniff: Environmental Noise Pollution

Reference books

1. Air Pollution Control Engineering-Noel de Nevers
2. Meteorology for Scientists and Engineers- Roland & Stull
3. R. K. Trivedi and P. K. Goel: An Introduction to Air Pollution.
4. Pandey and Carney: Environmental Engineering
5. S.P. Singal: Noise pollution and Control Strategy

BCE-70 GROUND IMPROVEMENT TECHNIQUES

Course category	:	Programme Elective-4 (PE4)
Pre-requisite Subjects	:	Geotechnical Engineering-I (BCE-27) Geotechnical Engineering-II (BCE-31)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To analyse the quality of soil
2. To identify the appropriate method for ground improvement
3. To study the various insitu densification methods in granular soil and cohesive soil
4. To study the method of dewatering and pre-loading
5. To learn the advanced methods of ground improvement techniques

Topics Covered

UNIT-I 9

Introduction, Review of compaction theory, effect of compaction on surface behaviour, Field methods of compaction, Quality Control, Design of soil-lime, soil-cement, soil-bitumen and soil-lime-fly-ash mixes.

UNIT-II 9

In-situ densification methods in granular soils, Deep compaction: Introduction, Terra-Probe, Vibroflotation techniques, Ground Suitability for Vibroflotation, Advantages, Mueller Resonance Compaction, Dynamic Compaction, Depth of Improvement

UNIT-III 9

In-situ densification methods in cohesive soil: Introduction, Pre-loading and de-watering, Vertical drains, Electrical method, Thermal method

UNIT-IV 9

Grouting: introduction, suspension grout, solution grout, grouting equipments and methods, Grouting design and layout Granular Piles: Ultimate bearing capacity and settlement, method of construction, load test. Underpining of foundations: importance and situations for underpinning, methodology, typical examples

Textbooks

1. Purshotham Raj – Ground Improvement.

Reference books

1. S. K. Garg – Soil Mechanics & Foundation Engineering.
2. A. K. Samadhiya – Ground Improvement Techniques
3. Gopal Ranjan and A. S. R. Rao – Basic and Applied Soil Mechanics
4. J. N. Mandal – Geosynthetics World
5. Bergado et. al. – Soft Ground Improvement
6. Koerner, R. M. - Designing with geosynthetics

BCE-71 TRANSPORTATION SYSTEM AND PLANNING

Course category	:	Programme Elective-4 (PE4)
Pre-requisite Subjects	:	Transportation Engineering-I (BCE-28) Transportation Engineering-II (BCE-34)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the different types of public transportation systems.
2. Apply the principles of transportation planning process and demand estimation.
3. Analyze the trip production and trip attraction models.
4. Understand the various methods of economic evaluation for transportation projects.
5. Demonstrate the fundamentals of Intelligent Transportation Systems.

Topics Covered

UNIT-I 9

Introduction: Overview of transportation system, nature of traffic problems in cities, Present Scenario of road transport and transport assets. Role of transportation: Social, Political, Environmental, Goals and objectives of transportation planning.

UNIT-II 9

Type of transportation system: Intermediate Public Transport (IPT), Public Transport, Rapid and mass transport system. Traffic Flow and traffic stream variables.

UNIT-III 9

Travel demand: Estimation and fore casting, trip classification, trip generation: factors and methods, multiple regression analysis. Trip distribution methods, modal split, trip assignment

UNIT-IV 9

Evaluation of transport planning proposals: Land Use Transport Planning, Economic Evaluation methods, net-present-Value methods, Benefit Cost method, Internal rate of return method.

Transportation Facilities: Pedestrian facilities, Bicycle facilities, parking and terminal facilities. Transport system management. Long term and short term planning, use of Intelligent Transport in transportation

Textbooks

1 Introduction to Transportation Engineering: William W. Hay.

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Reference books

1. Introduction to Transportation Engineering planning – E.K. Mortak.
2. Metropolitan transportation planning – J.W. Dicke

BCE-72 INDUSTRIAL POLLUTION CONTROL AND ENVIRONMENTAL AUDIT

Course category	:	Programme Elective-4 (PE4)
Pre-requisite Subjects	:	Environmental Engineering-I (BCE-26) Environmental Engineering-II (BCE-32)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Discuss about various types of waste and their origin from different industries.
2. Explain the various control and abatement techniques for control of pollution.
3. Illustrate the various types of pollutants released by different industries.

