Bachelor of Technology (CIVIL Engineering), KUK

SCHEME OF STUDIES/EXAMINATIONS (Modified)
(Semester -III) Credit-Based (w.e.f. 2019-20)

S. No.	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Major Test	Minor Test	Practical	Total	Duration of exam (Hours)
1	HM-251A	Introduction to Civil Engineering	2:0:0	2	2	75	25	0	100	3
2	BS-204A	Higher Engineering Mathematics	3:0:0	3	3	75	25	0	100	3
3	CE-201A	Introduction to Solid Mechanics	3:0:0	3	3	75	25	0	100	3
4	CE-203A	Introduction to Fluid Mechanics	2:1:0	3	3	75	25	0	100	3
5	CE-205A	Surveying & Geomatics	3:0:0	3	3	75	25	0	100	3
6	CE-207A	Building Construction Practice	3:0:0	3	3	75	25	0	100	3
7	CE-213LA	Fluid Mechanics Lab	0:0:2	2	1	-	40	60	100	3
8	CE-215LA	Surveying & Geomatics Lab	0:0:2	2	1	-	40	60	100	3
9	CE-217LA	Computer-aided Civil Engineering Drawing	0:0:2	2	1	-	40	60	100	3
10	MC-901A**	Environmental Sciences	2:0:0	2	0	75	25	0	100	3
11	**SIM-201A***	Seminar on Summer Internship*	2:0:0	2	0	--	50	0	50	
		Total	20:1:6	27	20	450	270	180	900	

Note: ***Note: SIM-201A*** is a mandatory credit-less course in which the students will be evaluated for the Summer Internship (training) undergone after 2nd semester and students will be required to get passing marks to qualify.

MC-901A** is a mandatory credit less course in which the student will be required to get passing marks in the major test.

B. Tech (3rd Semester) Civil Engineering							
HM-251A	Introduction to Civil Engineering						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs)
2	0	0	2	75	25	100	3

UNIT-I

Basic Understanding: What is Civil Engineering/ Infrastructure? Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes for a career, Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminent civil engineers.

Structural Engineering:

Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies;

UNIT-II

Overview of National Planning for Construction and Infrastructure Development;

Position of construction industry vis-à-vis other industries, five year plan outlays for construction; current budgets for infrastructure works;

Surveying & Geomatics: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR;

UNIT-III

Fundamentals of Building Materials: Stones, bricks, mortars, Plain, Reinforced & Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes.

Basics of Construction Management & Contracts Management:

Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management

UNIT-IV

Environmental Engineering & Sustainability:

Water treatment systems; Effluent treatment systems; Solid waste management; Sustainability in Construction.

Hydraulics, Hydrology &Water Resources Engineering:

Fundamentals of fluid flow, basics of water supply systems; Underground Structures;

Underground Structures Multipurpose reservoir projects

Text/Reference Books:

1. Basic Civil and Mechanical Engineering, G. Shanmugam & M.S. Palanichamy, McGeraw

Hill Education(India) Private Limited, Chennai.

2. Basic Civil and Mechanical Engineering, Shamugasundaram, Cengage New Delhi.

3. Basic Civil and Mechanical Engineering, by Dhale Shrikrishna A. & Tajne Kiran , S. Chand's Publication New Delhi.

Note: The examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BS-204A	HIGHER ENGINEERING MATHEMATICS						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3 h
Purpose	The objective of this course is to familiarize the prospective Engineers with Laplace Transform, partial differential equations which allow deterministic mathematical formulations of phenomena in engineering processes and to study numerical methods for the approximation of their solution. More precisely, the objectives are as under:						
Course Outcomes							
CO 1	Introduction about the concept of Laplace transform and how it is useful in solving the definite integrals and initial value problems.						
CO 2	To introduce the Partial Differential Equations, its formation and solutions for multivariable differential equations originated from real world problems.						
CO 3	To introduce the tools of numerical methods in a comprehensive manner those are used in approximating the solutions of various engineering problems.						
CO 4	To familiar with essential tool of Numerical differentiation and Integration needed in approximate solutions for the ordinary differential equations.						

