EVALUATION SCHEME
&
SYLLABI

FOR

BACHELOR OF TECHNOLOGY
in
CIVIL ENGINEERING

(Effective from the Session 2021-2022)

Offered by

Department of Civil Engineering
G. B. Pant Institute of Engineering and Technology
Ghurdauri, Pauri Garhwal, U.K. 246194

EVALUATION SCHEME
B.TECH. (Civil Engineering)
I- Year (I-SEMESTER)
(Effective from session: 2021-2022)

S. No.	Course Code	SUBJECT	PERIODS			EVALUATION SCHEME					
						Sessional Exam			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1	TCS-111	Programming for Problem Solving	3	1	0	30	20	50	100	150	3
2	TME-111	Basic Mechanical Engineering	3	1	0	30	20	50	100	150	3
3	TAH-111	Engineering Chemistry	3	1	0	30	20	50	100	150	3
4	TAH-112	Engineering Mathematics I	3	1	0	30	20	50	100	150	3
5	TAH-115	Professional Communication	2	0	0	30	20	50	100	150	2
PRACTICALS											
6	PCS-111	Programming for Problem Solving Lab	0	0	2	10	15	25	25	50	1
7	PME-111	Basic Mechanical Engineering Lab	0	0	2	10	15	25	25	50	1
8	PAH-111	Engineering Chemistry Lab	0	0	2	10	15	25	25	50	1
9	PME-112	Workshop Practice	1	0	2	10	15	25	25	50	2
10	PAH-115	Language Lab	0	0	2	10	15	25	25	50	1
11	GPP-111	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**4**	**10**	**200**	**225**	**425**	**625**	**1050**	**20**

EVALUATION SCHEME
B.TECH. (Civil Engineering)
I- Year (II-SEMESTER)
(Effective from session: 2021-2022)

S. No.	Course Code	SUBJECT	PERIODS			EVALUATION SCHEME					
						Sessional Exam			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1	TEC-121	Basic Electronic Engineering	3	1	0	30	20	50	100	150	3
2	TEE-121	Basic Electrical Engineering	3	1	0	30	20	50	100	150	3
3	TCE-121	Environmental Science	2	0	0	30	20	50	100	150	2
4	TAH-122	Engineering Mathematics II	3	1	0	30	20	50	100	150	3
5	TAH-124	Engineering Physics	3	1	0	30	20	50	100	150	3
PRACTICALS											
6	PEC-121	Basic Electronic Engineering Lab	0	0	2	10	15	25	25	50	1
7	PEE-121	Basic Electrical Engineering Lab	0	0	2	10	15	25	25	50	1
8	PCE-121	Engineering Graphics	1	0	2	10	15	25	25	50	3
9	PAH-124	Engineering Physics Lab	0	0	2	10	15	25	25	50	1
10	GPP-121	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**4**	**8**	**190**	**210**	**400**	**600**	**1000**	**20**

EVALUATION SCHEME
B.TECH. (Civil Engineering)
Second- Year (III-SEMESTER)
(Effective from session: 2022-2023)

S. No.	Course Code	SUBJECT	PERIODS			EVALUATION SCHEME					
						Sessional Exam			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1	TCE-231	Building Materials	3	1	0	30	20	50	100	150	3
2	TCE-232	Engineering Mechanics	3	1	0	30	20	50	100	150	3
3	TCE-233	Fluid Mechanics	3	1	0	30	20	50	100	150	3
4	TCE-234	Surveying	3	1	0	30	20	50	100	150	3
5	TAH-232	Engineering Mathematics III	3	1	0	30	20	50	100	150	3
PRACTICALS											
6	PCE-231	Building Materials Lab	0	0	2	10	15	25	25	50	1
7	PCE-233	Fluid Mechanics Lab	0	0	2	10	15	25	25	50	1
8	PCE-234	Surveying Lab	0	0	2	10	15	25	25	50	1
9	PCE-235	Introduction to Programming for Civil Engineers I	0	0	2	10	15	25	25	50	2
10	GPP-231	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**5**	**8**	**190**	**210**	**400**	**600**	**1000**	**20**

EVALUATION SCHEME
B.TECH. (Civil Engineering)
Second- Year (IV-SEMESTER)
(Effective from session: 2022-2023)

S. No.	Course Code	SUBJECT	PERIODS			EVALUATION SCHEME					
						Sessional Exam			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1	TCE-241	Concrete Technology	3	1	0	30	20	50	100	150	3
2	TCE-242	Environmental Engineering I	3	1	0	30	20	50	100	150	3
3	TCE-243	Geomatics Engineering	3	1	0	30	20	50	100	150	3
4	TCE-244	Hydraulic Engineering	3	1	0	30	20	50	100	150	3
5	TCE-245	Solid Mechanics	3	1	0	30	20	50	100	150	3
PRACTICALS											
6	PCE-241	Concrete Technology Lab	0	0	2	10	15	25	25	50	1
7	PCE-242	Environmental Engineering Lab I	0	0	2	10	15	25	25	50	1
8	PCE-244	Hydraulic Engineering Lab	0	0	2	10	15	25	25	50	1
9	PCE-246	Introduction to Programming for Civil Engineers II	0	0	2	10	15	25	25	50	2
10	GPP-241	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**5**	**8**	**190**	**210**	**400**	**600**	**1000**	**20**

EVALUATION SCHEME
B.TECH. (Civil Engineering)
Third- Year (V-SEMESTER)
(Effective from session: 2023-2024)

S. No.	Course Code	SUBJECT	PERIODS			EVALUATION SCHEME					
						Sessional Exam			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1	TCE-351	Environmental Engineering II	3	1	0	30	20	50	100	150	3
2	TCE-352	Geotechnical Engineering I	3	1	0	30	20	50	100	150	3
3	TCE-353	Hydrology	3	1	0	30	20	50	100	150	3
4	TCE-354	Structural Analysis I	3	1	0	30	20	50	100	150	3
5	TAH-351	Principle of Management	2	1	0	30	20	50	100	150	3
PRACTICALS											
6	PCE-351	Environmental Engineering Lab II	0	0	2	10	15	25	25	50	1
7	PCE-352	Geotechnical Engineering Lab I	0	0	2	10	15	25	25	50	1
8	PCE-354	Structural Analysis Lab	0	0	2	10	15	25	25	50	1
9	PCE-355	Industrial Interaction	0	0	2	0	50	50	0	50	2
10	GPP-351	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**14**	**5**	**8**	**180**	**245**	**425**	**575**	**1000**	**20**

EVALUATION SCHEME
B.TECH. (Civil Engineering)
Third- Year (VI-SEMESTER)
(Effective from session: 2023-2024)

S. No.	Course Code	SUBJECT	PERIODS			EVALUATION SCHEME					
						Sessional Exam			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1	TCE-361	Design of Concrete Structures	3	1	0	30	20	50	100	150	3
2	TCE-362	Geotechnical Engineering II	3	1	0	30	20	50	100	150	3
3	TCE-363	Structural Analysis II	3	1	0	30	20	50	100	150	3
4	TCE-364	Transportation Engineering I	3	1	0	30	20	50	100	150	3
5	TCE-365	Water Resources Engineering	3	1	0	30	20	50	100	150	3
PRACTICALS											
6	PCE-362	Geotechnical Engineering Lab II	0	0	2	10	15	25	25	50	1
7	PCE-364	Transportation Engineering Lab	0	0	2	10	15	25	25	50	1
8	PCE-366	Implementation of Civil Engineering Software	0	0	2	10	15	25	25	50	1
9	PCE-367	Seminar	0	0	2	0	50	50	0	50	2
10	GPP-361	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**5**	**8**	**180**	**245**	**425**	**575**	**1000**	**20**

EVALUATION SCHEME
B.TECH. (Civil Engineering)
Fourth- Year (VII-SEMESTER)
(Effective from session: 2024-2025)

S. No.	Course Code	SUBJECT	PERIODS			EVALUATION SCHEME					
						Sessional Exam			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1	TCE-471	Design of Steel Structure	3	1	0	30	20	50	100	150	3
2	TCE-472	Transportation Engineering II	3	1	0	30	20	50	100	150	3
3	ECE-41X	Program Elective I	3	1	0	30	20	50	100	150	3
4	ECE-42X	Program Elective II	3	1	0	30	20	50	100	150	3
5	TOE-XY	Open Elective I	3	1	0	30	20	50	100	150	3
PRACTICALS											
6	PCE-471	Structural Detailing Lab using CAD	0	0	2	10	15	25	25	50	1
7	PCE-473	Industrial Interaction	0	0	2	0	50	50	0	50	2
8	PCE-474	Minor Project	0	0	6	0	50	50	50	100	2
9	GPP-471	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**5**	**10**	**160**	**265**	**425**	**575**	**1000**	**20**

Program Elective I

ECE-411 Advanced Fluid and Hydraulic Engineering
ECE-412 Advanced Highway Engineering
ECE-413 Data science for Geoinformatics
ECE-414 Design of Water and Wastewater Systems
ECE-415 Ground Improvement Techniques
ECE-416 Repair and Rehabilitation of Structures

Program Elective II

ECE-421 Advanced Remote Sensing and GIS
ECE-422 Air and Noise Pollution
ECE-423 Earthquake Resistant Design of Structure and Seismology
ECE-424 Environmental Geotechnology
ECE-425 Intelligent Transportation Systems
ECE-426 Water Resources Systems: Planning and Management

EVALUATION SCHEME
B.TECH. (Civil Engineering)
Fourth- Year (VIII-SEMESTER)
(Effective from session: 2024-2025)

S. No.	Course Code	SUBJECT	PERIODS			EVALUATION SCHEME					
						Sessional Exam			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1	TCE-481	Construction Engineering and Management	3	1	0	30	20	50	100	150	3
2	TAH-483	Engineering Economics	2	1	0	30	20	50	100	150	2
3	ECE-43X	Program Elective III	3	1	0	30	20	50	100	150	3
4	ECE-44X	Program Elective IV	3	1	0	30	20	50	100	150	3
5	TOE-XY	Open Elective II	3	1	0	30	20	50	100	150	3
PRACTICALS											
6	PCE-482	Major Project	0	0	12	0	100	100	100	200	6
7	GPP-481	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**14**	**5**	**12**	**150**	**250**	**400**	**600**	**1000**	**20**

Program Elective III

ECE-431	Bridge Engineering
ECE-432	Eco-Hydro Climatology
ECE-433	Geoinformatics for Water Resources
ECE-434	Highway Construction and Management
ECE-435	Slope Stability Analysis and Stabilization
ECE-436	Solid and Hazardous Waste Management

Program Elective IV

ECE-441	Advanced Concrete Technology
ECE-442	Groundwater Engineering
ECE-443	Industrial Pollution Prevention
ECE-444	Subsurface Investigation and Instrumentation
ECE-445	Theory of GPS and Its Applications
ECE-446	Traffic Management and Road Safety

BACHELOR OF TECHNOLOGY
in
CIVIL ENGINEERING

SYLLABI
of
FIRST YEAR

Department of Civil Engineering
G. B. Pant Institute of Engineering and Technology, Pauri Garhwal, U.K.

SYLLABUS:

Unit 1: Introduction and Natural Resources; Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development. Land resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over exploitation of surface and ground water, floods, conflicts over water (international & inter-state). Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 2: Ecosystems Concept of an ecosystem. Structure and function of ecosystem; Energy flow in an ecosystem: food chains; food webs and ecological succession, Case studies of the following ecosystems: Forest ecosystem**,** Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, systems, lakes, rivers, oceans, estuaries).

Unit 3: **Biodiversity and Conservation:** Levels of biological diversity : genetic species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots; India as a mega-biodiversity nation; Endangered and endemic species of India; Threats to biodiversity : Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity; Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and informational value.

Unit 4: **Environmental Pollution, Policies & Practices:** Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution; Nuclear hazards and human health risks; Solid waste management : Control measures of urban and industrial waste.; Pollution case studies; Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture; Environment Laws: Environment Protection Act; Air(Prevention & Control of Pollution) Act; Water(Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD); Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit 5: **Human Communities and the Environment:** Human population growth: Impacts on environment, human health and welfare; Resettlement and rehabilitation of project affected persons; case studies; Disaster management movements : Floods, earthquake, cyclones and landslides; Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan; Environmental ethics : Role of Indian and other religions and cultures in

environmental conservation; Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

TEXT/REFERENCE BOOKS:

- Environmental Studies by Anubha Kaushik & CP Kaushik, New age International Publisher.
- Environmental studies by Daniel. Wiley.
- Environmental studies by Erach Bharucha, University press.
- Ecology, Environmental Science and Conservation by JS Singh, SP Singh and SR Gupta. S. Chand Pubs Delhi.

COURSE OUTCOMES:

After the end of the course student

1. Will possess an understanding about the different resources and their distribution.
2. Will possess knowledge about ecosystem and its kind.
3. Will have exposure to the different human activities that are adversely affecting the biodiversity and environment.
4. Will be having clear understanding about pollution and the various measures that are set out to curb pollution.

SYLLABUS:

Unit 1: Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, Types of line and dimensions, lettering, Conic sections; Scales – Plain, Diagonal and Vernier Scales;

Unit 2: Principles of Orthographic Projections, Projections of Points and lines; Projections of planes, Auxiliary Planes, Projections of Regular Solids i.e., Prism, Cylinder, Pyramid, Cone, Auxiliary Views.

Unit 3: Principles of Isometric projection, Isometric Scale, Isometric Views, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Unit 4: Introduction of AutoCAD, Drawing Setting- Units, Limits; Basic drawing commands- Ortho, Line, Zoom, Polyline, Circle, Arc, Rectangle, Polygon, Ellipse, Osnap etc.; Editing Drawings- Select, Erase, Move, Copy, Break, Fillet, Trim, Extend, Rotate, Offset, Mirror, Stretch, Chamfer, Array; Intermediate Drawing Commands- Layers, Change, Fill, Hatch, Block, Insert, etc.;

Unit 5: Dimensioning- Associative, Base-line, Linear, Angular, Center Mark, Diameter, Leader, Radius; 3-Dimensioning Drafting- Iso commands, 3D Shapes, Draw cycloidal curves i.e., Cycloid, Epicycloid, and Hypocycloid

LIST OF PRACTICALS:

1. Lettering, Numbering and Dimensioning & line
2. Conic Section
3. Orthographic Projection
4. Section Views and Auxiliary Views
5. Isometric, Pictorial and Oblique Drawing
6. Development of Surfaces
7. Drawing setting and drawing commands
8. Editing commands
9. 3D drawings
10. Drawing cycloidal curves

TEXT/REFERENCE BOOKS:

- Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
- Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
- Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
- Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers (Corresponding set of) CAD Software Theory and User Manuals

COUSRE OUTCOMES:

At the end of the course, students will achieve following outcomes:

1. Students understand basic knowledge of engineering graphics with using letter writing, different type of scales, lines and dimensions.
2. Student will be able to draw orthographic projections of points, lines, planes and solids.
3. Student will be able to understand principle of isometric projection and develop isometric views by different methods.
4. Students will become familiar with Auto CAD 2-D and 3-D drawings and learn various commands used in Auto CAD.
5. Students will be able to use appropriate computer technology and to work as a team.

BACHELOR OF TECHNOLOGY
in
CIVIL ENGINEERING

SYLLABI
of
THIRD SEMESTER

Department of Civil Engineering
G. B. Pant Institute of Engineering and Technology, Pauri Garhwal, U.K.

SYLLABUS:

Unit 1: Principal properties of Building Material, Bricks: Manufacturing, Classification & Testing of Bricks, Defects of Bricks, **Stone** – Classification of rocks, Quarrying, Seasoning, Dressing, Uses, Characteristic of good stone, **Masonry-** Brick closers, Bonds, Brick & stone masonry **Aggregate** – Classification, Characteristic, Testing.

