III–I

STRUCTURAL ANALYSIS – I

(Professional Core courses)

Subject Code: UGCE5T0122	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: The student should have knowledge in Solid Mechanics for developing Shear Force and Bending moment.

Course Objectives:

The course is designed to

1. Give preliminary concepts of assessment of bending moment and shear force in Propped cantilevers, fixed beams and continuous beams due to various loading conditions.
2. Impart concepts of Bending Moment and Shear force for beams with different boundary and loading conditions and to draw the diagrams of variation across the length.
3. Learn the procedure for development of slope deflection equations and to solve application to continuous beams with and without settlement of supports.
4. Impart the concepts of moving loads and influence lines are imparted for assessment of maximum SF and BM at a given section when loads of varying spans are passing over beams of different spans of Pratt and Warren trusses.

Syllabus

UNIT-I **(8 hours)**

PROPPED CANTILEVERS: Degree of static determinacy and indeterminacy, compatibility conditions, Analysis of propped cantilevers with elastic and rigid prop, different moment of inertia for single span problems-shear force and Bending moment diagrams. Analysis of truss - Deflection of Truss using unit load method**.**

UNIT-II **(9 hours)**

FIXED BEAMS: Introduction to statically indeterminate beams with U.D.load central point load, eccentric point load, Number of point loads, uniformly varying load, couple and combination of loads, different moment of inertia for single spans problems, shear force and Bending moment diagrams-effect of sinking of support, effect of rotation of a support.

UNIT-III **(8 hours)**

CONTINUOUS BEAMS: Introduction-Clapeyron's theorem of three moments-

(A)Analysis of continuous beams with constant moment of inertia with one or both ends fixed-continuous beams with overhang, continuous beams with different moment of inertia for different spans

(B) Analysis of continuous beams with Effects of sinking of supports-shear force and Bending moment diagrams.

UNIT-IV **(6 hours)**

SLOPE-DEFLECTION METHOD: Introduction, derivation of slope deflection Equation, application to continuous beams with and without settlement of supports.

UNIT-V **(10 hours)**

MOVING LOADS: Introduction maximum SF and BM at a given section and absolute maximum S.F. and B.M due to single concentrated load, U.D load longer than the span, U.D load shorter than the span, two point loads with fixed distance between them and several point loads.

INFLUENCE LINES: Definition of influence line for SF, Influence line for BM- load position for maximum SF at a section -Load position for maximum BM at a section single point load, U.D. load longer than the span, U.D. load shorter than the span.

Course outcomes

Upon the completion of this course, the students will be able to:

CO1: Analyze & draw the shear force and bending moment diagrams for various indeterminate beams and loading conditions.(L4)

CO2: Analyze deflection of trusses using unit load method(L4)

CO3: Make use of approximate methods to solve continuous beams, with and Without settlement of supports.(L3)

CO4: Inspect the maximum internal actions at cross sections of members of Statically determinate structures under the effects of moving loads(L4)

CO5: Evaluate and draw the influence lines for reactions, shear and Bending Moments in Beams and girders due to moving loads(L5)

Mapping of CO's and PO's:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	3	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	2	3	-	-	-	-	-	-	-	3	-	-
CO5	3	3	2	3	-	-	-	-	-	-	-	3	-	-

Text books:

1. Analysis of Structures-Vol I & Vol II by V.N. Vazirani & M.M.Ratwani, Khanna Publications, New Delhi.

2. Structural Analysis by V.D.Prasad Galgotia publications, 2nd Editions.
3. Theory of Structures by M.Ramamrutham, R.Narayan, and Dhanapat Rai Publishing Company (p) Ltd.

References:

1. Analysis of Structures by T.S. Thandavamoorthy, Oxford University Press, New Delhi
2. Comprehensive Structural Analysis-Vol.I & 2 by Dr. R. Vaidyanathan & Dr. P.Perumal-Laxmi publications pvt. Ltd., New Delhi
3. Basic structural Analysis by C.S. Reddy, Tata McGraw-Hill, New Delhi.
4. Mechanics of Structures by S.B.Junnarkar, Charotar Publishing House, Anand, Gujarat.
5. Theory of Structures by Gupta, Pandit & Gupta; Tat McGraw – Hill Publishing Co.Ltd. New Delhi.
6. Strength of Materials and Mechanics of Structures- by B.C.Punmia, Khanna Publications, New Delhi.
7. Negi, L. S. and Jangid, R.S. (2003). Structural Analysis, Tata McGraw-Hill Publishing Company Limited, New Delhi, ISBN 0-07-462304-4

GEOTECHNICAL ENGINEERING

(Professional Core courses)

Subject Code: UGCE5T0222 **L T P C**

III Year / I Semester **3 0 0 3**

Prerequisite: The student should have knowledge in mathematics and physics for determining basic index properties and engineering properties of soil.