4. Categorize various control and abatement techniques for handling industrial waste.
5. Defend the concept of zero discharge effluent from industries.
6. Identify the types of industries as sources of harmful gaseous emissions.
7. Recommend the control and abatement technology for harmful emissions from industries.
8. Discuss about the solid waste generation from industries.
9. Figure out the life cycle analysis for any by-product of specific industry.
10. Differentiate between environmental audit and accounts credit.

Topics Covered

UNIT-I 9

Industrial wastes & their sources: various industrial processes, sources and types of wastes: solid, liquid, gaseous, noise & radiation emissions. Sources for industrial water usages and various industrial processes requiring water use and water quality.

UNIT-II 9

Processes responsible for deterioration in water quality, Various waste water streams, Control and removal of specific pollutants in industrial wastewaters, e.g., oil and grease, bio-degradable organics, chemicals such as cyanide, fluoride, toxic organics, heavy metals, radioactivity etc. Wastewater re-uses & recycling, concept of zero discharge effluent.

UNIT-III 9

Control of gaseous emissions: hood and ducts, tall stacks, particulate and gaseous pollutant control; Solid waste generation and disposal management; Hazardous wastes: definitions, concepts and management aspects; Noise & radiation: generation, control and management. Recent trends in industrial waste management, clean technologies

UNIT-IV 9

Environmental audit: definitions and concepts, environmental audit versus accounts audit, compliance audit, relevant methodologies, various pollution regulations, Introduction to ISO and ISO 14000

Textbooks

1. Patrick D. Cunniff: Environmental Noise Pollution
2. Industrial Wastewater management handbook, Azad, Hardon Singh, Editor-in-Chief, McGraw Hill, New York

Reference books

1. Air Pollution Control Engineering-Noel de Nevers
2. Meteorology for Scientists and Engineers- Roland & Stull
3. R. K. Trivedi and P. K. Goel: An Introduction to Air Pollution.
4. Pandey and Carney: Environmental Engineering
5. S.P. Singal: Noise pollution and Control Strategy

BCE-73 STRUCTURAL DYNAMICS

Course category	:	Programme Elective-4 (PE4)
Pre-requisite Subjects	:	Structural Engineering-I (BCE-14) Structural Engineering-II (BCE-17)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Relate the structural idealization to properties of real structure.
2. Able to establish dynamic equilibrium.
3. Able to solve the Eigen value problem and knowledge to its properties.
4. To calculate response from different types of loading.

Topics Covered

UNIT-I 9

Structures modeled as single degree freedom System: Undamped Single Degree Freedom system, Damped Single Degree Freedom System, Response of one degree freedom system to dynamic loading, Response to general dynamic loading, Fourier analysis and Response in frequency domain, Generalized coordinates and Raleigh's Method, Nonlinear Structural Response, Response spectra

UNIT-II 9

Structures modeled as shear buildings: The multi Storey Shear Building, Free vibration of shear building; Forced Vibration of Shear Buildings, Damped Motion of Shear Building, Reduction of Dynamic Matrices

UNIT-III 9

Framed Structures modeled as discrete multi-degree-freedom system: Dynamic Analysis of beams, Dynamic Analysis of plane frames; Dynamic Analysis of grids; Three Dimensional frames, Dynamic Analysis of Trusses, Non-Linear Response of Multi Degree freedom systems

UNIT-IV 9

Structures Modeled with Distributed Properties: Dynamic analysis of structures with distributed properties, Discretization of continuous systems, random variables.