Unit 2: Cement- Chemical Composition of raw material, Bogue Compound, hydration of cement, Rate of hydration, testing of cement, Types of cement, admixtures, **Lime-** Varieties of lime, Slaking, Lime & Cement mortar.

Unit 3: Timber- Requirements of good Timber, Processing of Timber, Seasoning of Timber, Defects & Preservation of Timber; **Pozzolanas-** Activity of Pozzolana, and different types. **Glass-** Manufacturing, Annealing, Properties, Different types of glass.

Unit 4: Ferrous Metals- Iron: different types, Steel, Rolled Steel Sections, Reinforcing Steel Bars, **Non-Ferrous Metals**- Aluminium, **Plastic-** Composition, Classification, and properties.

Unit 5: Construction Principles, Doors, Windows, Roofs, Lintel, Staircase, Damp Proofing, Plastering.

TEXT/REFERENCE BOOKS:

- Duggal, S.K. (2017), "*Building materials",* Routledge.
- Varghese, P.C. (2015), "*Building materials"*, PHI Learning Pvt. Ltd.
- Rangawala S. C. "*Engineering Materials*", Charter Publishing House, Anand, India.

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Understand properties and uses of building stones and clay bricks.
2. Have knowledge of cement, lime and mortar.
3. Will be able to understand Timber processing, uses, properties of pozzolanas and glass
4. Have the knowledge of various steel sections and other non-ferrous building materials.
5. Understand the basic components of building and construction principles involved.

SYLLABUS:

Unit 1: Fundamentals of Engineering Mechanics, System of Forces – Coplanar Collinear and Concurrent Forces, Resultant of Force Systems, Free body diagrams, Moment of Forces and its Application, Moment of Couples and Resultant of Force System.

Unit 2: Equilibrium of System of Forces on a Particle and on a rigid body, Types of friction, limiting friction, Laws of Friction, Angle of repose, Equilibrium of a body lying on a rough inclined plane, Analysis of ladder friction, analysis of wedge friction.

Unit 3: Centre of Gravity and its implications, Centroid of simple figures from first principle, centroid of composite sections, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections, Product of Inertia.

Unit 4: Type of beams and supports, determination of reactions for determinant beams under different type of loadings, Work, Virtual displacements, Virtual Work, Principle of virtual work for particle and ideal system of rigid bodies.

Unit 5: Simple Trusses, zero force members, the method of joints, the method of sections, bending moment (BM) and shear force (SF) diagrams for determinant beams under different type of loadings.

TEXT/REFERENCE BOOKS:

- Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
- F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
- R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
- Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
- Shanes and Rao (2006), Engineering Mechanics, Pearson Education

COURSE OUTCOMES: Upon successful completion of the course, student should be able to:

1. Use scalar and vector analytical techniques for analyzing forces in statically determinate structures, Use the equilibrium equation and friction law
2. Draw Shear force and bending moment diagram of beam subjected to various loading and able to analyses the trusses.
3. Determine the reactions for different determinate beams under different loading conditions

4. Determine centroid and moment of inertia for different shapes.
5. Understand the virtual work principles.

SYLLABUS:

Unit 1: Fluid Statics: Definition of a fluid, Fluid as a continuum, Properties of fluids (mass density, specific weight, compressibility and vapour pressure), Pressure on a fluid element, Pascal's Law, Newton's law of viscosity, Surface Tension, Archimedes principle of buoyancy, Hydrostatic pressure and hydrostatic forces on submerged surfaces, Manometers, Stability of submerged bodies and metacentric height.

Unit 2: Fluid Kinematics: Lagrangian and Eulerian description of fluid flow visualization, Definitions of stream line, streak line and path line. Substantial derivative, Velocity field, local and convective acceleration, Angular velocity and angular acceleration, free and forced vortices, Velocity potential and stream function.

Unit 3: Fluid Dynamics: Different types of fluid flow (Steady and Unsteady, Rotational and Irrotational, Uniform and Non-uniform). System and control volume approaches, Reynold's Transport Theorem (RTT), Conservation of mass (continuity), Conservation of energy, Integration of Euler's Equation to Bernoulli's Equation. Conservation of momentum and development of Navier-Stokes Equation. Applications of conservation principles (mass, momentum and energy).

Unit 4: Dimensional Analysis and Flow through Pipes: Dimensional homogeneity, Buckingham's π method, Dimensionless numbers – Reynold's Number, Froude Number, Mach Number, Euler Number, Weber Number. Laminar Flow through pipes, Hagen-Poiseullie Equation, Flow measurement in pipes using venturimeter and orifice meter. Turbulent flow through pipes, friction factor, Moody's diagram, minor losses, pipe networks, Hardy-Cross method, water hammer and surge tanks. Reynold's Equation and Reynolds Stress tensor,

Unit 5: Boundary Layer Theory, Drag and Lift: Concept of Boundary Layer, Laminar and turbulent boundary layer, Boundary layer thickness- displacement, momentum and energy thickness, von Karman integral equation, Hydro-dynamically smooth and rough boundaries, separation of flow, Skin-friction and form drag, Drag on sphere, cylinder and flat plates, Von Karman vortex trail- eddy shedding, Coanda effect, Coriolis effect, Magnus effect, Generation of lift around a cylinder, Computation of lift force.

TEXT/REFERENCE BOOKS:

- Bansal, R.K., "A text book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications Pvt. Ltd. 2011
- Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House. 2011

- White, F.M., “Fluid Mechanics”, Tata McGraw Hill Education Pvt. Ltd. 2013
- Fox and Mc Donald, “Introduction to Fluid Mechanics”, John Wiley and Sons Inc. 2009

COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

1. Describe the principles of the fluid statics such as Pascal’s Law, Newton’s Law of viscosity, surface tension, Archimedes Principle and Hydrostatic law and apply these principles in determining the forces on submerged surfaces and stability of floating bodies.
2. Understand the Lagrangian and Eulerian fluid flow visualizations of velocity fields, local and convective accelerations, angular velocity fields and vortex flows.
3. Derive the fundamental equations of continuity, Navier Stoke’s Equation and Bernouli’s Equation using the basic principles of conservation laws. Apply these equations to solve different problems of fluid flow.
4. Develop a small scale physical prototype for a large scale model. Determine the losses in a pipe network due to friction and bends. Analyse the effects of water hammer and provide remedial measures such as air relief valves and surge tanks.
5. Understand the concept of boundary layer and turbulence, Magnus, Coriolis and Coanda effects of fluid flow separation. Determine the drag and lift forces on bodies such as cylinders and other streamlined bodies.

SYLLABUS:

Unit 1: Importance of surveying in civil engineering projects, principle of surveying, types of surveying, map and scales, basics of map coordinate systems, types of errors. Linear measurements, ranging, error in linear measurement & corrections, field work, miscellaneous problems. Compass surveying, types of compasses, angle measurement, types of bearing, magnetic declination, dip, local attraction and it's correction, compass traversing and it's adjustment.

Unit 2: Levelling – Elements and types of levels, two peg tests, methods booking of levels, effect of earth curvature and refraction, tachometry methods, reciprocal levelling, trigonometric levelling, contouring. Theodolite - basic definitions, fundamental lines, adjustments, methods of angle measurement theodolite traversing methods, adjustments of traverse, computation of Gale's traverse table.

Unit 3: Classification of curves, elements of horizontal curve, transition curve and vertical curves. Theory and methods of setting out horizontal circular curve, special field problems. Methods of area computations, Methods of volume computation.

Unit 4: Plane table surveys and mapping – Accessories, plane table adjustments, methods of mapping, two-point problem and it's solutions, three-point problem and it's solution. Control surveying- principle & use of triangulation, classification of triangulation systems, strength of figure, Station marks, towers and signals, indivisibility of stations, angular measurement, base line measurement and its extension, satellite station, computations in triangulation.

Unit 5: Modern surveying instrument: EDMs, total stations. digital levels. Theory of random errors, law's random error, law's of weights, propagation of random error, normal equation methods, method of difference, method of correlate, adjustment of level, triangulation, and quadrilaterals.

TEXT/REFERENCE BOOKS:

- Duggal S. K., "Surveying Vol 1 & 2" Tata McGraw Hill.
- Subramanian R., "Surveying and Levelling" Oxford Higher Education.
- Anderson, J.M. and Mikhail, E.M., "Surveying: Theory and Practice", McGraw Hill. 1998
- Arora, K.R., "Surveying", Vol. I, II and III, Standard Book House. 1995
- Chandra, A.M., "Surveying", New Age Publishers. 2002.
- Schofield, W. and Breach M., "Engineering Surveying", 6th Ed., Butterworth-Heineman. 2007.

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. To collect data, analyse it and draw basic plan/map of given area using chain and compass surveying
2. To calculate elevation of place using levelling, height and width of inaccessible object and setup small horizontal control using angular measurement with help of theodolite.
3. To design and layout the horizontal curve for road and railways line.
4. To perform plane table mapping.
5. To Analyse, evaluate and design triangulation system.
6. To estimate errors in observations and then reduce them using statistical methods.

LIST OF PRACTICALS:

1. Dimension tolerances of brick - IS 1077: 2007
2. Water absorption of brick - IS 3495 (Part 2): 2002
3. Compressive strength of brick - IS 3495 (Part 1): 2002
4. Efflorescence of brick - IS 3495 (Part 3): 2002
5. Fineness of cement by sieving - IS 4031 (Part 1): 2005
6. Soundness test of cement by Le-Chatelier apparatus - IS 4031 (Part 3): 2000
7. Normal consistency of cement - IS 4031 (Part 4): 1995
8. Initial & final setting time of cement - IS 4031 (Part 5): 2000
9. Compressive strength of cement - IS 4031 (Part 6): 2000
10. Gradation and fineness modulus of coarse aggregate and fine aggregate (sand) - IS 2386 (Part 1): 2002, IS 383: 2002
11. Tensile strength of steel - IS 1608: 2005

TEXT/REFERENCE BOOKS:

- Duggal, S. K. (2017). Building materials. New Age International Publication.
- Gambhir, M.L. (2013). "Concrete technology: Theory and Practice". Tata McGraw-Hill Education.
- Gambhir, M.L. "Concrete Manual". Dhanpat Rai Publication.
- Kukreja C.B. "Material Testing Laboratory Manual". Nem Chand Jain Publication.
- Indian Standards Codes for all tests, Bureau of Indian Standards.

COURSE OUTCOMES:

At the end of the course, students will achieve following outcomes:

1. The theoretical concepts of properties of brick, cement, aggregate, steel and concrete will be better understandable by performing practical on these materials.
2. The students will be able to analyze experimental data using advanced tools.
3. Technical writing skills of students will be improved.
4. The students will be able to work as a team.

LIST OF PRACTICALS:

1. Differentiation of Laminar and Turbulent flows using Reynold's Apparatus.
2. Determination of coefficient of discharge and calibration of a venturimeter.
3. Determination of coefficient of discharge and calibration of an orifice meter.
4. Determination of coefficient of discharge and calibration of a mouth piece.
5. Determination of coefficient of discharge and calibration of an orifice.
6. Determination of friction factor of a flow through a pipe.
7. Determination of force on a flat plate by the impact of jet of water.
8. Determination of force on a curved plate by the impact of jet of water.
9. Determination of losses of energy in a pipeline through the bends.
10. Determination of drag on a cylinder in the wind tunnel experiment.

TEXT/REFERENCE BOOKS:

- Bansal, R.K., "A text book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications Pvt. Ltd. 2011
- Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House. 2011

COURSE OUTCOMES:

At the end of the course, students will achieve following outcomes:

1. Determine the flow behaviour of laminar, transition and turbulent flows.
2. Determine the coefficient of discharge and calibration of orifice, mouthpiece, venturi meter and orifice meter.
3. Determine the coefficients for major losses and minor losses in a pipeline.
4. Verify the force created due to impact of jet on a flat and curved plate.
5. Determine the drag on a cylinder due to flowing fluid.

LIST OF PRACTICALS:

1. Study of different types of topographical maps and to prepare conventional symbols chart.
2. To survey an open field by chain survey in order to calculate an area of the field
3. To measure bearings of a closed traverse by prismatic compass and to adjust the traverse by graphical method.
4. To find out reduced levels of given points using dumpy/Auto level.
5. To perform fly leveling with an Auto /tilting level.
6. To study parts of a vernier / Electronic theodolite and practice for taking angle measurements using method of repetition and reiteration.
7. To perform theodolite traversing and adjusting it using Bowditch Rule.
8. To determine the elevation of hill top by trigonometrical levelling by taking observations in single vertical plane.
9. To set out a horizontal curve using Rankine methods.
10. To Setting up the plane table and plotting a few objects by radiation method.
11. To Setting up the plane table and plotting a few objects by Intersection method.

TEXT/REFERENCE BOOKS:

- Duggal S. K., "Surveying Vol 1" Tata McGraw Hill.
- Subramanian R., "Surveying and Levelling" Oxford Higher Education.
- Anderson, J.M. and Mikhail, E.M., "Surveying: Theory and Practice", McGraw Hill. 1998
- Arora, K.R., "Surveying", Vol. I, II and III, Standard Book House. 1995
- Chandra, A.M., "Surveying", New Age Publishers. 2002
- Schofield, W. and Breach M., "Engineering Surveying", 6th Ed., Butterworth-Heineman. 2007

COURSE OUTCOMES:

At the end of the course, students will achieve following outcomes:

1. To collect data, analyse it and draw basic plan/map of given area using chain and
2. compass surveying
3. To calculate elevation of place using levelling, height and width of inaccessible object and setup small horizontal control using angular measurement with help of theodolite.

4. To design and layout the horizontal curve for road and railways line.
5. To perform plane table mapping.

LIST OF PRACTICALS/EXERCISE:

1. Introduction to Object oriented programming
2. Introduction to Python and its installation
3. Practicing Python variables,
4. Practicing Python data types,
5. Practicing Python numbers,
6. Practicing Python Booleans
7. Practicing Python Strings
8. Practicing Python operators
9. Practicing Python lists
10. Practicing Python tuples
11. Practicing Python dictionaries
12. Practicing Python sets
13. Practicing Python if else command
14. Practicing Python While loop
15. Practicing Python For loop
16. Practicing Python Functions

TEXT/REFERENCE BOOKS:

- https://www.w3schools.com/python/
- https://www.python.org/

COURSE OUTCOME:

At the end of the course:

1. students will be able to develop a small project based on above syntaxes to solve simple data based civil engineering numerical from various subjects like Surveying, Hydraulics, Building materials, Strength of Materials etc in groups.

BACHELOR OF TECHNOLOGY
in
CIVIL ENGINEERING

SYLLABI
of
FOURTH SEMESTER

Department of Civil Engineering
G. B. Pant Institute of Engineering and Technology, Pauri Garhwal, U.K.

SYLLABUS:

Unit 1: Constituent Materials: Cement, Different types, Chemical composition and Properties, Hydration of cement, Tests on cement, IS Specifications, Aggregates, Classification, Mechanical properties and tests as per BIS, Grading requirements, Water, Quality of water for use in concrete.

Unit 2: Chemical and Mineral Admixtures: Accelerators, Retarders, Plasticizers, Super plasticizers, Water proofers, Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaoline, Effects on concrete properties.

Unit 3: Concrete mix preparation procedure: Proportioning, mixing, transporting, placing, curing. **Properties of Fresh concrete: -** Properties of fresh concrete, Workability of concrete and factor affecting the workability and its measurement, Problem of segregation bleeding and laitance.

Unit 4: Properties of Hardened concrete: - Operations involved in concrete production, Chemical and mineral admixtures, Properties of hardened concrete and maturity concept of concrete, Strength and durability, Factors affecting strength and durability of concrete. Time dependent behavior of concrete -creep, shrinkage and fatigue, Mechanics of setting and hardening of concrete.

Unit 5: Concrete mix design: - Statistical Quality controls, Concrete Rheology, Concrete Mix Design: principle and Methods, Concrete mix design by IS 10262:2019, Illustrative examples of Concrete mix design following IS 10262:2019.