Course Objectives:

1. Understand the importance of soil in civil engineering
2. Equip student with concepts of laboratory experiments
3. Able to understand the difference between compaction and consolidation
4. Familiarize the concepts of permeability and shear parameters
5. Analyze the stresses induced in the soil.

Syllabus

UNIT-I **(9 hours)**

INTRODUCTION: Physical Properties of Soil: Soil formation, Soil types, composition, three phase relations, Specific gravity, water content, shape and size, grain size distribution curves, relative density, consistency of soils, Sieve analysis and Hydrometer methods

UNIT-II **(7 hours)**

INDEX PROPERTIES OF SOILS: Consistency limits and indices –Various Types of soil Classifications – Unified soil classification and I.S. Soil classification.

COMPACTION: Clay minerals, Mechanism of compaction – factors affecting – effects of compaction on soil properties, Methods of compaction in field-compaction control

UNIT-III **(10 hours)**

CAPILLARITY, PERMEABILITY AND SEEPAGE: Darcy's law, determination of permeability, equivalent permeability in stratified soils, insitu permeability test, 1-D flow, Laplace's equation, flow nets: Characteristics and Uses, seepage, uplift pressure, filter criteria.

STRESS DISTRIBUTION IN SOILS: Total, neutral and effective stresses – quick sand condition. Stresses induced by applied loads - Boussinesq's and Westergaard's theories for point loads and areas of different shapes–Newmark's influence chart 2:1 stress distribution method.

UNIT-IV **(7 hours)**

COMPRESSIBILITY AND CONSOLIDATION: Fundamentals, 1-D consolidation, normally and over-consolidated clays, void ratio – pressure relationships, compressibility characteristics, time rate of consolidation, coefficient of consolidation, curve fitting techniques, settlement, secondary consolidation, 3-D consolidation - vertical sand drains.

UNIT-V **(6 hours)**

SHEAR STRENGTH OF SOILS: Principle of effective stress, Basic mechanism of shear

strength Mohr – Coulomb Failure theories- Tests and Drainage conditions direct shear test, unconfined compression test, Tri-axial shear test: consolidated drained, consolidated undrained, unconsolidated undrained, vane shear test, shear strength of clays and sands, critical void ratio, Liquefaction in Sands

Course outcomes

Upon the completion of this course, the students will be able to:

CO1: Understand various quantities related to soil structure and understand the inter-relationship(L2)

CO2: Familiarize with different types of soil classification and understand the importance of soil compaction in geotechnical engineering(L2)

CO3: Understand the flow of water through the soils. (L3)

CO4: Analyze the stresses induced by different loads on soils. (L4)

CO5: Equip students with the concepts of consolidation. (L3)

CO6: Determine the shear parameters of soils(L3)

Mapping of CO's and PO's:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	-	-	-	-	-	-	-	-	-	-	-	2
CO2	2	3	-	2	-	-	-	3	-	-	-	-	-	3
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3	3	-	3	-	-	-	-	-	-	-	-	-	2
CO5	3	3	3	3	-	-	-	-	-	-	-	-	-	3
CO6	3	3			-	-	-	-	-	-	-	-	-	3

Text books:

1. 'Basic and Applied Soil Mechanics' by Gopal Ranjan and A.S.R.Rao, New Age Internationa Publishers.
2. 'Soil Mechanics and Foundation Engineering' by V.N.S.Murthy ,CBS publishers.
3. 'Soil Mechanics' by M.Palani Kumar, PHI Learning.

Reference books:

1. Soil Mechanics and Foundation Engineering' by Dr K.R. Arora , Standard Publishers Distributors, 2005

WATER RESOURCES ENGINEERING

(Professional Core courses)

Subject Code: UGCE5T0322	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**0**	**0**	**3**

Prerequisite: Basic Knowledge in Engineering Mathematics and fluid Mechanics.

Course Objectives:

The course is designed to

1. Introduce the hydrologic cycle and examine its various components.
2. Offer an overview and comprehension of unit hydrograph theory, as well as its analysis.
3. Enable students to comprehend the significance of floods and how to determine maximum flood through visualization.
4. Comprehend flood frequency analysis, design flood, and flood routing procedures.
5. Understand groundwater movement concepts and well hydraulics principles with appreciation.