UNIT-1

Laplace Transform

Laplace Transform, Laplace Transform of Elementary Functions, Basic properties of Laplace Transform, Laplace transform of periodic functions, finding inverse Laplace transform by different methods, Convolution theorem, solving ODEs by Laplace Transform method.

UNIT-2

Partial Differential Equations

Formation of Partial Differential Equations, Solutions of first order linear and non-linear PDEs, Charpit's method, Solution to homogenous linear partial differential equations (with constant coefficients) by complimentary function and particular integral method.

UNIT-3

Numerical Methods-1

Solution of polynomial and transcendental equations: Bisection method, Newton-Raphson method and Regula-Falsi method, Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

UNIT-4

Numerical Methods-2

Numerical Differentiation using Newton's forward and backward difference formulae, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules, Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations.

Textbooks/References:

1. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993. AICTE Model Curriculum in Mathematics.
2. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.
3. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1964.
4. Manish Goyal and N.P. Bali, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
8. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
9. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
10. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
11. Erwin Kreyszig and Sanjeev Ahuja, Applied Mathematics-II, Wiley India Publication, Reprint, 2015.

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B. Tech (3rd Semester) Civil Engineering							
CE-201A	Introduction to Solid Mechanics						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs)
3	0	0	3	75	25	100	3

UNIT-I

Analysis of stresses and strains:

Analysis of simple states of stresses and strains, elastic constraints, bending stresses, theory of simple bending, flexure formula, combined stresses in beams, shear stresses, Mohr's circle, Principle stresses and strains, torsion in shafts and closed thin walled sections, stresses and strains in cylindrical shells and spheres under internal pressure.

Theory of Columns:

Slenderness ratio, end connections, short columns, Euler's critical buckling loads, eccentrically loaded short columns, cylinder columns subjected to axial and eccentric loading.

UNIT-II

Bending moment and shear force in determinate beams and frames:

Definitions and sign conventions, axial force, shear force and bending moment diagrams.

Three hinged arches:

Horizontal thrust, shear force and bending moment diagrams.

UNIT-III

Deflections in beams:

Introduction, slope and deflections in beams by differential equations, moment area method and conjugate beam method, unit load method, principle of virtual work, Maxwell's Law of Reciprocal Deflections, Williot's Mohr diagram.

UNIT-IV

Analysis of statically determinate trusses:

Introduction, various types, stability, analysis of plane trusses by method of joints and method of sections, analysis of space trusses using tension coefficient method.

Text Books

1) Structural Analysis-I, Bhavikatti S.S.,Vikas Pub.House, N.Delhi.
2) Strength of Materials, Dr. Sadhu Singh, Khanna Publishers
3) Fundamentals of Structural Analysis, M.K.Pant,S.K.Kataria & Sons, N.Delhi

Reference Books

1) Strength of Materials Part-I, S.Timoshenko, Affiliated East-West Press, New . Delhi
2) Mechanics of Solids, Prasad, V. S. Gakgotia Pub., New Delhi.
3) Elementary Structural Analysis, Jain, A. K., Nem Chand & Bros, Roorkee.
4) Elementary Structural Analysis, Wibur & Nooris, McGraw Hill Book Co., Newyork.

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B. Tech (3rd Semester) Civil Engineering							
CE-203A		Introduction to Fluid Mechanics					
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs)
2	1	0	3	75	25	100	3

UNIT-I

Introduction:

Fluid properties, mass density, specific weight, specific volume and specific volume and specific gravity, surface tension, capillarity, pressure inside a droplet and bubble due to surface tension, compressibility viscosity, Newtonian and Non-Newtonian fluids, real and ideal fluids.

Kinematics of Fluid Flow:

Steady & unsteady, uniform and non-uniform, laminar & turbulent flows, one, two & three dimensional. flows, stream lines, streak lines and path lines, continuity equation in differential form, rotation and circulation, elementary explanation of stream function and velocity potential, rotational and irrotational flows, graphical and experimental methods of drawing flow nets.