REFERENCE BOOKS:

- Shetty, M.S. "Concrete Technology Theory & Practice", Published by S.CHAND & Company, Ram Nagar, New Delh (2005).
- Gambhir, M.L. (2013). "Concrete technology: Theory and Practice". Tata McGraw-Hill Education.
- Neville, A.M. "Fundamentals of Concrete Technology" Latest Edition, Pearson Publication

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Identify the properties and functional role of ingredients of concrete and apply this knowledge to mix design philosophy.
2. Understand the properties of fresh and hardened concrete and identifying the factors which influence these properties and its impact on mix design of concrete.

3. Understand the impact and importance of waste material like fly ash, silica-fume, ground granulated blast furnace slag, rice husk ash as a supplementary cementitious material in concrete making and develop an awareness to utilize the waste materials as novel innovative materials for concrete production.
4. Evaluate the effect of the environment on service life performance of concrete, properties and failure modes of structural concrete and demonstrate techniques of Non-Destructive Testing of concrete structure.
5. Do concrete mix design as per IS 10262:2019 which fulfills the required properties for fresh and hardened concrete with emphasis on its strength and durability in given environmental condition and also discuss other prevalent methods of concrete mix design.

SYLLABUS:

Unit 1: Water: -Sources of water supply and quality issues, water quality requirement for different beneficial uses, Water quality standards, Water Supply systems, Need for planned water supply schemes, types of water demand and population forecasts.

Unit 2: Water Treatment: Aeration, sedimentation, coagulation, flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes.

Unit 3: Components of water supply system, Transmission of water, distribution system, water pipes, water supply system in building, plumbing and various valves used in W/S systems, service reservoirs and design.

Unit 4: Water pollution, cause and ill effects, Noise- Basic concept, measurement, specification and various control methods, effects of noise on health.

Unit 5: Air - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution. Air quality standards, Control measures for Air pollution.

TEXT/REFERENCE BOOKS:

- Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
- Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
- Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International Editions, New York 1985.
- MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi.
- Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi.
- Plumbing Engineering. Theory, Design and Practice, S.M. Patil, 1999

COURSE OUTCOMES:

After successfully studying this course, students will:

1. Be able to identify and value the effect of the pollutants on the environment: atmosphere, water and soil.
2. Be able to plan strategies to control, reduce and monitor air and water pollution.
3. Be able to select the most appropriate technique for the treatment of water.
4. Be able to design various treatment units for water treatment.

5. Apply sampling techniques for water, air and noise.

SYLLABUS:

Unit 1: Introduction, history of geomatics engineering, Fundamentals of remote sensing, EMR, Platforms and sensors, visual image interpretation, Types of remote sensing and their applications, resolutions in remote sensing.

Unit 2: Introduction to digital image processing, data formats, image pre-processing- radiometric & geometric, remote sensing image distortion and rectification, georeferencing, image enhancement, transformation, classification, classification algorithms, accuracy assessment, image fusion and change detection.

Unit 3: Photogrammetry – advantages and disadvantages, types of photographs, and geometry of aerial photograph, scale of tilted photograph. relief displacement, flight planning. Stereoscopy, introduction, types of stereoscopes, base lining, parallax and its use for elevation determination, Introduction to LiDAR, UAV photogrammetry.

Unit 4: GIS- Introduction, Data Sources, Data Models and Data Structures, Algorithms, DBMS, Creation of Databases (spatial and non-spatial), Spatial analysis - Interpolation, Buffer, Overlay, Terrain Modelling and Network analysis.

Unit 5: GNSS- Principle used, Components of GNSS, Data collection methods, DGPS, Errors in observations and corrections.

TEXT/REFERENCE BOOKS:

- Duggal S. K., "Surveying Vol 1 & 2" Tata McGraw Hill.
- Subramanian R., "Surveying and Levelling" Oxford Higher Education.
- Anderson, J.M. and Mikhail, E.M., "Surveying: Theory and Practice", McGraw Hill. 1998
- Arora, K.R., "Surveying", Vol. I, II and III, Standard Book House. 1995
- Chandra, A.M., "Surveying", New Age Publishers. 2002

COURSE OUTCOMES:

At the end of the course, students will achieve following outcomes:

1. To enable the students to understand and apply the basic concepts of geospatial analysis.
2. To augment imagination of students so that they can visualize 3D models before the construction of civil work.
3. To enhance the capabilities of student in analysis of survey data which is very important for designing a civil engineering work.

4. To increase knowledge of modern techniques in surveying like remote sensing, GPS, GIS for industry readiness.
5. To broaden the scope of surveying keeping in mind environmental impacts of civil engineering projects.

SYLLABUS:

Unit 1: Turbines: General layout of a hydroelectric power plant, Efficiencies of a turbine, Classification of turbines, Impulse and Reaction turbines, Radial, axial and mixed flow turbines, Pelton turbine, Francis Turbine, Kaplan Turbine, Draft Tube, Unit Quantities of a turbine (Unit Speed, Unit Discharge and Unit Power), Specific speed of a turbine, Characteristic Curves of a turbine (Main Characteristics, Operating Characteristics and Iso-Efficiency Curves).

Unit 2: Pumps: Centrifugal Pumps, Work done by impeller, Efficiencies of centrifugal pump, multistage centrifugal pumps, Pumps in Series and parallel, Specific speed of centrifugal pump, Main, Operating and Constant efficiency characteristic curves, priming of centrifugal pump, Cavitation, Net Positive Suction Head (NPSH), Reciprocating pumps and work done, Comparison between centrifugal and reciprocating pumps.

Unit 3: Open Channel Hydraulics (Uniform Flow): Introduction, Velocity and pressure distributions in open channels, Froude number, Specific energy and critical depth, Alternate depths, Hydraulic radius and Hydraulic mean depth, Chezy's Equation, Darcy-Weisbach friction factor, Manning's formula, bed shear stress, hydraulically efficient channel sections.

Unit 4: Open Channel Hydraulics (Gradually Varied Flow): Introduction to gradually varied flow, differential equation of GVF, Classification of flow profiles, Features of all the flow profiles, Direct integration of GVF differential equation, Bresse's Solution, Simple numerical solutions of GVF equation, Direct step method.

Unit 5: Open Channel Hydraulics (Rapidly Varied Flow): Introduction to Rapidly varied flow, Momentum equation formulation, Definition of Specific force, Hydraulic jump in a horizontal rectangular and non-rectangular channel, Use of jump as an energy dissipater, Types of Hydraulic Jump, Subcritical and Supercritical flow transitions, rapidly varied Unsteady flows (Positive and Negative Surges).

TEXT BOOKS/REFERENCES

- Subramanya, K. "Flow in Open Channels", Tata McGraw-Hill, 1982.
- Bansal, R.K. "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, 1983.
- Modi, P.N., and Seth S.M., "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House, 1973.

COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

1. Understand the behaviour of different types of turbines and suggest an appropriate turbine that is efficient for the given conditions at a construction site of a hydroelectric power plant.
2. Develop an understanding of working of centrifugal and reciprocating pumps and suggest a pump based on the requirements of head and discharge that are needed to be generated by the pumps.
3. Design a channel that is most efficient in conductance of water and is most economical in construction. Differentiate between subcritical and supercritical flows, uniform and non- uniform flows in open channels.
4. Determine the gradually varied flow profiles that can occur at the back of a dam or at the fall from a spillway or when the slope is horizontal or adverse or when the flow transitions from a slope type to a different slope type. Approximately determine the inundation of a reservoir with the flow profiles.
5. Understand the behaviour of a hydraulic jump and use the jump as an energy dissipater for flow transitions from supercritical to subcritical. Calculate the impact of positive and negative surges of flash floods in an open channel.

SYLLABUS:

Unit 1: Simple Stresses and Strains- Concept of stress and strain, Types of stresses and strains, St. Venant's principle, Stress and strain diagram, Hooke's law, Properties of material, Strain Energy, Resilience, Working stress, Factor of safety, Bars of varying section, composite bars, Temperature stresses, Lateral strain, Poisson's ratio and volumetric strain, Elastic moduli and the relationship between them.

Unit 2: Compound Stresses and Strains- Plain stress, Transformation of plain stress, Angle of obliquity, Principal stresses and principal planes, Maximum shear stress and absolute maximum shear stress, Mohr circle of stress, Ellipse of stress, Plain strain, Transformation of plain strain, Principal strains and principal axis of strain, Strain rosette, Circle of strain and ellipse of strain. Theories of failure.

Unit 3: Bending moment and Shear Force Diagrams - Bending moment (BM) and shear force (SF) diagrams for determinant beams under different type of loadings.

Flexural Stresses-Theory of simple bending – Assumptions and Derivation of bending equation, Determination of bending stresses, Section modulus of different cross-sections, Beam of uniform strength, bending stresses of composite Section.

Unit 4: Shear Stresses Distribution- Derivation of shear formula, Shear stress distribution across various beam sections, Shear flow, Shear centre.

Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts.

Unit 5: Thick and Thin shells - Derivation of formulae and calculations of hoop stress, longitudinal stress in a thin and thick shells subjected to internal pressures.

Columns- Introduction, Euler's theory, Rankine formula.

Slope and deflection- Relationship between moment, slope and deflection, Double integration method, Moment area method, Castigliano's Theorem.

TEXT/REFERENCE BOOKS:

- James, M. Gere Mechanics of Materials. 8th ed. (INDIAN). Cengage Learning Publishing, 2014
- Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall, 2004

- Rajput, R. K. Strength of Materials (Mechanics of Solids). 6th ed. S. Chand Publishing, 2015

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Describe the concepts and principles, understand the theory of elasticity including strain/displacement and Hooke's law relationships; and perform calculations, relative to the strength and stability of structures and mechanical components.
2. Define the characteristics and calculate the magnitude of combined stresses in individual members and complete structures stresses by application of Mohr's circle of stress; apply various failure criteria for general stress states at points.
3. Draw shear force and bending moment diagram of beam subjected to various loading; analyze different beams under bending stresses.
4. Define shear stress distribution across various beam sections; Calculate the deflection at any point on a beam subjected to a combination of loads.
5. Solve torsion problems in bars and thin-walled members; Calculate the stresses in a cylinder and sphere subjected to internal pressures; determine the critical load for column supported by different end conditions.

LIST OF PRACTICALS:

1. Specific surface area of cement by Blain's Apparatus – IS 4031(Part 2): 1999
2. Tensile strength of hydraulic cement.
3. Water Absorption and specific gravity of coarse aggregate and fine aggregate (sand) - IS 2386 (Part 3): 2002
4. Silt content of sand - IS 2386 (Part 2): 2002
5. Bulking of sand - IS 2386 (Part 3): 2002
6. Workability of concrete by slump test - IS 1199: 2004
7. Workability of concrete by compaction factor - IS 1199: 2004
8. Compressive strength of plain cement concrete - IS 516: 2004, IS 10262: 2019
9. Split tensile strength of plain cement concrete - IS 5816: 2004

TEXT/REFERENCE BOOKS:

- Shetty, M.S. "Concrete Technology Theory & Practice", Published by S. CHAND & Company, Ram Nagar, New Delh (2005).
- Gambhir, M.L. (2013). "Concrete technology: Theory and Practice". Tata McGraw-Hill Education.
- Gambhir, M.L. "Concrete Manual". Dhanpat Rai Publication.
- Indian Standards Codes for all tests, Bureau of Indian Standards.

COURSE OUTCOMES:

At the end of the course, students will achieve following outcomes:

1. The theoretical concepts of properties of cement, steel and concrete will be better understandable by performing practical on these materials.
2. The students will be able to analyze experimental data using advanced tools.
3. Technical writing skills of students will be improved.
4. The students will be able to work as a team.

LIST OF PRACTICALS:

1. Measurement of pH of water samples.
2. Determination of Turbidity of water samples.
3. Determination of Electrical conductivity water samples.
4. Determination of Total Dissolved Solids in water samples.
5. Determination of Chlorides in water.
6. Determination of Iron in water samples.
7. Determination of Fluoride in water samples.
8. Determination of Alkalinity and acidity in water samples.
9. Determination of hardness of water samples.
10. Ambient Air quality monitoring (RSPM)
11. Ambient noise measurement.
12. Determination of optimum coagulant dosage.

TEXT/REFERENCE BOOKS:

- APHA, "Standard Methods for the Examination of Water and Wastewater", 21st Ed. Washington, 2005.
- "Laboratory Manual for the Examination of water, wastewater soil Rump", H.H. and Krist, H. – Second Edition, VCH, Germany, 1992.
- "Methods of air sampling & analysis", James P.Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.

COURSE OUTCOMES:

At the end of the course, students will achieve following outcomes:

1. The students at the end of the experimental exercise would be able to perform field-oriented testing of water, Air and Noise waste for microbial contamination.
2. The students would be knowledgeable to perform toxicity test.
3. The students would be able to observe and identify the Bacteriological quality of water.

LIST OF PRACTICALS:

1. Determination of Characteristic curves in a Pelton wheel turbine.
2. Determination of Characteristic curves in a Francis turbine.
3. Determination of Characteristic curves in a Kaplan turbine.
4. Determination of Characteristic curves in a Centrifugal pump.
5. Series and Parallel connections in a multistage centrifugal pump.
6. Determination of shape of a specific energy curve using subcritical and supercritical depths in an open channel.
7. Determination of Discharge in an open channel using Alternate depths.
8. Determination of Discharge in an open channel using Sequent depths of hydraulic jump.
9. Determination of Gradually Varied Flow (GVF) profile in an open channel in subcritical conditions.
10. Determination of Coefficient of discharge of Rectangular, Triangular and Trapezoidal notches.

TEXT /REFERENCES BOOKS:

- Subramanya, K. "Flow in Open Channels", Tata McGraw-Hill, 1982.
- Modi, P.N., and Seth S.M., "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House, 1973.

COURSE OUTCOMES:

At the end of the course, students will achieve following outcomes:

1. Determine the characteristic curves of turbines (both impulse and reaction turbines).
2. Determine the characteristic curves of centrifugal pumps.
3. Determine the arrangement of multistage centrifugal pumps in series and parallel.
4. Develop a specific energy graph for a given discharge in an open channel.
5. Determine the discharge of a channel using alternate depths and sequent depths.
6. Determine the GVF flow profiles for backwaters and coefficient of discharges for different notches.

LIST OF PRACTICALS/EXERCISE:

1. Practicing Python Lambda
2. Practicing Python Arrays
3. Practicing Python Classes/Objects
4. Practicing Python Inheritance
5. Practicing Python Iterators
6. Practicing Python Scope
7. Practicing Python Modules
8. Practicing Python Dates
9. Practicing Python Math
10. Practicing Python Json
11. Practicing Python File handling
12. Practicing Python Numpy
13. Practicing Python Pandas
14. Practicing Python Scipy

TEXT/REFERENCE BOOKS:

- https://www.w3schools.com/python/
- https://www.python.org/

COURSE OUTCOME:

At the end of the course,

1. students will be able to develop a small project based on above syntaxes to solve complex iterative civil engineering numerical from various subjects like Structural Analysis, Soil mechanics, Environment, Geomatics etc in groups.

BACHELOR OF TECHNOLOGY
in
CIVIL ENGINEERING

SYLLABI
of
FIFTH SEMESTER

Department of Civil Engineering
G. B. Pant Institute of Engineering and Technology, Pauri Garhwal, U.K.

SYLLABUS:

Unit 1: Wastewater Collection: Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; fixtures and fittings used. Sewer appurtenances, self-cleaning velocity, hydraulic of sewers, design of sewer, laying of sewers, sewerage systems.

Unit 2: Wastewater characterization, wastewater treatment on sites, pre-and primary treatment system: screen, grit removal, oil and grease removal.

Unit 3: Secondary Treatment: activated sludge process, conventional and extended aeration, waste oxidation ponds, trickling filter, rotating biological contractor, UASB process, advance wastewater treatment.