Syllabus

UNIT-I **(10 hours)**

INTRODUCTION: Engineering hydrology and its applications, Hydrologic cycle, hydrological data-sources of data.

PRECIPITATION: Types and forms, measurement, rain gauge network, presentation of rainfall data, average rainfall, continuity and consistency of rainfall data, frequency of rainfall, Intensity-Duration-Frequency (IDF) curves, Depth-Area-Duration (DAD) curves, Probable Maximum Precipitation (PMP), design storm

UNIT II **(10 hours)**

ABSTRACTIONS FROM PRECIPITATION: Initial abstractions.

EVAPORATION: factors affecting, measurement, reduction

EVAPOTRANSPIRATION: factors affecting, measurement and control

INFILTRATION: factors affecting, Infiltration capacity curve, measurement, infiltration indices

RUNOFF: Catchment characteristics, Factors affecting runoff, components, computation- empirical formulae, tables and curves, stream gauging, rating curve, flow mass curve and flow duration curve.

UNIT-III **(6 hours)**

HYDROGRAPH ANALYSIS: Components of hydrograph, separation of base flow, effective rainfall hyetograph and direct runoff hydrograph, unit hydrograph, assumptions, derivation of unit hydrograph, unit hydrographs of different durations, principle of superposition and S-hydrograph methods, limitations and applications of unit hydrograph, synthetic unit hydrograph.

UNIT-IV **(9 hours)**

FLOODS: Causes and effects, frequency analysis- Gumbel's and Log-Pearson type III distribution methods, Standard Project Flood (SPF) and Probable Maximum Flood (MPF), flood control methods and management.

FLOOD ROUTING: Hydrologic routing, channel and reservoir routing- Muskingum and Puls methods of routing.

UNIT-V **(7 hours)**

GROUNDWATER: Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, permeability, transmissivity and storage coefficient, types of wells, Darcy's law, Dupuit's equation- steady radial flow to wells in confined and unconfined aquifers, yield of an open well-recuperation test.

Course outcomes

Upon the completion of this course, the students will be able to:

CO1: Make use of major hydrologic components to interpret the rainfall data and Develop Intensity-Duration-Frequency and Depth-Area Duration curves to design hydraulic structures. (L3)

CO2: Understand the factors affecting evaporation, evapotranspiration, infiltration as well as the methods to control it and calculate infiltration indices (L3)

CO3: Analyze the components of hydrographs and develop ERH, DRH, Unit hydrograph and synthetic hydrograph. (L4)

CO4: Estimate flood magnitude and carry out flood routing (L4)

CO5: Determine aquifer parameters and yield of wells. (L4)

Mapping of CO's and PO's:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	2	2	-	-	-	-	-	-	-	2	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-	2	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-	2	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	2	-	-
CO5	3	2	2	2	-	-	-	-	-	-	-	2	-	-

Text books:

1. 'Engineering Hydrology', K. Subramanya, Tata McGraw Hill
2. 'Irrigation water resources and water power engineering', Dr. P.N. Modi, Standard Book House
3. 'Irrigation and water power engineering', Dr. B.C. Punmia and Lal, Laxmi Publication

Reference books:

1. 'Irrigation Engineering', G.L.Asawa, Wiley Eastern
2. 'Irrigation Engineering and Hydraulic Structures', S. K. Garg, Khanna Publishers
3. 'A Text Book of Hydrology',Dr. P. Jaya Ram Reddy, Laxmi Publication.
4. 'Irrigation, Water power and water resources engineering ', Dr. K.R. Arora, Standard Publishers.
5. 'Irrigation Engineering & Hydraulic Structures', S. R. Sahasrabudhe , S. K. Kataria & Sons
6. 'Water Resources Engineering through objective questions', K. Subramanya, Tata McGraw Hill
7. 'Hydrology – Principle – Analysis – Design H. M. Raughunath, New Age international

Employability Skills

(English, Aptitude and Logical Reasoning)

(Common to All Branches**)**

Subject Code: UGBS5T0122	**L**	**T**	**P**	**C**
III Year / I Semester	**2**	**0**	**2**	**3**

Prerequisite : Basic competency in understanding passages and the use of grammar & words correctly

Course Objectives:

1. To expose students to enhance their verbal ability and interpersonal skills
2. To prepare students to acquire skills in aptitude for careers prospects
3. To prepare students to develop logical reasoning for employment

Syllabus

UNIT I: (9 Hours)

High frequency words: Selected 101 words with their *basic* meaning, commonly used synonyms and 101 words usage in sentences

UNIT II: (9 Hours)

Reading Comprehension passages: Tactics in understanding the given Comprehension passages & Practice tests

UNIT III: (9 Hours)

Interpersonal Skills: Verbal & Non-verbal Communication & Team Work

Percentages -Percentage-Conversion of fraction to percentage and Percentage to Fraction-percentage excess & shortness, Effect of percentage change on a Number-Effect of two step change-Effect of percentage change on product.