UNIT-II

Fluid Statics:

Pressure-density-height relationship, gauge and absolute pressure, simple differential and sensitive manometers, two liquid manometers, pressure on plane and curved surfaces, center of pressure, Buoyancy, stability of immersed and floating bodies, determination of metacentric height, fluid masses subjected to uniform acceleration, free and forced vortex.

UNIT-III

Dynamic of Fluid Flow:

Euler's equation of motion along a streamline and its integration, limitation of Bernoulli's equation, Pitot tubes, venture meter, Orifice meter, flow through orifices & mouth pieces, sharp crested weirs and notches, aeration of nappe.

UNIT-IV

Boundary layer analysis:

Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, turbulent boundary layer, laminar sub-layer, smooth and rough boundaries, local and average friction coefficient, separation and its control.

Dimensional Analysis and Hydraulic Similitude:

Dimensional analysis, Buckingham theorem, important dimensionless numbers and their significance, geometric, kinematic and dynamic similarity, model studies, physical modeling, similar and distorted models.

Text Books

1) Hydraulic and Fluid Mechanics by P.N.Modi & S.M.Seth

2. Fluid Mechanics and Hydraulic Machines, Sukumar Pati, McGeraw Hill Education (India) Private Limited, New Delhi.

2) Fluid Mechanics and Hydraulic Machines,Dr. R.K.Bansal, Luxmi Publication

Reference Books

1.Introduction to Fluid Mechanics by Robert W.Fox & Alan T.McDonald

2. Introduction to Fluid Mechanics and Hydraulic Machines, S.K.Som, G. Biswas & S. Chakraborty, McGeraw Hill Education (India) Private Limited.

2) Fluid Mechanics Through Problems by R.J.Garde

3) Engineering Fluid Mechanics by R.J.Garde & A.G.Mirajgaoker

Note: The paper setter will set the paper as per the question paper templates provided.

	B. Tech. (3rd Semester) Civil Engineering						
CE-205A	Survey and Geomatics						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	3	75	25	100	3

Unit I

Introduction to Surveying

Fundamental Principles of Surveying, Survey Stations, Survey Lines – Ranging, Methods of traversing, instruments for measurement of angles-prismatic and surveyor's compass, bearing of lines, local attraction, examples

Triangulation and Trilateration

Theodolites Survey: Instruments, temporary adjustment of theodolite, measurement of angles, repetition and reiteration method, traverse surveying with theodolite, checks in traversing, adjustment of closed traverse, examples. Intervisibilty of Height and Distances: Trigonometric Levelling, Axis Signal Corrections

Unit II

Levelling:

Definition of terms used in levelling, types of levels and staff, temporary adjustment of levels, principles of leveling, reduction of levels, booking of staff readings, examples

Contours:

Definition, representation of reliefs, horizontal equivalent, contour interval, characteristics of contours, methods of contouring, contour gradient, uses of contours maps.

Plane Table Surveying:

Plane table, methods of plane table surveying, radiation, intersection, traversing and resection, two point and three point problems.

Unit III

Curves:

Classification of curves, elements of simple circular curve, location of tangent points-chain and tape methods, instrumental methods, examples of simple curves. Transition Curves-Length and types of transition curves, length of combined curve, examples. Vertical Curves: Necessity and types of vertical curves.

Modern Field Survey Systems:

Principal of Electronic Distance Measurement, Modulation, Types of EDM Instruments.
Working principle and survey with total station.

Unit IV

Elements of Photogrammetry:

Introduction: types of photographs, types of aerial photographs, aerial camera and height displacements in vertical photographs, stereoscopic vision and stereoscopies, height determination from parallax measurement, flight planning,

Introduction of remote sensing and its systems:

Concept of G.I.S and G.P.S. -Basic Components, data input, storage & output.

Text Books

1. Surveying Vol.I & II by B.C.Punmia
2. Surveying Vol.I & II by S.K.Duggal, TMH Publication

Reference Books

1. 1. Surveying Vol.I by T.P.Kanitkar

CE-207A	B. Tech (3rd Semester) Civil Engineering						
	Building Construction Practice						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time (Hrs.)
3	0	0	4	75	25	100	3

UNIT-I

Masonry Construction:
Introduction, various terms used, stone masonry-Dressing of stones, Classifications of stone masonry, safe permissible loads, Brick masonry-bonds in brick work, laying brick work, structural brick work-cavity and hollow walls, reinforced brick work, Defects in brick masonry, composite stone and brick masonry, glass block masonry.