Unit 4: Wastewater and sludge disposal: Reuse system, wastewater disposal on land and water bodies and disposal of sludge, septic tank.

Unit 5: Solid waste management-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: solid waste from construction activities, Disposal of solid waste-segregation, reduction at source, recovery, recycle and disposal methods. Hazardous waste: Types and nature of hazardous waste, as per the HW Schedules of regulating authorities.

TEXT/REFERENCE BOOKS:

- Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
- Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M.Morgan, Thompson /Brooks/Cole; Second Edition 2008.
- Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, McGraw - Hill International Editions, New York 1985.
- MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi.

COURSE OUTCOMES:

After successfully studying this course, students will:

1. Be able to understand the characteristic of wastewater, and able to treat for different uses.
2. Be able to identify the effect of the pollutants on the quality of water and soil.
3. Be able to plan strategies to control, reduce and monitor water pollution.

4. Be able to select the most appropriate technique for the treatment of wastewater.
5. Be able to design various treatment units for wastewater management.

SYLLABUS:

Unit 1: Engineering Geology: Geological processes, rock forming minerals, rock types and their engineering properties. Structural geology: Dip, strike, faults, folds, joints, their formation and importance in respect of civil engineering structures, rock mass movements, causes of landslides.

Unit-2: Elementary properties: Soil types, composition, three phase relations, Physical properties: Specific gravity, water content, in-situ density, consistency of soils, grain size distribution curves, relative density, IS soil classification system, soil structure and clay mineralogy.

Unit-3: Capillarity, Permeability: Darcy's law, determination of coefficient of permeability, factors affecting permeability, equivalent permeability of stratified soils, in-situ permeability test, effective stress, seepage analysis, 1-D flow, Laplace's equation, flow nets, uplift pressure, confined and unconfined flows, piping failure, filter criteria.

Unit-4: Compressibility: Compaction: General principles, Proctor tests, factors affecting compaction, field compaction, compaction techniques.

Consolidation: Fundamentals, 1-D consolidation, normally and over-consolidated soil, void ratio – pressure relationships, compressibility characteristics, time rate of consolidation, coefficient of consolidation, curve fitting techniques, settlement analysis, secondary consolidation, vertical sand drains.

Unit-5: Shear strength of Soil: Principle of effective stress, Mohr-Coulomb failure criterion, direct shear test, unconfined compression test, triaxial shear test: unconsolidated undrained, consolidated undrained, consolidated drained, vane shear test.

TEXT/REFERENCE BOOKS:

- Ranjan, G. and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age International Publishers. 2007
- Punmia, B. C., "Soil Mechanics and Foundations", Laxmi Publications (P) LTD. 2017
- Murthy, V.N.S., "Text Book of Soil Mechanics and Foundation Engineering", CBS Publishers. 2007
- Arora K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, new Delhi. 2002
- Das, B.M., "Principles of Geotechnical Engineering", Thomson Asia. 2002
- Holtz, R.D. and Kovacs, W.D., "An Introduction to Geotechnical Engineering", Prentice Hall. 1981

- Schofield, W. and Breach M., “Engineering Surveying”, 6th Ed., Butterworth-Heineman. 2007

COURSE OUTCOMES:

At the end of the course, students will achieve following outcomes:

1. Student will able to identify the main and most common igneous, sedimentary and metamorphic rocks.
2. Solve three phase system problems, Carry out soil classification.
3. Solve any practical problems related to soil stresses estimation, permeability and seepage including flow net diagram.
4. Solve practical problems related to consolidation settlement and time rate of settlement.

SYLLABUS:

Unit 1: Water as a resource and residence times, Hydrologic cycle, Hydrologic Planning, Precipitation and its types, Measurement of rainfall, Average depth of rainfall over an area by different methods, Mean annual rainfall, Analysis of Rainfall Data, Consistency of rainfall record, Methods to find the missing data of rainfall, Double mass curve, Depth Intensity and Frequency (IDF) curves, Depth area duration (DAD) curves.

Unit 2: Infiltration, Factors affecting infiltration and its determination, Infiltrometers, Evaporation and Evapo-Transpiration, Pan Evaporation, Consumptive use, determination of evapotranspiration by different methods, interception and depression storage, rain water harvesting and its procedure.

Unit 3: Runoff measurement, w-index and ϕ-index from hyetograph, Streamflow measurement in a watershed, factors effecting runoff and streamflow, Flood hydrograph, Base flow separation, Direct runoff hydrograph (DRH) and Unit hydrograph (UH), SCS Curve number method, Calculation of DRH for different durations from UH, Direct method of proportioning, S-Curve method, Synthetic Unit Hydrograph.

Unit 4: Frequency Analysis, Return period, random variables, flood-frequency distributions, binomial, Gumbell and poisons distributions, simple regression and correlation analysis, Governing equations of Flood Routing, Reservoir routing, Hydrologic Routing by Modified Pul's Method, and by Muskingam Method.

Unit 5: Groundwater and other forms of subsurface water, Aquifer properties, Porosity and Compressibility of aquifers, Equation of motion (Darcy Law), Hydraulic Conductivity and Transmissivity of an aquifer, Wells, Steady flow into an unconfined and a confined aquifer in radial coordinates, Dupuit's assumptions and equation of motion in an unconfined aquifer, Unsteady flow into a confined aquifer, Specific capacity of a well.

TEXT/REFERENCE BOOKS:

- Chow, V.T., Maidment, D.R. and Mays, W.L., "Applied Hydrology", McGraw Hill. 1988
- Subramanya, K., "Engineering Hydrology", Tata McGraw Hill, 1994.

COURSE OUTCOMES:

On the successful completion of the course the student will be able to:

1. Determine the importance of hydrological cycle on the environment and analyze the rainfall and other hydrological data.
2. Distinguish the different sources of storage in hydrological cycle along with their residence times
3. Estimate the amount of conversion of rainfall to runoff through unit hydrographs

4. Develop a frequency analysis and compare the results with different distribution systems
5. Determine the role of subsurface water resource and manage the resources of groundwater to use for human activities

SYLLABUS:

Unit 1: Static and kinematics indeterminacy, stability of structure, Conjugate Beam Method, deflection of beams and frames by Strain Energy Method, Castigliano's Theorems, Maxwell's Reciprocal Theorem.

Unit 2: Deflection of beams and frames by Unit load method, deflection due to lack of fit and temperature changes.

Unit 3: Moving loads and influence lines for determinate beams, influence lines for bridge trusses, maximum shear force and bending moment values due to moving loads.

Unit 4: Analysis of two and three hinged arches, influence lines and rolling loads, maximum bending moment diagram, effect of temperature on two and three hinged arches.

Unit 5: Analysis of cables, forces on anchor cables and towers, effect of temperature on cable, suspension bridge with two and three hinged stiffening girders, maximum shear force and bending moment diagram, influence lines and rolling loads.

TEXT/REFERENCE BOOKS:

- Bhavikatti S.S., Structural Analysis, Volume 1 & 2, Vikas Publishing House Pvt. Ltd., New Delhi-4.
- Pandit G.S. and Gupta S.P., Structural Analysis–A Matrix Approach, Tata McGraw Hill Publishing Company Ltd. 2006.
- Norris, C.H. et.al, "Elementary Structural Analysis", Tata McGraw Hill. 2003
- Hibbeler, R.C., "Structural Analysis", Pearson Press. 2007
- Reddy, C.S., "Basic Structural Analysis", Tata McGraw Hill. 2000

COURSE OUTCOMES:

On successful completion of the course, the student will be able to:

1. To enable the students to understand various methods to find slope and deflection of determinate beam.
2. To bring the knowledge of unit load method for beams and frames.
3. To understand influence lines and its applications.
4. To bring the understanding of different types of arches.
5. To analyze cables and suspension bridges.

LIST OF PRACTICALS:

1. Measurement of pH of the given sample.
2. Determination of total solids from the given sample.
3. Determination of Total dissolved solids from the given sample.
4. Determination of Total suspended solids from the given sample.
5. Determination of Dissolved Oxygen (D.O).
6. Determination of Biochemical Oxygen Demand (BOD).
7. Determination of Chemical Oxygen Demand (COD).
8. Determination of Heavy metals.
9. Determination of O&G (oil and grease)
10. Determine of Ammonia Nitrogen in the given sample.

TEXT/REFERENCE BOOKS:

- APHA, "Standard Methods for the Examination of Water and Wastewater", 21st Ed. Washington, 2005.
- "Laboratory Manual for the Examination of water, wastewater soil Rump", H.H. and Krist, H. – Second Edition, VCH, Germany, 1992.
- "Methods of air sampling & analysis", James P.Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.

COURSE OUTCOMES:

At the end of the course, students will achieve following outcomes:

1. The candidate at the end of the experimental exercise would be able to perform field-oriented testing of wastewater for microbial and heavy metals contamination.
2. The candidate would be knowledgeable to perform toxicity test.
3. The candidate would be able to observe and identify the Bacteriological quality of waste water.

LIST OF PRACTICALS:

1. Megascopic study: Igneous, Sedimentary, Metamorphic of Rocks.
2. Megascopic study of minerals.
3. Field identification of Fine-Grained soils.
4. Natural moisture content using Oven Drying method.
5. Specific gravity of Soils.
6. Grain size distribution by Sieve Analysis and Hydrometer Analysis.
7. Consistency limits by Liquid limit, Plastic limit and Shrinkage limit.
8. Field Density using Core Cutter method and Sand replacement method.
9. Relative density.
10. Permeability test using Constant-head test method.
11. Permeability test using Falling-head method.
12. Compaction test: Standard Proctor test and Modified Proctor test.
13. Consolidation Test.
14. Direct Shear Test.

TEXT/REFERENCE BOOKS:

- Das, B. M. (2021). Soil mechanics laboratory manual.
- Kalinski, M. E. (2011). Soil mechanics: lab manual (No. Ed. 2). John Wiley & Sons.
- Ventura Tejeda, F. R. (2020). Soil Mechanics Laboratory Manual.
- Ranjan, G. and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age International Publishers. 2007
- Punmia, B. C., "Soil Mechanics and Foundations", Laxmi Publications (P) LTD. 2017

COURSE OUTCOMES:

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

1. Determine index properties of soils.
2. Classify soils.
3. Determine engineering properties of soils.

LIST OF PRACTICALS:

1. To verify clerk Maxwell's reciprocal theorem.
2. To find the value of flexural rigidity (EI) for a given beam and compare it with theoretical value.
3. To determine the elastic displacement of the curved members experimentally and verification of the same by analytical methods.
4. To determine the horizontal thrust in a three hinged arch for a given system of loads experimentally and verify the same with calculated values.
5. To study experimentally a two-hinged arch for the horizontal displacement of the roller end for a given system of loading and to compare the same with those obtained analytically.
6. To study behaviour of different types of columns and find Euler's buckling load for each case.
7. To determine the deflection of a pin connected truss analytically & graphically and verify the same experimentally.
8. To analyse a redundant system of a coplanar forces with the help of a three-bar suspension system and compare theoretical and experimental values.

TEXT/REFERENCE BOOKS:

- Bhavikatti S.S., Structural Analysis, Volume 1 & 2, Vikas Publishing House Pvt. Ltd., New Delhi-4.
- Pandit G.S. and Gupta S.P., Structural Analysis–A Matrix Approach, Tata McGraw Hill Publishing Company Ltd. 2006.
- Reddy, C.S., "Basic Structural Analysis", Tata McGraw Hill. 2000

COURSE OUTCOMES:

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

1. Apply the concept of slope and deflection to solve the beam.
2. Relate the behaviour of column in different end conditions & solve for critical load.
3. Apply concept of horizontal thrust in maintaining parabola of two hinged parabolic arch for external loading & analyze the horizontal thrust.
4. Compare the experimental and theoretical results.
5. Work as a team.

BACHELOR OF TECHNOLOGY
in
CIVIL ENGINEERING

SYLLABI
of
SIXTH SEMESTER

Department of Civil Engineering
G. B. Pant Institute of Engineering and Technology, Pauri Garhwal, U.K.

SYLLABUS:

Unit 1: Introduction, Materials for Reinforced Concrete and IS Code requirements, Sampling and strength of designed concrete mix, **Design Philosophies** - Working stress and limit state design methods, Characteristic and design loads, Characteristic and design strength, Design stress-strain curve of concrete and steel.

Unit 2: Limit State Design of R.C. Beams in Flexure: Singly and doubly reinforced rectangular, flanged Beam, Design for shear.

Unit 3: Bond and Anchorages of bars, check for development length, Reinforcement requirements, Slenderness limits for beams to ensure lateral stability, **General aspects of serviceability**-serviceability limits in IS: 456-2000, Calculation of deflections and crack width as per IS code, Design of RC beams subjected to torsion,

Unit 4: Design of Slabs: General consideration of design of slabs, Design of one-way and two-way slabs, design of staircases.

Unit 5: Design of Columns: General aspects, effective length of column, loads on columns, slenderness ratio for columns, minimum eccentricity, design of short axially loaded columns, design of column subject to combined axial load and uniaxial moment and biaxial moment using SP – 16 charts.

TEXT/REFERENCE BOOKS:

- Shah, V.L. et al., "Limit State Theory and Design of Reinforced Concrete: Structures Publications 2007.
- Pillai, S.U. and Menon, D., "Reinforced Concrete Design", Tata McGraw Hill 2003.
- Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice-Hall 2002.
- Park, R. and Pauley, T., "Reinforced Concrete Structures", John Wiley 1976.
- Gambhir, M.L., "Fundamentals of Reinforced Concrete Design", Prentice-Hall of India 2006.

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Understand basic properties of materials used in RCC, and variation in strength based on various parameters and difference between limit state and working stress method.
2. Design of beams for flexure and shear stresses.
3. Concept of development length and general aspects of serviceability criteria.
4. Designing of one way and two-way slabs.
5. Designing of columns under axial and biaxial loadings.

SYLLABUS:

Unit 1: Earth Pressure and Retaining Walls: Earth pressure at rest, active and passive earth pressure, Rankine and Coulomb's earth pressure theories, earth pressure due to surcharge, retaining walls, stability analysis of retaining walls, proportioning and design of retaining walls.

Unit 2: Stability of Slopes: Modes of failure-mechanism, stability analysis of infinite slopes, methods of slices, Bishop's simplified method.

Unit 3: Foundations: Types of foundations, mechanism of load transfers in shallow and deep foundations, shallow foundations, Terzaghi's bearing capacity theory, computation of bearing capacity, effect of various factors, use of field test data in design of shallow foundations, stresses below the foundations, settlement of footings and rafts, proportioning of footings and rafts, sheeting and bracing of foundation excavation.

Unit 4: Pile Foundation: Types and methods of construction, estimation of pile capacity, capacity and settlement of group of piles, proportioning of piles.

Well foundations: Methods of construction, tilt and shift, remedial measures, bearing capacity, settlement and lateral stability of well foundation.

Unit 5: Soil Exploration: Methods of soil exploration; boring, sampling, penetration tests, correlations between penetration resistance and soil design parameters.

Machine Foundations: Types of machine foundations, mathematical models, response of foundation - soil system to machine excitation, cyclic plate load test, block resonance test, criteria for design.

TEXT/REFERENCE BOOKS:

- Ranjan, G. and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age International Publishers. 2007
- Das, B.M., "Principles of Foundation Engineering", PWS. 2004
- Peck, R.B., Hanson, W.E. and Thornburn, T.H., "Foundation Engineering", John Wiley. 1974
- Punmia, B. C., "Soil Mechanics and Foundations", Laxmi Publications (P) LTD. 2017
- Murthy, V.N.S., "Text Book of Soil Mechanics and Foundation Engineering", CBS Publishers. 2007
- Arora K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, new Delhi. 2002

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Determine the earth pressures on foundations and retaining structures.
2. Analyze shallow and deep foundations.
3. Calculate the bearing capacity of soils and foundation settlements.
4. Understand soil exploration methods.
5. Design machine foundation.