Textbooks

1. Structural Dynamics - Mario Paz CBS Publishers & Distributors.
2. Dynamics of Structures, 2nd Edition R.W. Clough and Penzien Mc Graw Hill

Reference books

1. Dynamics of Structures - J.L. Humar PHI
2. The Dynamic Behavior of Structures, 2nd Edition - Warburton G.B. Pergamon Press

BCE-74 ADVANCED HYDRAULIC STRUCTURES

Course category	:	Programme Elective-4 (PE4)
Pre-requisite Subject	:	Water Resources Engineering (BCE-41)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To design the embankment dam and gravity dam
2. To design the spillway and spillway gates
3. To demonstrate the different types of channel transition and its design aspect
4. To develop a skill of design of hydraulic structures

Topics Covered

UNIT-I 9

Introduction: Hydraulic structure for water resources projects.

Embankment Dams: Types, Design considerations, seepage analysis and control, stability analysis, construction techniques.

UNIT-II 9

Gravity dams: Forces acting on failure of a gravity dam, stress analysis, elementary profile, design of gravity dam, other functional features of a gravity dam.

UNIT-III 9

Spillways: Types and their design, spillway gates, cavitation, aerators and energy dissipation (terminal structures).

UNIT-IV 9

Channel Transitions: Design principles for subcritical and supercritical flows (Channel transitions).Hydropower plant: Term relating to hydropower, basic design aspects of different unit of hydropower plant.

Textbooks

1. Irrigation Engg. and Hydraulic Structures - S.K. Garg, Khanna Publishers.
2. Irrigation and water Power engineering - B.C. Punmia, Laxmi Publications.
3. Engineering Hydrology - K. Subramanya, TMH.
4. Irrigation Water Power and Water Resource Engg. - K.R. Arora

Reference books

1. Water Resources Engg. - Larry W. Mays, John Wiley India.
2. Water resources Engg. - Wurbs and James, John Wiley India.
3. Water Resources Engg. - R. K. Linsley, McGraw Hill.
4. Irrigation and water Resources Engg. - G L Asawa, New age International Publishers.
5. Irrigation Theory and practices - A.M. Michel.

BCE-75 ENVIRONMENTAL QUALITY MANAGEMENT

Course category	:	Programme Elective-4
Pre-requisite Subjects	:	Environmental Engineering-I (BCE-26) Environmental Engineering-II (BCE-32)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Discuss the importance of Environmental Impact Assessment and Environmental Audit for different projects and programmes
2. Identify the role of environmental management to achieve sustainable development in present scenario
3. Figure out the rules and regulations to be followed for getting environmental clearance for industries and projects
4. Differentiate among various routes of entry of toxic substances into animals, plants and human
5. Illustrate the various environmental laws framed for environmental protection and handling of various types of wastes and its disposal.

Topics Covered

UNIT-I 9

Introduction, Overview of Environmental Scenario. Global and Regional Perspectives. Environmental Impact Assessment, Environmental Audit

UNIT-II 9

Environment management – principle of sustainable development; Environment management plan (EMP), Rules and Regulation for getting Environmental Clearance for industries and various other projects.

UNIT-III 9

Concept of Environmental Health Hazard and Risk Assessment, Toxic substances in the

environment, their sources and entry roots, Bio-transformation and bio-magnification.

UNIT-IV 9

Environmental laws in India: Water Act 1974, Air Act 1981, Environment (Protection) Act 1986, Municipal Solid Wastes and Hazardous waste handling Rules, Biomedical and E-Waste handling methods and rules. Stockholm Conference and Rio Conference. Global warming and climate change, Ozone depletion, Acid rain

Textbooks

1. Environmental management: G. N. Pandey, Vikash Publishing House
2. Environmental Law and Policy in India: S. Divan & A. Rosencranz; Oxford University Press
3. Environmental Management – Physio-ecological facets (Vol. I & II): Rai, Mohapatra & Goel Rawat Publications
4. Environmental Management in India Vol. I & II): R. K. Sapru; Ashish Publishing House

Reference books

1. Canter R.L., Environmental Impact Assessment, McGraw Hill International Edition, 1997.
2. John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company

Reference Sites

1. http://www.cpcb.nic.in/Industry_Specific_Standards.php
2. http://envfor.nic.in/division/guidelinesnotifications