Cavity and Partition Walls:
Advantages, position of cavity, types of non-bearing partitions, constructional details and precautions, construction of masonry cavity wall.

Foundation:
Functions, types of shallow foundations, sub-surface investigations, geophysical methods, general feature of shallow foundation, foundations in water logged areas, design of masonry wall foundation, introduction to deep foundations i.e. pile and pier foundations.

UNIT-II

Damp-Proofing and Water-Proofing:
Defects and causes of dampness, prevention of dampness, materials used, damp-proofing treatment in buildings, water proofing treatment of roofs including pitched roofs.

Roofs and Floors:
Types of roofs, various terms used, roof trusses-king post truss, queen post truss etc. Floor structures, ground, basement and upper floors, various types of floorings.

Doors and Windows:
Locations, sizes, types of doors and windows, fixures and fastners for doors and windows.

UNIT-III

Brick and Tiles:
Classification of bricks, constituents of good brick earth, harmful ingredients, manufacturing of bricks, testing of bricks. Tiles: Terra-cotta, manufacturing of tiles and terra-cotta, types of terra-cotta, uses of terra-cotta.

Limes, Cement and Mortars:
Classification of lime, manufacturing, artificial hydraulic lime, pozzolona, testing of lime, storage of lime, cements composition, types of cement, manufacturing of ordinary Portland cement, testing of cement, special types of cement, storage of cement.
Mortars: Definition, proportions of lime and cement mortars, mortars for masonry and plastering.

UNIT-IV

Stones:
Classification, requirements of good structural stone, quarrying, blasting and sorting out of stones, dressing, sawing and polishing, prevention and seasoning of stone.

Timber:
Classification of timber, structure of timber, seasoning of timber, defects in timber, fire proofing of timber, plywood, fiberboard, masonite and its manufacturing, important Indian timbers.

Paints and Varnishes:
Basic constituents of paints, types of paints, painting of wood, constituents of varnishes, characteristics and types of varnishes.

Text Books
1.Building Construction and Material, Gurcharan Singh, Standard Book House
2. Building Material and Construction, G.C.Sahu & Joygopal Jena, McGeraw Hill Education(India) Private Limited, Chennai.
3. Building Construction, Dr. B.C.Punmia, Luxmi Publication
4. Building Construction, Sushil Kumar, Standard Pub., N. Delhi

Reference Books
1. Building Material, Rangawala
2. Construction Engineering, Y.S. Sane
3. Building Construction, Gurcharan Singh, Standard Pub., N. Delhi

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B. Tech (3rd Semester) Civil Engineering								
CE-213 LA	**Fluid Mechanics Lab**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**

List of experiments

1. To determine metacentric height of the ship model.
2. To verify the Bernoulli's theorem.
3. To determine coefficient of discharge for an Orifice meter.
4. To determine coefficient of discharge of a venturimeter.
5. To determine the various hydraulic coefficients of an Orifice (C_d, C_c, C_v).
6. To determine coefficient of discharge for an Orifice under variable head.
7. To calibrate a given notch.
8. To determine coefficient of discharge for a mouth piece.
9. Drawing of a flow net by Viscous Analogy Model and Sand Box Model.
10. To study development of boundary layer over a flat plate.
11. To study velocity distribution in a rectangular open channel.
12. Velocity measurements by current meter, float, and double float (demonstration only)
13. Experiment on Vortex formation (demonstration only).

	B. Tech (3rd Semester) Civil Engineering							
CE-215 LA	**Surveying & Geomatics Lab**							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**

List of Experiments:

1. To plot a traverse of a given area by chain surveying & also locate offsets
2. To plot a traverse of a given area with the help of a compass and a chain.
3. To work out relative elevations of various points on the grounds by performing profile or by fly leveling
4. To plot a longitudinal section and cross section of given alignment.
5. To determine the difference in elevations of two points by reciprocal leveling.
6. To plot a contour map of given area.
7. To determine the position of station occupied by plane table using three point problem.
8. To determine the position of station occupied by plane table using two point problem.
9. Use of a tangent clinometer with plane table.