SYLLABUS:

Unit 1: Analysis of Pin-connected indeterminate frames, indeterminate beams and rigid frames by Method of Consistent Deformation, stresses due to error in length of member, temperature stresses.

Influence Lines for Indeterminate Beams- Muller Breslau's principle, influence line for Shearing force, Bending Moment and support reaction components of propped cantilever, continuous beams (Redundancy restricted to one) and fixed beams.

Unit 2: Moment Distribution Method- Stiffness and carry over factors, distribution and carryover of moments, analysis of continuous beams, plane rigid frames with and without sway, support settlement, symmetric frames with symmetric and skew-symmetric loadings.

Unit 3: Slope Deflection Method- Slope deflection equations, equilibrium conditions, analysis of continuous beams and rigid frames, rigid frames with inclined members, support settlements, symmetric frames with symmetric and skew-symmetric loadings.

Unit 4: Matrix Method- Primary structures, compatibility conditions, formation flexibility matrices, analysis of indeterminate pin- jointed plane frames, continuous beams and rigid jointed plane frames by direct flexibility method, restrained structure, formation of stiffness matrices, analysis of continuous beams, pin-jointed plane frames and rigid frames by direct stiffness method.

Unit 5: Plastic Analysis- Plastic theory, statically indeterminate structures, plastic moment of resistance, plastic modulus, shape factor, load factor, plastic hinge and mechanism, collapse load, static and kinematic methods, upper and lower bound theorems, plastic analysis of indeterminate beams and frames.

TEXT/REFERENCE BOOKS:

- Bhavikatti S.S., Structural Analysis, Vol.1, & 2, Vikas Publishing House Pvt. Ltd., NewDelhi-4.
- Pandit G.S. and Gupta S.P., Structural Analysis–A Matrix Approach, Tata McGraw Hill Publishing Company Ltd. 2006.
- Norris, C.H. et.al, "Elementary Structural Analysis", Tata McGraw Hill. 2003.
- Reddy, C.S., "Basic Structural Analysis", Tata McGraw Hill. 2000.
- Gambhir M.L., Fundamentals of Structural Mechanics and Analysis, PHIL earning Pvt. Ltd., 2011.
- Prakash Rao D.S., Structural Analysis, Universities Press, 1996.

COURSE OUTCOMES:

At the end of the course, students will achieve following outcomes:

1. To bring the understanding of Method of consistent deformation and influence line.
2. To understand Moment distribution method.
3. To analyze Slope deflection method.
4. To understand Matrix method.
5. To enable the students to understand Plastic Analysis of structure.

SYLLABUS:

Unit 1: Highway development and planning- Classification of roads, road development in India, Current Road projects in India; highway alignment and project preparation, road development plans, engineering surveys.

Unit 2: Geometric design of highways- Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems.

Unit 3: Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems, intelligent transport systems.

Unit 4: Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements.

Unit 5: Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC.

TEXT/REFERENCE BOOKS:

- Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
- Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', Khanna Publishers.
- Partha Chakraborty, ' Principles Of Transportation Engineering, PHI Learning,
- Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley
- Srinivasa Kumar, R, Textbook of Highway Engineering, Universities Press, 2011.
- Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.

COURSE OUTCOMES:

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

1. Carry out surveys involved in planning and highway alignment.
2. Design the geometric elements of highways and expressways.
3. Carry out traffic studies and implement traffic regulation and control measures and intersection design.

4. Characterize pavement materials.
5. Design flexible and rigid pavements as per IRC.

SYLLABUS:

Unit 1: Water resources in India, need for irrigation in India, Definition of irrigation, Types of irrigation systems – Direct and Indirect, Lift and Inundation irrigation Systems, Methods of irrigation – Surface and Sprinkler methods, Trickle or Drip Irrigation, Soil moisture Constants, Depth of water held by soil in different zones, Water extraction - Quality of irrigation water.

Unit 2: Water requirements of crops, Duty, Delta and Base period - Their relationship, Crops – Seasons, Factors affecting duty and methods of improving duty, consumptive use of water – Determination of canal capacities for cropping patterns, Size of reservoir, Types of reservoirs, Zones of storage in a reservoir, Purpose of reservoir, Reservoir yield, Mass curve and Demand curve, Determination of reservoir capacity, yield from a reservoir of given capacity.

Unit 3: Classification of irrigation canals – Canal alignment, Design of unlined canals, Regime theories – Kennedy's and Lacey's theories, Critical Tractive force method, Design problems – Balancing depth – L.S. of a channel. Schedule of area statistics, Cross section of an irrigation channel, -Maintenance of irrigation channel, Regulation of channel system – Canal outlets, Requirements of a good outlet – Types of outlets, Water logging-Causes and control – land drainage.

Unit 4: Storage works: Classification of dams, factors governing selection of types of dams, selection of site, preliminary investigation, Gravity Dams: Forces acting on a gravity dam, stability criteria, modes of failure, elementary and practical profiles, stability analysis, principal and shear stress. Earth Dams: Types, foundation for earth dams, design of earth dams, causes for failure of earth dams, criteria for safe design, phreatic line, seepage analysis – seepage control through body and foundation.

Unit 5: Spillways: Essential requirements, spillway capacity, components, types of spillways and their working, energy dissipation below spill way, scour protection, use of hydraulic jump as energy dissipater, stilling basins – USBR and IS standard basins. Types, location and components of diversion head works, effects of construction of weirs on permeable foundation, Bligh's, Lanes and Khosla's theories.

TEXT/REFERENCE BOOKS:

- Punmia, B.C., "Water Resources Engineering", Laxmi Publications.
- Asawa, G.L., "Irrigation and water Resources engineering", New Age International, 2005.
- K. Linsley, Water Resources Engineering, McGraw Hill, 1995.
- S. K. Garg, Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 1992.

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Differentiate the types of irrigation systems and their suitability for practice.
2. Estimate the water requirement of crops and determine the size and capacity of reservoirs to meet the requirement.
3. Design the conveyance of estimated water through lined and unlined canals.
4. Analyze the forces on a gravity dam or an earth dam to carry out the requirement of storage in reservoirs.
5. Determine the different types of spillways and evaluate the suitability of an appropriate spillway for a designed hydraulic structure.

LIST OF PRACTICALS:

1. Triaxial Test (UU).
2. Vane shear test.
3. Unconfined Compression Strength Test.
4. Study of various boring tools and techniques.
5. Study of various sampling tools.
6. Standard Penetration Test.
7. Cone Penetration Test.

TEXT/REFERENCE BOOKS:

- Das, B. M. (2021). Soil mechanics laboratory manual.
- Kalinski, M. E. (2011). Soil mechanics: lab manual (No. Ed. 2). John Wiley & Sons.
- Ventura Tejeda, F. R. (2020). Soil Mechanics Laboratory Manual.
- Ranjan, G. and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age International Publishers. 2007
- Punmia, B. C., "Soil Mechanics and Foundations", Laxmi Publications (P) LTD. 2017

COURSE OUTCOMES:

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

1. Determine engineering properties of soils.
2. Understand the use of different tools for collecting the soil sample.
3. Perform field tests on a soil stratum.

LIST OF PRACTICALS:

1. Shape test (flakiness and elongation) of aggregate
2. Impact value test of aggregate
3. Crushing strength test of aggregate
4. Abrasion test of aggregate
5. Specific gravity test of bitumen
6. Ductility test of bitumen
7. Flush point and fire point test of bitumen
8. Float test of bitumen
9. Penetration test of bitumen
10. Softening test of bitumen
11. Viscosity test of bitumen
12. Water content test of bitumen
13. Marshal test for stability and flow value

TEXT/REFERENCE BOOKS:

- Khanna, S. K., & Justo, C. E. G. (1971). *Highway Material Testing: Laboratory Manual*. Nem Chand.
- Khanna, S. K., & Justo, C. E. G. (1991). *Highway engineering*. Nem Chand & Bros.
- Kadiyali, L. R. (2017). *Highway Engineering*. KHANNA PUBLISHING HOUSE.

COURSE OUTCOMES:

After a successful completion of the course, the students will be able to

1. Understand the importance of these highway materials in construction of road.
2. Identify engineering properties of aggregate.
3. Identify the grade & properties of bitumen.

LIST OF PRACTICALS:

1. Introduction to Civil 3D interface (Application menu, Ribbon, Quick Access Toolbar, the tool space, drawing area, Command Area, Status bar) and Creating Object Styles and Labels Description Keys, an easy way to process survey data.
2. Creating points from a Surface, from segment: divide object by Intervals: measure object and creating points on an alignment, elevation from the surface finally exporting point.
3. Creating and defining surfaces by point groups, from break lines, surface Boundary, surface by Edits, and surface from Contours.
4. Surface Properties, Analysis by Water Drop Path, Analysis by Quick Profiles, Volume Surfaces (Cut and Fill), Surface Styles and Labels, Surface Labels and Tables
5. Introduction to Parcel, Sites, Parcel from Objects, Parcel Creation Tools, Free Form Create, Parcel Adjustment, Parcel Cul-de-Sac Area, Parcel renumbering, Parcel Styles, Parcel Label Style.
6. Introduction to alignment, Alignment from objects, Alignment by Layout, Alignments Labels
7. Introduction to Profile, Profile from Surface, Profile by Layout, Profile Styles and Labels
8. Introduction to Corridor, Cross-section or Assembly, Corridor Creation,
9. Modifying a Corridor: Baselines, Corridor Frequencies, Corridor targets, splitting a corridor, Creating a corridor Surface
10. Laying out a Storm Sewer network, Pipe Rules, Pipe Parts List, creating a Network by objects, Creating a Network by Creation Tools, Projecting Pipes in Profiles

TEXT/REFERENCE BOOKS:

- Eric Chappell, 2016, AutoCAD Civil 3D 2016 Essentials, Autodesk Official Press, Sybex
- Davenport Cyndy, Voiculescu Ishka, Mastering AutoCAD Civil 3D 2016: Autodesk Official Press.

COURSE OUTCOMES:

At the end of the course, students will achieve following outcomes:

1. To creating object styles and labels description keys in AutoCAD Civil 3D.
2. To perform analysis by water, drop path, quick profiles and volume surfaces (cut and fill) AutoCAD Civil 3D.
3. To perform alignment from objects, alignment by layout, alignments labels in AutoCAD Civil 3D.
4. To do laying out a storm sewer network creating a network by objects, by creation tools in AutoCAD Civil 3D.

BACHELOR OF TECHNOLOGY
in
CIVIL ENGINEERING

SYLLABI
of
SEVENTH SEMESTER

Department of Civil Engineering
G. B. Pant Institute of Engineering and Technology, Pauri Garhwal, U.K.

SYLLABUS:

Unit 1: Design of Connections Common steel structure, advantages and disadvantages of steel structures, type of steel, rolled steel sections, special considerations in steel design, design philosophy, limit state design, design strength, deflection and serviceability limits, stability checks; Riveted, bolted and welded connections.

Unit 2: Design of Tension Members: Design strength of tension member due to yielding of gross section, rupture strength of critical section and block shear, tension splices and lug angles; design of bolted and welded connections for ties subjected to both bending and axial tension.

Unit 3: Design of Compression Members: Shape of compression members, buckling class of cross–section, slenderness ratio, design compressive stresses and strengths, use of IS800-2007 tables for design stresses, design of compression members.

Unit 4: Design of Beams: Behaviour of beam in flexure, section classification, plastic moment carrying capacity of a section, bending and shear strengths of laterally supported beams, design of laterally supported beams, deflection limits, web buckling and web crippling.

Unit 5: Plate-girders including stiffeners, splices and curtailment of flange plates.

TEXT/REFERENCE BOOKS:

- Limit State Design of Steel Structures, S.K. Duggal, Tata Mcgrawhill Publication-2010.
- Limit State Design of Steel Structures by N. Subramanium, Oxford University Press-2009
- IS 456-2000, Code of practice for Plain and R. C., Bureau of Indian Standards, New Delhi.
- I.S.800-2007, Code for general construction in steel structures, Bureau of Indian Standards, New Delhi.
- I.S. 875 (Part I to Part V), Code of Practice for Design Loads, Bureau of Indian Standards, New Delhi.
- I.S. 226, Steel for general structural purposes, Bureau of Indian Standards, New Delhi.
- I.S.808-1989, Code for Classification of Hot Rolled Steel, Bureau of Indian Standards, New Delhi.
- I.S.816-1969, Code of practice for use of metal arc welding for general construction in mild steel, Bureau of Indian Standards, New Delhi.

COURSE OUTCOMES:

Upon successful completion of the course student should be able to:

1. Learn the concept of analysis and design of steel structures.
2. Analyze and design of bolted and welded connections.
3. Analyze and design of tension members with different failure criteria.

4. Analyze and design of columns/built up columns with various configurations and end conditions.
5. Analyze and design of plate girder.

SYLLABUS:

Unit 1: Introduction, Permanent Way and Components: History and administrative setup of Indian Railways; rail gauges, permanent way – functions, requirements, sections in embankment and cutting (single/double track), electrified tracks, locomotives, wheel and axle arrangement, coning of wheels, components – rails, sleepers, ballast and formation. Resistances and Stresses in Tracks, Hauling Capacity: Types of resistances to traction, stresses in different components of track, hauling capacity of a locomotive, tractive effort.

Unit 2: Joints and Fastenings: Types of joints: short welded rails, long welded rails and continuous welded rails, rail to rail and rail to sleeper fastenings, elastic fastenings. Track Geometrics, Turnouts and Crossings: Railway alignment, vertical alignment – gradients and grade effects, horizontal alignment – horizontal curves, super-elevation, concepts of cant excess and deficiency, safe permissible speed, transition curves, widening of gauges and track clearances, points and crossings – terminologies, types of turnouts, design of turnouts, types of crossings, design of crossings.

Unit 3: Track Safety, High speed tracks, Urban railways: Signals classification and their functions, train operation control systems – absolute, automatic block systems, centralized train control system, ATS, interlocking of tracks – principle of interlocking, types of interlocking, high speed tracks – track requirements, speed limitations, high speed technologies, and urban railway - railway systems in urban areas**.**

Unit 4: 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 an airport, selection of site for an airport, airport obstruction, imaginary surfaces, runway orientation clam period and wind coverage.

Unit 5: 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 lighting of runway and apron area, wind and landing direction indicator.

TEXT/REFERENCE BOOKS:

- Chandra, S. and Agarwal, M. M., "Railway Engineering", Oxford.
- Arora, S. P. and Saxena, S. C., "A Text Book of Railway Engineering", Dhanpat Rai Publications.
- Mundrey, J. S., "Railway Track Engineering", Tata Mcgraw Hill.
- Khanna, S. K., Arora, M. G. and Jain, S. S., "Airport Planning & Design", Nem Chand and Bros.
- Horonjeff, Robert and McKelvey, Francis X., "Planning & Design of airports', 4th Ed., McGraw Hill.

- Saxena, S.C., “Airport Engineering – Planning and Design”, CBS Publishers.

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Understand the basics of railway engineering, its history and components.
2. Get insight into practical design of laying down railway tracks by understanding the numeric behind it.
3. Understand the safety aspects in railways and high-speed rails including signal systems.
4. Comprehend the need, design and planning of Airports.
5. Learn the design of components of Airports like runway, taxiways, aprons etc. according to their specific purposes.

SYLLABUS:

Unit 1: Basics of Tensor Mechanics: Introduction to cartesian tensors and tensor operations, spatial (Eulerian) and material (Lagrangian) description of motion of deformable bodies, rotation and vorticity, strain rate tensor, time rate of change of volume and line integrals.

Unit 2: Conservation Laws: Reynolds Transport Theorem (RTT), Stress tensor, continuity and equilibrium equations, constitutive equations, derivation of Navier-Stokes equation and its applications, derivation of energy equations.

Unit 3: Fluid Flows and Applications: Introduction to laminar flow, Blasius equation, Karman momentum equation, description of turbulent flow, Kevin-Helmoltz instability, mean flow equations, Prandtl's mixing length, turbulent Poiseuille flow, jets and wakes.

Unit 4: Open Channel Hydraulics-1: Uniform flow, critical flow and GVF for compound channels, GVF flow profiles for channel slope transitions, Saint Vennant Equations for open channels.

Unit 5: Open Channel Hydraulics-2: Rapidly varied flow in prismatic and non-prismatic open channels, channel design for erodible and non-erodible open channels, silt theories and river mechanics.

TEXT/REFERENCE BOOKS:

- Ligett, J. A., Fluid Mechanics, McGraw-Hill International Editions, 1994.
- Batchelor, G. K., An Introduction to Fluid Mechanics, Cambridge University Press, London, 2005.
- Shames, L. H., Mechanics of Fluids, McGraw-Hill, 1992
- Chatterjee, R.., Mathematical Theory of Continuum Mechanics, Narosa Publishing House, 1999.
- Chung, T. J., Continuum Mechanics, Prentice Hall, 1988.
- Chaudhry, M. H., Open Channel Flow, Prentice Hall of India, 1998.
- Chow, V.T, Open Channel Hydraulics, McGraw Hill, New York, 1959

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Describe the use and importance of tensor mechanics in fluid flows.
2. Derive the conservation laws governing the flow of fluid in various conditions
3. Apply the fluid flow principles to different problems of real world
4. Critique the flows of open channels according to the conditions of the flows
5. Design the erodible and non-erodible channels for conveyance of fresh water.

SYLLABUS:

Unit 1: Introduction: National Road development programmes, financial analysis of highway projects, vehicle operating cost. **New Road Materials:** Alternate forms of aggregates, theory and specifications of fillers, additives, emulsions, cutbacks and modified binder, Mix designs-Marshall, requirement of a mix

Unit 2: Pavement Structure-Soil Interaction: Tests on soil (Plate Load, CBR and Triaxial), strength of pavement materials, importance and functions of each layer of pavement and subgrade.

Unit 3: Design of Flexible Pavements: Design factors, empirical, semiempirical and analytical design methods, California bearing ratio, triaxial, Mclead and Burmister method, advantages and limitations, IRC method of design, design considerations for expressways.

Design of Rigid Pavements: Design factors, load and temperature stresses, load transfer devices, design of Dowel and Tie bars, joint requirement and working, IRC methods of design, construction techniques and specifications, quality control tests, reinforced concrete pavements, continuously reinforced and prestressed.

Unit 4: Different type of pavements WBM, Premix carpet, bituminous concrete etc. **Stabilized Roads:** Aggregate mixtures, proportioning, types of stabilizations, advantages and limitation, special problems related to drainage, control of seepage and capillary rise.

Unit 5: Pavement Evaluation Techniques for Functional and Structural Evaluation: Benkalman beam deflection method, flexible and rigid overlays. **Maintenance of Pavements:** Routine and periodic maintenance, special repairs, case study of failure of flexible and rigid pavements cracking, settlement, frost heaving and mud pumping in pavements.

TEXT/REFERENCE BOOKS:

- Kerbs, R.D. and Walker, R.D., "Highway Materials", MCGraw-Hill.
- Khanna, S.K. and Justo, C.E.G. "Highway Engineering", Chand and Bros.
- Huang, Y.H. "Pavement Analysis and Design" Prentice Hall
- Wright, P.H. and Dixon, K.K., "Highway Engineering", John Wiley.
- Kadiyali, L.R. and Lal, N.B., "Principles and Practices of Highway Engineering", Khanna Publishers.

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Identify different additives admixture and materials and their uses.
2. Will have an understanding of soil and pavement interaction and factors affecting it.
3. Design flexible and rigid pavement as per codes and other methods.

4. Identify different type of road construction and problems related to road stabilization and drainage
5. Will be able to evaluate pavement and understand maintenance process.

SYLLABUS:

Unit 1: Introduction to Data Science: Definition of data science, constituents of data science, Introduction to statistics, Visualization, machine learning, deep learning.

Unit 2: Introduction to Geo-spatial data: Characteristics of Geo-spatial data, Geo-spatial computational environment, difference between spatial and non-spatial data, spatial weights.

Unit 3: Spatial data Analysis: Choropleth Mapping, Spatial Autocorrelation, Local Spatial Autocorrelation, Point pattern analysis.

Unit 4: Data mining in geoinformatics: Spatial inequality, Clustering and regionalization, Spatial Regression, Spatial Feature processing.

Unit 5: Deep learning in geoinformatics: Applications of artificial neural network in processing geo-spatial data. Case studies related to use various neural architectures like CNN, GCNN, GAN etc. in geoinformatics data analysis.

TEXT/REFERENCE BOOKS:

- Geospatial Data Science Quick Start Guide, Abdishakur Hassan, Jayakrishnan Vijayaraghavan, 2019.
- Geospatial Data Science Techniques and Applications, Bobak Karimi, Hassan A. Karimi, 2017**.**

COURSE OUTCOMES:

On completion of the course, the following outcome will be achieved:

1. To familiarize students with data science instruments.
2. To enable students to apply data science to geoinformatics applications
3. To utilize spatial data for various geo-spatial applications.

SYLLABUS:

Unit 1: Design of water treatment system, intake structure, PST, Mechanical rapid mixing devices and Flocculators, Sedimentation tanks, Filters and Disinfection, etc.

Unit 2: Design of Sewerage system and Drainage system.

Unit 3: Design of wastewater treatment system, Trickling filters, Activated Sludge Process, Stabilization ponds, Lagoons.

Unit 4: Design criteria of Anaerobic Biological Reactors including Anaerobic Filter, UASBR, etc.; sludge digesters and sludge beds.

Unit 5: Case Studies (Complete design of water and wastewater systems).

TEXT/REFERENCE BOOKS:

- Rich, L.G. "Unit Processes in Sanitary Engineering ", John Wiley & Sons, Inc., New York, 1963.
- Metcalf & Eddy, Inc. "Wastewater Engineering - Treatment, Disposal, and Reuse ", Seventh Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.
- Arceivala, S. J. (2002), “Wastewater Treatment for Pollution Control” 2nd Ed. 3rd Reprint, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- Gray, N. F., “Water Technology”, Ist Indian Ed., Viva Books Pvt. Ltd., New Delhi, 2000.
- Qasim, S.R., “Wastewater Treatment Plants – Planning, Design and Operation”, Holt, Rinehart and Winston Publisher, New York, 1985.
- CPHEEO, "Manual on water supply and Treatment,” Ministry of Urban Development, GOI, New Delhi, 1999.
- CPHEEO, "Manual on Sewerage and Sewage Development ", Ministry of Urban Development, GOI, New Delhi, 1993.

COURSE OUTCOMES:

On completion of the course, the following outcome will be achieved:

1. Design of water treatment system
2. Understand the Design of Sewerage system and Drainage system to improve the quality of water.

SYLLABUS:

Unit 1: Introduction- Problematic Geomaterials and Conditions, Ground Improvement Methods and Classification, Selection of Ground Improvement Method.

Unit 2: Mechanical modification- Dynamic compaction, Impact loading, Compaction by blasting, Vibro-compaction; Pre-compression, Stone columns; Hydraulic modification: Dewatering systems, Preloading and vertical drains, Electro-kinetic dewatering.

Unit 3: **Chemical modification and Thermal modification-** Modification by admixtures, Stabilization using industrial wastes, Grouting, Ground freezing and thawing.

Unit 4: Soil reinforcement- Reinforced earth, Basic mechanism, Type of reinforcements, Selection of stabilization/Improvement of ground using Geotextiles, Geogrid, Geomembranes, Geocells, Geonets and Soil nails.

Unit 5: Application of soil reinforcement- Shallow foundations on reinforced earth, Design of reinforced earth retaining walls, Reinforced earth embankments structures, Wall with reinforced backfill, Analysis and design of shallow foundations on reinforced earth, road designs with geosynthetics.

TEXT/REFERENCE BOOKS:

- Patra, N. R. (2014). Ground improvement techniques. Vikas Publishing House.
- Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-Hill International Editions, 1990.
- Yonekura, R., Terashi, M. and Shibazaki, M. (Eds.), Grouting and Deep Mixing, A.A. Balkema, 1966.
- Moseley, M.P., Ground Improvement, Blackie Academic & Professional, 1993.
- Xanthakos, P.P., Abramson, L.W. and Bruce, D.A., Ground Control and Improvement, John Wiley & Sons, 1994.

COURSE OUTCOMES:

At the completion of the course the students will be able to:

1. Identify difficult ground conditions in engineering practice.
2. Identify different ground improvement techniques and select site specific method of improvement and its design.
3. Promote wider use of techno – economical construction techniques such as Stone columns, Reinforced soil structures, Soil Nails etc.

SYLLABUS:

Unit 1: **Maintenance and Repair Strategies:** Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating damaged structure, causes of deterioration, Introduction to evaluation of structure.

Unit 2: Serviceability and Durability of Concrete: Quality assurance for concrete construction concrete properties – strength, permeability, thermal properties and cracking. – Effects due to climate, temperature, chemicals, corrosion – design and construction errors – Effects of cover thickness and cracking.

Unit 3: Materials and Techniques for Repair: Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete. Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coating and cathodic protection.

Unit 4: **Repairs, Rehabilitation and Retrofitting of Structures:** Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.

Unit 5: **Demolition Techniques:** Engineered demolition techniques for Dilapidated structures – case studies.

TEXT/REFERENCE BOOKS:

- Neville, A.M., Properties of Concrete, Pearson Education Asia (P) Ltd, England, 2000.
- Mehta, P.K and Montevic. P.J., Concrete- Microstructure, Properties and Materials, ICI, 1997.
- Vedhikizen Van Zanten, R., (Ed), Gerotextiles and Geomembranes in Civil Engineering.
- Koerner, R.M., Construction and Geotechnical Methods in Foundation Engineering, McGraw Hill Co., 1985.

COURSE OUTCOMES:

At the end of the course, the student will be able:

1. Understand the importance of Repair Strategies.
2. Understand the Serviceability and Durability of concrete.
3. Summarize the various techniques for repairs.
4. Understand the demolition techniques.

SYLLABUS:

Unit 1: Concept of Remote Sensing, types of remote sensing and sensor characteristics. History of remote sensing and Indian space program. Photographic Imaging.

Unit 2: Digital Imaging, framing and scanning systems, spectrometer, spectroradiometer, Thermal remote sensing, Lidar, Microwave remote sensing.

Unit 3: Visual image interpretation, Digital image processing, high and low pass filters, convolution matrices, Data integration, analysis and Presentation.

Unit 4: Applications of remote sensing, Geological, geomorphological and urban, Concept of Geographic information systems, Functions and advantages of GIS, Special data models.

Unit 5: Attribute data management and metadata concept. Process of GIS, Geospatial analysis, Planning, implementation and management of GIS, Modern trends of GIS.

TEXT/REFERENCE BOOKS:

- Remote Sensing and GIS 3rd Edition, Dr. Basudeb Bhatta.
- Fundamentals Of Remote Sensing by George Joseph and C Jeganathan .
- Concepts and Techniques of Geographic Information Systems by Chor Pang Lo & Albert K.W. Yeung.

COURSE OUTCOMES:

At the end of the course, the student will be able:

1. Understand the basic concept of remote sensing and the factors affecting them
2. Know about the different remote sensing systems and the relative advantages and disadvantages.
3. Understand the different spectral reflectance curves and benefit of using different band combinations to extract the information of interest.
4. Understand various key parameters that aid visual interpretation.
5. Understand different methods of digital image processing to extract useful information.
6. Know the Basics of GIS and its application areas, different geospatial models.
7. Assign and analyse different attribute data to GIS models for specific applications.

SYLLABUS:

Unit 1: Air pollutants, Sources, classification, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects, Smoke, smog and ozone layer disturbance, Greenhouse effect, Indoor air quality.

Unit 2: Air sampling and pollution measurement methods, principles and instruments, Indoor and ambient air quality and emission standards, Air pollution indices.

Unit 3: Air Act, legislation and regulations, control principles, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods. Particulate emission control, settling chambers, cyclone separation.

Unit 4: Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation, and biological air pollution control technologies.

Unit 5: Noise- Basic concept, noise monitoring procedure, specification and various control methods, effects of noise on health.

TEXT/REFERENCE BOOKS:

- Kenneth, W., Warner, F.C. And Davis Wayne, T., "Air Pollution, Its Origin and Control", 3rd Ed., Prentice Hall.
- Mishra, P.C., "Fundamentals of Air and Water pollution", South Asia Books.
- Davis, M.L. and Cornwell, D.A., "Introduction to Environmental Engineering", McGraw Hill.
- S.P Singal Noise Pollution and Control Technology, Narosa Pub House; 1 edition (March 1, 2000).

COURSE OUTCOMES:

At the end of the course, the student will:

1. Be able to understand the impact of air and noise on human's health and environment.
2. Be able to identify the success of air and noise pollution.
3. Be able to plan strategies to control, reduce and monitor air and noise pollution.
4. Be able to select the most appropriate technique for mitigation of air and noise pollution.
5. Be conversant with basic environmental legislation.

SYLLABUS:

Unit 1: Introduction to Earthquake Parameters: Earthquake occurrences –Global Seismic Belts. Indian Seismic Zoning map, their engineering implications: Damage survey, seismic intensity, isoseismal maps, more commonly used earthquake parameters like epicenter, epicentral distance, origin time, focus, magnitude, frequency. Elementary information on seismic wave propagation. Demonstration of seismographs to explain earthquake recording.

Unit 2: Single Degree of Vibration Freedom System: Introduction to vibration problems, Undamped and Damped free vibration with viscous damping, Forced vibrations, Steady state, Vibration Isolation.

Unit 3: Single Degree of Vibration Freedom System: Vibration Measuring Instruments, (Demonstration for determination of damping, frequency etc.), Response of undamped systems to time dependent force functions (Pulse/impulses), Duhamel's Integral, Response to ground motion, Response spectra.

Unit 4: Two Degree of Freedom System: Determination of natural frequency and mode shapes, Steady state forced vibrations, Undamped vibration absorbers.

Multi Degree of Freedom System: Rayleight's Method - Determination of fundamental frequency of simple systems, free vibrations of undamped systems – Determination of frequency and mode shapes by Holzer method, Stodola Method, Evaluation of earthquake forces in multi-storeyed buildings using response spectra.

Unit 5: Earthquake Effects: Ground failures, Local site effects, Effects on ground and structure.

Introduction to IS Code: IS-1893, Codal Provisions for evaluation of earthquake forces on buildings.

TEXT/REFERENCE BOOKS:

- Krishna, J., Chandrasekaran, A. R., & Chandra, B. (1994). Elements of earthquake engineering. South Asian Publishers.
- Chopra, A. K. (2007). Dynamics of structures. Pearson Education India.
- Damodarasamy, S. R. (2009). Basics of structural dynamics and aseismic design. PHI Learning Pvt. Ltd.
- Shrikhande, M., & Agarwal, P. (2006). Earthquake Resistance Design Of Structure. First Revised Edition, PHI Learning Private Limited, New Dehli.
- Hu, Y. X., Liu, S. C., & Dong, W. (1996). Earthquake engineering. CRC Press.
- Okamoto, S. (1984). Introduction to earthquake engineering. Steve Parish.

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Summaries engineering seismology and discuss the causes and effects of earthquakes.
2. Characterize different types of vibration for single degree freedom system.
3. Understand principle of vibration measuring instrument.
4. Analyze pulse or impulse loading using Duhamel's Integral.
5. Draw the response spectra for different ground condition and understand their application.
6. Explain the concept of isolators.
7. Draw the node shape for multi degree freedom system using different methods.
8. Understand the effects of earthquake.
9. Determine the earthquake forces on multi stories structure using IS:1893.