	B. Tech (3rd Semester) Civil Engineering							
CE-217 LA	Computer-aided Civil Engineering Drawing							
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Practical	Total	Time (Hrs.)
0	0	2	--	--	40	60	100	3

LIST OF EXPERIMENTS
Typical drawings of:
Bonds in brick work
Grillage foundation
Preparation of building drawing mentioning its salient features including the following details:
Ground floor plan
Two Sectional Elevations
Front and Side Elevations
Plan and Sectional Elevation of stair case, doors/ windows/ ventilators, floor and roof.
 Footings: Isolated footings, combined footings, rectangular, trapezoidal, strip, strap, raft footings
RCC Flat slabs
 Masonary columns, bearing walls, retaining walls.

MC-901A	Environmental Sciences						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	0	75	25	100	3 Hrs.
Purpose	To learn the multidisciplinary nature, scope and importance of Environmental sciences.						
Course Outcomes (CO)							
CO1	The students will be able to learn the importance of natural resources.						
CO2	To learn the theoretical and practical aspects of eco system.						
CO3	Will be able to learn the basic concepts of conservation of biodiversity.						
CO4	The students will be able to understand the basic concept of sustainable development.						

UNIT 1

The multidisciplinary nature of environmental studies, Definition, Scope and Importance, Need for public awareness, Natural Resources: Renewable and Non-Renewable Resources: Natural resources and associated problems.

(a) Forest Resources: Use and over-exploitation, deforestation, case studies. Timber eztraction, mining, dams and their effects on forests and tribal people.
(b) Water Resources: Use & over-utilization of surface & ground water, floods, drought, conflicts over water, dams-benefits and problems.
(c) Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
(d) Food Resources: World Food Problems, changes caused by agriculture and overgazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
(e) Energy Resources: Growing energy needs, renewable & non-renewable energy sources, use of alternate energy sources. Case studies.
(f) Land Resources: Land as a resource, land, degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyle.

UNIT II

Ecosystem-Concept of an ecosystem. Sturcture and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological Succession, Food Chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest Ecosystem, (b) Grassland Ecosystem, (c) Desert Ecosystem and (d) Aquatic Ecosystems (ponds, streams, lakes, rivers, oceans, esturaries)

Field Work: Visit to a local area to document Environment assets-river/forest/grassland/hill/mountain, Visit to a local polluted site-Urban /Rural Industrial/Agricultural, Study of common plants, insects and birds, Study of simple ecosystems-pond, river, hill, slopes etc. (Field work equal to 5 lecture hours).

UNIT III

Biodiversity and its conservation: Introduction, Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversityof global, National and local levels. India as a mega-diversity nation Hot spots of Biodiversity, Threats to biodiversity: Habitat loss, poaching of wild life, man-wildlife conflicts, Endangered and endemic species of India, Conservation of Biodiversity- In situ and Ex-Situ conservation of biodiversity.

Environmental Pollution Definition: Cause, effects and control measures of (a) Air Pollution (b) Water Pollution (c) Soil Pollution (d) Marine Pollution (e) Noise Pollution (f) Thermal Pollution (g) Nuclear Hazards

Solid waste management- cause, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides

UNIT IV

Social Issues and the Environment. From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people: Its problems and concerns, Case Studies: Environmental ethics-issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies: Wasteland Reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public Awareness, Human population and the Environment, Population growth, variation among nations, Population explosion-Family Welfare Programme, Environment and human health. Human rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human Health, Case Studies, Drugs and their effects; Useful and harmful drugs, Use and abuse of drugs, Stimulant and depressan drugs, Concept of drug de-addiction, Legal position on drugs and laws related to drugs.

Suggested Books

- Environmental Studies- Deswal and Deswal. Dhanpat Rai and Co.
- Environmental Science and Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India.
- Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
- Environmental Science- Botkin and Keller. 2012. Wiley , India

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