SYLLABUS:

Unit 1: Soil as a multiphase system: Soil-environment interaction; Properties of water in relation to the porous media; Water cycle with special reference to soil medium, Environmental Geotechnical Problems.

Unit 2: Soil mineralogy and Ion-Exchange Capacity: Significance of mineralogy in determining soil behavior; Mineralogical characterization, Size and Shape Measurement of Soil, Identification and Determination of Clay Minerals. Diffuse double layer models; Force of attraction and repulsion; Soil-water-contaminant interaction; Theories of ion exchange; Influence of organic and inorganic chemical interaction.

Unit 3: Soil–Water–Air Interaction in the Environment: Properties of Water and Water Substances, Solutions, Compounds, Mixtures, and Electrolytes, Electrochemical Characteristics of the Soil–Water System.

Unit 4: Hydraulic Conductivity and Mass Transport Phenomena: Capillarity, Hydraulic Conductivity, Infiltration, Percolation, and Retention, Mass Transport Phenomena, Osmosis and Reverse Osmosis Phenomena.

Unit 5: Solid/Liquid Waste Control: Characteristics of Urban Refuse, Compaction of Landfill, Slope Stability of Landfill, Waste Control System Components, Factors Affecting the Stability of Waste Control Systems.

TEXT/REFERENCE BOOKS:

- Introduction to Environmental geotechnology, Fang and Chaney, CRC press.
- Environmental Geotechnics, R. W. Sarsby, ICE Publishing.

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Describe Soil-environment interaction, Soil mineralogy and Mechanisms of soil-water interaction
2. Explain hydraulic conductivity and predict contaminant transport phenomenon
3. Design landfill system and remediation techniques for contaminated sites Draw the response spectra for different ground condition and understand their application.

SYLLABUS:

Unit 1: Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

Unit 2: Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System

Unit 3: ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveller Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

Unit 4: ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.

Unit 5: Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

TEXT/REFERENCE BOOKS:

- ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
- Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.
- National ITS Architecture Documentation, US Department of Transportation, 2007 (CD-ROM).

COURSE OUTCOMES:

At the completion of the course the students will be able to:

1. Understand the sensor and communication technologies.
2. Apply the various its methodologies.
3. Define the significance of its under INDIAN conditions.

SYLLABUS:

Unit 1: Basic concepts of systems, need for systems approach in water resources, system design techniques, problem formulation;

Unit 2: Introduction to Optimization, Optimization techniques, Linear Programming, Graphical Method, Simplex Method, Dual Simplex Problem, Reservoir operation and Reservoir sizing using Linear Programming

Unit 3: Non-Linear Programming, Dynamic programming, genetic algorithm, sensitivity analysis, capacity expansion, reservoir operation problems, simulation, case studies, Multi reservoir operation.

Unit 4: Probability, risk and uncertainty analysis for hydrologic and hydraulic design, Chance Constrained Linear Programming, Stochastic Processes and Transitional Probabilities, Stochastic Dynamic Programming, Time series analysis.

Unit 5: Planning, role of a planner, River basin planning and management, Water distribution system, Groundwater system, Flood plain Management, Urban storm water management, National water policies, public involvement, social impact, economic analysis.

TEXT/REFERENCE BOOKS:

- ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
- Loucks, D.P., Stedinger, P.J.R., Haith, D.A., Water Resources Systems Planning and Management, Prentice Hall, New Jersy, 1987
- Hall, K., A and Draoup, J.A., Water Resources Systems Engineering, Tata McGraw Hill, 1970.
- Neil, G.S., Water Resources Planning, McGraw Hill, 1985.
- National Water Policy, Ministry of Water Resources, Government of India, 1987.

COURSE OUTCOMES:

At the completion of the course the students will be able to:

1. Understand the need for systems approach for water resources.
2. Solve different problems of reservoir operation using linear programming principles.
3. Analyse different problems of multiple reservoirs and capacity planning using dynamic programming principles and genetic algorithms.
4. Evaluate the effect of time series analysis for the assessment of risk in hydraulic designs.

5. Systematize the types of water resource systems and perform analysis related to social and economic impact.

LIST OF PRACTICALS:

1. Design detailing of reinforced beam.
2. Design detailing of circular column.
3. Design detailing of slab.
4. Design detailing of footing.
5. Design detailing of retaining wall.
6. Rolled section and connections.
7. Gusset bases detailing.
8. Design detailing of roof truss.
9. Grillage footing.

TEXT/REFERENCE BOOKS:

- Handbook on Concrete Reinforcement and Detaling SP 34 (1987), Bureau of Indian Standards
- Manual for Detaling of steel Structure by S. Kanthimathinathan
- Structural Design and Drawing reinforced concrete and Steel by N Krishna Raju, University Press
- Practical Design of Reinforced Concrete Structures by Karuna Moy Ghosh, PHI publications
- Handbook on Concrete Reinforcement and Detailing SP 34 (1987), Bureau of Indian Standards

COURSE OUTCOMES:

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

1. Understand various reinforcement and their locations in Beam Design
2. Understand various reinforcement and their locations in Column Design
3. Differentiate between main and distribution reinforcement in slab design
4. Understand various reinforcement and their locations in footing and retaining wall.
5. Acquire knowledge about various rolled section and different connections
6. Explain about Gusset base design and details
7. Identify various roof components and their position
8. Learn Grillage foundation detailing

BACHELOR OF TECHNOLOGY
in
CIVIL ENGINEERING

SYLLABI
of
EIGHT SEMESTER

Department of Civil Engineering
G. B. Pant Institute of Engineering and Technology, Pauri Garhwal, U.K.

SYLLABUS:

Unit 1: Construction project planning: Unique features of construction, construction projects types and features, phases of a project, agencies involved and their methods of execution; Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning role of client and contractor, level of detail. Process of development of plans and schedules, work breakdown structure.

Unit 2: Techniques of planning: Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT- Assumptions underlying PERT analysis, determining three-time estimates, analysis, slack computations, calculation of probability of completion.

Unit 3: Construction Equipment basics*:* Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities.

Unit 4: Project Monitoring &Control: Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

Unit 5: Contracts Management basics: Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods.

TEXT/REFERENCE BOOKS:

- Varghese, P.C., "Building Construction", Prentice Hall India, 2007.
- Chudley, R., Construction Technology, ELBS Publishers, 2007.
- Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
- Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
- Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
- Punmia, B.C, Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Apply knowledge and skills of modern construction practices and techniques.
2. Plan, control and monitor construction projects with respect to time and cost.
3. Optimize construction projects based on costs.
4. Have an idea how construction projects are administered with respect to contract structures and issues.
5. Put forward ideas and understandings to others with effective communication processes.

SYLLABUS:

Unit 1: Introduction, components of bridges, classification of bridges, related structures, classical examples of various types of bridges, Selection of site and initial decision process, survey and alignment, geotechnical investigations, collection of bridge design data, hydrological calculations, waterway calculations, scour, depth of foundation, freeboard considerations, vertical clearance

Unit 2: Standard loadings for bridge design as per different codes of practice, IRC, BS and AASHTO codes, various types of loads considered for design of bridges, impact factor, centrifugal force, wind and seismic considerations, width and roadway considerations, influence lines, load combinations, limit and working stress design considerations, pre-design considerations, roadway vs. railway bridges.

Unit 3: Superstructure of bridge: selection of main bridge parameters, design methodologies, choice of superstructure type, load distribution in various types of superstructures, RCC and PSC superstructures, longitudinal analysis of bridges, transverse analysis of bridge, temperature analysis, effect of differential movements of supports, reinforced earth structures, box girder bridges

Unit 4: **Substructure of bridge:** pier, abutment, wing walls, importance of substructure soil interaction, open foundation, pile foundation, well foundation, simply supported and continuous bridges.

Unit 5: **Bearings and deck joints:** types of bearings, expansion joints, design of bearings and joints, parapets and railings for highway bridges, definitions, classifications of bridge parapets, related details.

TEXT/REFERENCE BOOKS:

- M.J. Ryall, Parke G.A.R and Harding J.E.,'The manual of bridge engineering', Thomas Telford Publishers ASIN 8000Q91ZDY 1997
- Raina V.K., 'Concrete bridge practice – analysis, design and economics, Tata McGraw-Hill Publishing Company Ltd. (ISBN 8184043783) 2002
- Ponnuswamy S., 'Bridge engineering', Tata McGraw-Hill Publishing Company Ltd. ISBN: 9780070656956200.

COURSE OUTCOMES: At the end of the course, the student will be able:

1. To understand the essentials of bridge engineering.
2. To understand the various types of bridge loadings.
3. To understand the RCC girder bridges.
4. To understand the substructure of RCC girder bridges.
5. To design bearings.

SYLLABUS:

Unit 1: Introduction: Climate system; climate, weather and climate change; overview of earth's atmosphere; vertical structure of atmosphere; radiation and temperature; laws of radiation; head-balance of earth atmosphere system; Random temperature variation; modelling vertical variation in air temperature; temporal variation of air temperature; temperature change in soil; thermal time and temperature extremes

Unit 2: Hydrologic Cycle: Introduction; Global water balance; cycling of water on land, a simple water balance model; climate variables affecting precipitation, precipitation and weather, humidity, vapor pressure, forms of precipitation, types of precipitation; cloud; atmospheric stability; monsoon; wind pattern

Unit 3: Climate Change: Introduction; causes of climate change; modelling of climate change, global climate models, general circulation models, downscaling; IPCC scenarios.

Unit 4: Statistical Methods in Hydro-Climatology: Trend analysis; Empirical orthogonal functions, principal component analysis; canonical correlation; statistical downscaling with regression.

Unit 5: Ecological Climatology: Leaf energy fluxes and leaf photosynthesis; plant canopies, ecosystem and vegetation dynamics; coupled climate vegetation dynamics, carbon cycle climate feedbacks, introduction to precipitation recycling.

TEXT/REFERENCE BOOKS:

- Bonan G. B., Ecological climatology, Cambridge university press, 2002
- Campbell, G. G. and Norman J. M., An introduction to environmental biophysics, Springer, 1998
- IPCC Assessment report 4
- Recent articles in journal, specifically water resources research, journal of geophysical research, journal of climate, climatic change, nature geoscience, nature climate change etc.

COURSE OUTCOMES:

At the end of the course, the student will be able:

1. Distinguish the weather and climate along with laws governing the earth climate system.
2. Determine the importance of hydrological cycle and its patterns in climate change of earth.
3. Evaluate the models of climate change like general circulation models and downscaling scenarios.
4. Estimate the impact of vegetation and plant canopies in the ecological climatic scenario.

SYLLABUS:

Unit 1: A Brief History of GIS and Its Use in Water Resources Engineering: What is geocomputation, Geocomputation and water resources science and engineering, GIS-enabled geocomputation in water resources science and engineering, why should water resources engineers and scientists study GIS, A Brief History of GIS and Its Use in Water Resources Engineering, History of GIS in water resources applications, Recent trends in GIS, Benefits of using GIS in water resources engineering and science Challenges and limitations of GIS-based approach to water resources.

Unit 2: Hydrologic Systems and Spatial Datasets: Hydrological processes in a watershed, Fundamental spatial datasets for water resources planning: management and modelling studies, Sources of data for developing digital elevation models, Sensitivity of hydrologic models to DEM resolution, Accuracy issues surrounding land use land cover maps, Sensitivity of hydrologic models to LULC resolution, Sources of data for developing soil maps, Accuracy issues surrounding soil mapping Sensitivity of hydrologic models to soils resolution.

Unit 3: **Water-Related Geospatial Datasets**: River basin, watershed, and sub-watershed delineations, Streamflow and river stage data, Groundwater level data, Climate datasets, Vegetation indices, Soil moisture mapping, Water quality datasets, Monitoring strategies and needs, Sampling techniques and recent advancements in sensing technologies, Data Sources and Models, Digital data warehouses and repositories, Software for GIS and geocomputations, Software and data models for water resources applications.

Unit 4: **Lake Volume Monitoring from Space**: Satellite Altimetry, Past, Present, and Future Satellite Altimetry, Combination of Multi-Satellite Data, Accuracy of Satellite Altimetry Over Lakes, Storage Change Calculation, Case Study.

Unit 5: **Assessing Global Water Storage Variability from GRACE**: Trends, Seasonal Cycle, Sub-seasonal Anomalies and Extremes, Signal Decomposition, Monthly Averaging of the Daily Decomposed Forcing Time Series, Significance Testing and Correlation Analysis, Identifying Droughts in the GRACE Record. Global Hydrological Variability in the GRACE Data, Groundwater Depletion in North West India, Major Challenges in Monitoring Groundwater Change Using GRACE

TEXT/REFERENCE BOOKS:

- Barnali Dixon, Venkatesh Uddameri, 2016, GIS and Geocomputation for Water Resource Science and Engineering, John Wiley & Sons, Ltd, ISBN 978-1-118-35414-8.
- A. Cazenave • N. Champollion J. Benveniste J. Chen, 2016, Remote Sensing and Water Resources, Surveys in Geophysics, Volume 37, Issue 2, Springer, DOI 10.1007/978-3-319-32449-4.

COURSE OUTCOMES:

At the end of the course, the student will be able:

1. Prepare the necessary data input for hydrological modelling such as watershed, drainage network etc. with the help of DEM.
2. Analyze and process LULC data, various indices, climate data set, soil maps etc. required in hydrological modelling.
3. Monitoring and estimating water reservoir using satellite altimeter data.
4. Monitoring and estimating ground water using GRACE satellite data.

SYLLABUS:

Unit 1: Pavement Materials and Design Considerations: Road Materials, Alternate forms of aggregates, theory and specifications of fillers, additives, emulsions, cutbacks and modified binder, Mix designs-Marshall, Hubbard Field and Hveem Method, requirement of a mix. Design factors, empirical, semi-empirical and analytical design methods of flexible pavement design. Design of flexible pavement using IRC 37: 2012.

Unit 2: Flexible Pavement Construction: Earthwork, compaction and construction of embankments, specifications of materials, construction methods and field control checks for various types of flexible pavement materials in sub- base, base, binder and surface course layers and their choice.

Unit 3: Cement Concrete Pavement Construction: Design of Rigid Pavements, Design factors, load and temperature stresses, load transfer devices, design of Dowel and Tie bars, joint requirement and working, Specifications and method of cement concrete pavement construction; Construction of interlocking block pavements, Quality control tests; Construction of various types of joints.

Unit 4: Soil Stabilized Pavement: Principles of gradation/proportioning of soil- aggregate mixes and compaction; Design factors, mix design, construction control and quality control checks for mechanical, soil-cement, soil-bitumen and soil-lime stabilization methods. Use of additives, Numerical problems on mix design and applications.

Unit 5: Pavement Evaluation and Management: Pavement Distress - Functional and structural condition of pavements, Pavement distresses, Functional condition evaluation of pavements. Structural evaluation of pavements - nondestructive testing, Benkelman beam and Falling Weight Deflectometer, Pavement strengthening based on deflection as per IRC, Maintenance and rehabilitation techniques; Pavement Management Systems - Components, structure, data requirements.

TEXT/REFERENCE BOOKS:

- L R kadiyali and N B Lal, principles and practices of highway engineering.
- S K Khanna and Justo, highway engineering.
- Yoder and Witczak, ‘Principles of Pavement Design’, John Wiley,1975
- Huang Yang H., Pavement Analysis and Design, Pearson Education India, 2008
- Nai C. Yang, ‘Design of Functional Pavements’, McGraw Hill ,1972
- IRC: 37 -2001, ‘Guidelines for the Design of Flexible Pavements’
- IRC: 58 -2002, ‘Guidelines for the Design of Rigid Pavements’

- Hass and Hudson, ‘Pavement Management System’, McGraw Hill Book Co. ,1978
- Mix Design Methods for Asphalt Concrete and other Hot mix types MS 2, Sixth Edition, The Asphalt Institute, 1997
- IRC 81-1981, ‘Tentative Guidelines for Strengthening of Flexible Pavements by Benklman Beam Deflections Techniques’

COURSE OUTCOMES:

On completion of the course, the student will be able to:

1. Understand the purpose and characteristics of different materials used in highway design and factors affecting them.
2. Understand the process of flexible pavement construction and filed checks while laying different layers.
3. Understand the process of rigid pavement and effect of various factors that governs the structural characteristics.
4. Understand the need and process of soil stabilization, different factors in design and effect of different additives.
5. Understand the different techniques that are used to check the quality of pavement post construction and maintenance techniques.

SYLLABUS:

Unit 1: Introduction to Slope Stability Concepts: Aim of slope stability analysis, Types of slopes, Factors contributing to slope failure, Concept of slope stability and contributing factors, Inputs for slope stability analysis.

Unit 2: Various important aspects in Slope Stability: Various geological features associated with slopes, Groundwater in slope stability analysis, Geological site exploration for input data, Laboratory testing and interpretation of properties of slope structure.

Unit 3: **Slope Stability Analysis:** Various modes of failure, Factor of safety concept, Block analysis, Infinite slope analysis, Planar surface analysis, Circular surface analysis, Methods of slices, Design charts.

Unit 4: **Advanced Analysis of Slope Stability:** Seismic analysis of slope stability, Three-dimensional slope stability analysis, Rock slope stability, FEM analysis of slopes.

Unit 5: **Slope Stabilization Methods:** Buttressing, providing drainage, Reinforcement of the soil section, Retaining walls, Surface slope protection, Rock slope stabilization, Selection of stabilization method.

TEXT/REFERENCE BOOKS:

- Basic and applied Soil Mechanics, Rajan & Rao, New Age International Publishers
- Slope stability and Stabilization methods, Lee et al., John Wiley and Sons
- Slope Stability Analysis and Stabilization, Cheng and Lau, CRC press

COURSE OUTCOMES:

At the end of the course, the student will be able:

1. Explain slope failures and identify the factors contributing to slope failure
2. Describe various important aspects in slope stability
3. Perform slope stability analysis
4. Examine various advanced analysis methods of slope stability
5. Compare various slope stabilization methods and choose the suitable one

SYLLABUS:

Unit 1: Types and Sources of solid and hazardous wastes, Origin, Analysis, composition and Characteristics.

Unit 2: Integrated Solid Waste Management System: Collection, Storage, and Segregation, Reuse and Recycling possibilities, Transportation, Treatment / Processing and Transformation Techniques, Final Disposal.

Unit 3: Management of Municipal, Biomedical, Nuclear, Electronic and Industrial solid wastes and the rules and regulations.

Unit 4: Introduction to Hazardous wastes, Definition of Hazardous waste, The magnitude of the problem; Hazardous waste: Risk assessment, Salient features of Indian legislations on management and handling of Hazardous wastes, Characterization and site assessment, Waste minimization and resource recovery, Transportation of hazardous waste, Physical, chemical and biological treatment, Ground water contamination.

Unit 5: Solid waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills, leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation.

TEXT/REFERENCE BOOKS:

- George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
- Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York, 2001.
- CPHEEO, “Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
- Vesilind P.A., Worrell W and Reinhart, "Solid Waste Engineering", Thomson Learning Inc., Singapore, 2002. 5 Paul T Williams, "Waste Treatment and Disposal", Wiley, 2005

COURSE OUTCOMES:

At the end of the course, the student will be able:

1. Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation.
2. Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste.

3. Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges.

SYLLABUS:

Unit 1: Materials and Their Properties: Review of properties of cement, their physical and chemical properties, special purpose cements, Classification and properties of aggregates, soundness of aggregates, alkali aggregate reaction, thermal properties of aggregates, Importance of shape and Surface area and grading, gap graded and aggregates. Admixtures & construction chemicals, Use of Fly Ash, Silica Fumes, Metakaolin & GGBS in concrete Introduction to prestressed concrete.

Unit 2: Properties of Concrete: Rheological behaviour of concrete, requirements of workability of concrete, Durability & Effect of environmental conditions, Strength & maturity of hardened concrete, Impact, Dynamic and fatigue behaviour of concrete, shrinkage and creep of concrete, behaviour of concrete under fire.

Unit 3: **Permeability and durability of concrete**: Permeability and Durability of concrete, Parameters of durability of concrete, chemical attack on concrete, Production of concrete; batching mixing, transportation, placing, compaction of concrete. Special methods of concreting and curing, Hot weather and cold weather concreting, Guniting (Shotcreting).

Unit 4: **Concrete Mix Design**: Concrete mix design, Basic considerations and choice a mix proportions, various methods of mix designs including IS Code method. Quality control and quality assurance of concrete, Acceptance criteria, Quality management in concrete construction, Inspection and testing of concrete. Non-destructive testing of concrete, core test and load test.

Unit 5: **Special Concrete**: Special concrete such as high strength, Lightweight, heavy weight, vacuum processed concrete, Mass concrete, high performance concrete, Pumpable concrete, Self-Compacting concrete, Air entrained concrete, Ferro cement, Fiber reinforced concrete, Polymer impregnated concrete. Jet concrete. Recycling & re-use of industrial waste material. Deterioration and repair technology of concrete, Distress and type of repairs, crack sealing techniques.

TEXT/REFERENCE BOOKS:

- Neville, A.M., Properties of Concrete, Pearson Education Asia (P) Ltd, England, 2000.
- Concrete Technology, Gambhir M.L, Tata McGraw Hill
- Concrete Technology, M.S. Shetty, S. Chand & Company New Delhi
- Concrete microstructure, properties & materials, P. Kumar Mehata, Paulo & J.M. Monteiro,
- Light Weight Concrete, Short & Kenniburg, Asia Publishing House, Bombay.

COURSE OUTCOMES:

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

1. Understand the physical and chemical properties of cement.
2. Understand the various properties of concrete.
3. Understand, Analyze and Evaluate the Concrete mix design.
4. Understand the various special concrete and its uses.

SYLLABUS:

Unit 1: Groundwater occurrence and its role in hydrologic cycle, Moisture distribution in a vertical profile, Classification of aquifers, Continuum approach to flow through porous media, Darcy's law, Hydraulic Conductivity, Eigen values of the hydraulic conductivity tensor, Flow in anisotropic aquifers, Dupuit assumptions for a phreatic aquifer.

Unit 2: Aquifer storativity, Dupuit-Forchimer Equation, Basic equation of continuity in Cartesian coordinates, initial and boundary conditions, Simplified case of the continuity equation wit isotropic hydraulic conductivity and steady state, Laplace equation.

Unit 3: Differential equations governing ground water flow in polar coordinates, well hydraulics, analytical solutions for confined, leaky confined and unconfined aquifers, image well theory, time-variant pumping rates, well interference, Analysis of pumping test data.

Unit 4: Concept of interfacial tension, principles of flow in the unsaturated zone, Capillary pressure and retention curves, soil water characteristic curves (SWCC), Continuity equation in unsaturated zone, One dimensional Richard's equation.

Unit 5: Reasons for the depletion of groundwater, Artificial recharge, Contamination of Groundwater, different sources of contamination, solution procedure of the source identification problem, management of the aquifer using aquifer remediation techniques. Groundwater Modelling Systems (GMS): A software to model flow and transport in groundwater.

TEXT/REFERENCE BOOKS:

- Todd, D.K., "Groundwater Hydrology", Wiley.
- Bear J., "Hydraulics of Groundwater", McGraw-Hill.
- Bouwer, H., "Groundwater Hydrology", McGraw-Hill.

COURSE OUTCOMES:

At the end of the course, the student will be able:

1. Understand the importance of Groundwater for the domestic as well as industrial purposes.
2. Classify different kinds of aquifers and identify the aquifer parameters such as permeability and storativity by interpreting the experimental datasets.
3. Determine the role of unsaturated water with soil water characteristics for the root development of plants.
4. Modelling the fate and transport of contaminants in groundwater using Groundwater Modelling Systems (GMS) software.

SYLLABUS:

UNIT 1: Industrial wastes and their sources: Various industrial processes, Sources and types of solid, liquid, gaseous wastes, Noise & radiation emissions. Sources of industrial water usages and various industrial processes requiring water use and required water quality.

UNIT 2: Processes responsible for deterioration in water quality, Various waste water streams, Control and removal of specific pollutants in industrial waste waters, e.g., oil and grease, bio-degradable organics, chemicals such as fluoride, toxic organics, heavy metals etc. Waste water reuse & recycling, Concept of zero discharge effluent.

UNIT 3: **Air pollution sampling and measurement:** Types of pollutant and sampling and measurement, ambient air sampling: Collection of gaseous air pollutants, Collection of particulate air pollutants. **Stack sampling:** Sampling system, Particulate sampling, and gaseous sampling. Air pollution control, methods and equipment.

UNIT 4: Recent trends in industrial waste management, Cradle to grave concept, Life cycle analysis, clean technologies; Case studies of various industries, e.g., dairy, distillery, sugar, pulp and paper, iron and steel etc.

UNIT 5: Environmental audit: Definition and concepts, Environmental audit versus accounts audit, Compliance audit, Relevant methodologies, Various pollution regulations, Introduction to ISO and ISO14000.

TEXT/REFERENCE BOOKS:

- Peavy, H.S., Rowe, D.R., and Tchobanoglous, G. Environmental Engineering, McGraw Hill International (1985).
- Metcalf & Eddy, Wastewater Engineering, Tata McGraw-Hill Education Private Limited (2009).
- Masters, G.M., Introduction to Environmental Engineering and Science, Prentice Hall off India, (2008).
- Rao, C.S., Environmental Pollution Control Engineering, Wiley Eastern (2010).
- De Nevers, N., Air Pollution Control Engineering, McGraw-Hill (2000)

COURSE OUTCOMES: At the end of the course, the student will be able to:

1. Quantify and analyze the pollution load.
2. Analyze/design of suitable treatment for wastewater.
3. Model the atmospheric dispersion of air pollutants.
4. Selection and design of air pollution control devices.
5. Analyze the characteristics of solid waste and its handling & management.

SYLLABUS:

Unit 1: Introduction to Soil Exploration: Objectives of Site Investigation, Phases of investigation, Classification, Planning for Subsurface Exploration, Fact finding and Geological survey, Reconnaissance, Preliminary Exploration, Detailed Exploration, Codal Provisions.

Unit 2: Methods of investigations and Sampling: Trial pits/Trenches, Borings/drilling, Auger boring, Wash boring, Percussion drilling, Rotary drilling, Sample Disturbance, Disturbed Sample, Undisturbed Samples, Sampling by standard split spoon, Sampling by thin-wall tube, Sampling by Piston sampler.

Unit 3: **Geotechnical investigation (Semi-direct methods):** Vane Shear test, Standard Penetration Test, Pressuremeter Test, Cone Penetration Test, Dilatometer test, Rock core drilling, Sampling of rock, Core stacking, Rock Quality Designation (RQD), Total Core Recovery (TCR).

Unit 4: **Geophysical Tests (Indirect methods):** Seismic reflection survey, Seismic refraction survey, Electrical resistivity Survey, Applications, Advantages, Disadvantages and Limitations.

Unit 5: **Soil Exploration Report and Field Instrumentation:** Components of Soil Exploration Report, Drafting of Reports, Graphic Presentations of Bore Log, Study of Sample Reports, Field Instrumentation: Pressure meters, Piezometer, Pressure cells, Sensors, Inclinometers, Strain gauges etc.

TEXT/REFERENCE BOOKS:

- Principles of Geotechnical Engineering, Braja M. Das, Cengage
- Basic and applied Soil Mechanics, Rajan & Rao, New Age International Publishers
- Soil Properties and their correlations, Micheal Carter and Stephen P. Bentley, Wiley Publications
- Latest version of relevant IS codes for various tests.

COURSE OUTCOMES:

At the end of the course, the student will be able:

1. Describe the phases of soil investigation in depth and identify the plan for soil investigation
2. Identify various methods of soil investigation and soil sampling
3. Illustrate various field test of soils and rocks
4. Examine components of soil exploration report and estimate properties using correlations.
5. Work with relevant instrumentation required for characterizing the soil.

SYLLABUS:

Unit 1: Global and local coordinates systems, Fundamentals of Geodesy, Geoid, Reference ellipsoid, relationship between satellite and conventional geodetic system, GPS positioning.

Unit 2: GPS observables (Types, errors & quantity), GPS signal structures, Pseudo ranges, carrier phases, Format of data (Rinex), propagation medium- Troposphere, ionosphere.

Unit 3: Estimation procedures, GPS data pre-processing, cycle slips, anti-spoofing, multipath Preparation of GPS surveys. Introduction to GLONASS, GALILEO and NAVIC Systems.

Unit 4: Methods of processing of GPS data, available software, Kinematic GPS Processing, Relationship between satellite and conventional geodetic systems.

Unit 5: Applications and examples of GPS data analysis along with other space geodetic data. Geodetic Control Surveys, GIS, Vehicle tracking and Navigation, Location based service and special applications.

TEXT/REFERENCE BOOKS:

- Hofmann-Wellenhof, B., H. Lichtenegger, and J. Collins. GPS Theory and Practice. Springer, 1994
- Parkinson, B. W., J. Spilker, et al. Global Positioning System: Theory and Applications. Vol. 1.
- Global Positioning System: Theory and Applications. Vol. 2.
- A Text Book on GPS Surveying by Dr. Jayanta Kumar Ghosh.

COURSE OUTCOMES:

At the end of the course, the student will be able:

1. Understand different coordinate systems used in Global positioning.
2. Understand different parameters that affect the GPS accuracy and precision.
3. Plan and perform GPS Surveys and analyse the results.
4. Covert GPS data in different formats to be used in different applications.
5. Understand the possible applications of GPS in day-to-day life as well as research fields.

SYLLABUS:

Unit 1: Fundamentals of Traffic Management: Principles of Traffic management; Highway capacity and Level of service; Mixed Traffic flow: PCU concept and its limitations; Traffic stream parameters: Interrupted and Uninterrupted flow

Unit 2: Traffic Regulation and Control devices: Road Signs and markings; Channelization; At-grade and Grade separated intersections; Traffic Rotary; Design principles of traffic signals

Unit 3: Traffic Management techniques: Regulatory measures for Traffic management; Travel Demand Management; Role of ITS in-traffic management

Unit 4: Road accidents: Causes of road accidents: Vehicle design factors & Driver characteristics influencing road safety, Road condition, Parking and its influence on traffic safety

Unit 5: Road safety measures: Accident data collection methods; Representation of accident data: Collision and condition diagram; Methods to Identify and Prioritize Black spots; Road safety: 3 'E' measures. **Road safety audits**: Key elements in Road safety audit; Road safety audit procedure and investigations; Role of ITS in-Road safety

TEXT/REFERENCE BOOKS:

- Fred L. Mannering, Scott S. Washburn. Principles of Highway Engineering and Traffic Analysis.7th Edition, Wiley, 2019.
- Kadiyali L.R. Traffic Engineering & Transport Planning. Khanna Publications, 2013.
- Khisty C.J. and Lall B.K. Transportation Engineering – An Introduction. 3rd Edition, Pearson, 2017.
- Khanna S.K., Justo C.E.G and Veeraragavan A. Highway Engineering. Revised 10th Edition,Nem Chand & Bros, 2017.

COURSE OUTCOMES:

At the end of the course, the student will be able:

1. Understand the traffic flow parameters, traffic control measures and management.
2. Analyse the feasibility of different control devices for traffic management.
3. Create the solution of the problem related to traffic congestion and safety.
4. Outline the causes of road accidents and procedure to assess the road safety audit.
5. Apply the methods to identify the black spots and propose the solutions to improve road safety.
6. Assess the need of modernization in traffic management and road safety.