UNIT IV: (9 Hours)

Time & Work: Rate of work -Work as a single unit -No. of persons working together – No. of man days.

Time & Distance: Speed - Average Speed - problems on trains – Relative speed - Boats and streams

UNIT V: (9 Hours)

Coding, Decoding, Letter and Number Series: Letter Coding, Direct Lettercoding, Number / Symbol coding, Substitution Coding, Deciphering message word coding and its types, Number series, Letter Series.

Data Analysis and Interpretation: Tabulation- Pie Charts – Bar Diagrams – LineGraphs.

COURSE OUTCOMES:

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

CO1: Make effective use of words in receptive as well as productive Communication (L3)

CO2: Examine the Reading comprehension passages to understand and later, answer the questions correctly (L2)

CO3: Develop team work and interpersonal skills with groups as well as the calculating percentages (L3)

CO4: Apply the knowledge of math in distance, time related concepts (L3)

CO5: Develop proficiency in numerical reasoning. (L3)

Mapping of COs to POs:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	3	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	3	-	-

Text Books:

1. Objective English – Hari Mohan Prasad & Uma Rani
2. Professional Communication – Globarena – IEG publications
3. A Modern Approach to Verbal and Non-verbal Reasoning by Dr.R.S.Aggarwal
4. Quantitative aptitude and Reasoning by R V Praveen (3rd edition)

References:

1. High frequency 101 word list: https://crunchprep.com/gre/101-high-frequency-gre-words
2. Quantitative Aptitude by Abhijit Guha – TMH Publishers

DESIGN AND DETAILING OF REINFORCED CONCRETE STRUCTURES

(Professional Elective-I)

Subject Code: UGCE5T0422	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**0**	**0**	**3**

Prerequisite: Knowledge of Mathematics, Building construction, Strength of materials, Structural Engineering.

Course Objectives:

1.To understand the principle of reinforced structures.

2.To design of structure using limit state analysis.

3.Know various elements of a reinforced concrete structure

4.Aim to understand the RC Design decisions related to hazards and risks

Syllabus

UNIT-I **(10 hours)**

LIMIT STATE DESIGN and SERVICEABILITY: Introduction to working stress method. Difference between Working stress and Limit State Method of design, Modular Ratio and Factor of Safety. Philosophy and principle of limit state design with assumptions, Partial Safety factors, Characteristic load and strength. Stress block parameters, concept of balanced section, under reinforced and over reinforced section. Limiting deflection, short term deflection, long term deflection, Calculation of deflection of singly reinforced beam only, Cracking in reinforced concrete members, calculation of crack width of singly reinforced beam, Side face reinforcement, slender limits of beams for stability.

UNIT-II **(10 hours)**

LIMIT STATE DESIGN OF BEAMS: Beams: limit state analysis and design of singly reinforced, doubly reinforced, T and L beams sections, Design examples in simply supported beams, Design examples in continuous beams, detailing

LIMIT STATE DESIGN OF SHEAR, TORSION AND BOND: limit state analysis and design of section for shear and torsion, concept of bond, anchorage and development length, IS code provisions

UNIT-III **(9 hours)**

LIMIT STATE DESIGN OF SLABS: Introduction to one way and two-way slabs, Design of simply supported one-way slab, Design of continuous slab, Design of two-way slabs for different boundary conditions.

LIMIT STATE DESIGN OF STAIRS: Design of dog legged staircase

UNIT-IV **(10 hours)**

LIMIT STATE DEIGN OF COLUMNS: Analysis and design of short axially loaded RC, Design of columns with uniaxial and biaxial moments.

UNIT-V **(9 hours)**

LIMIT STATE DEIGN OF FOOTINGS: Design concepts of the footings, Design of Rectangular column footings with axial load and also for axial load & moment, Design of Square column footings with axial load and also for axial load &moment

Course outcomes

Upon the completion of the course, the students will be able to

CO1: Summarize the philosophies of RCC design. (L2)
CO2: Design structural components of RCC beams. (L4)
CO3: Understand the design concept of shear, bond and anchorage. (L2)
CO4: Design of various Slabs and staircase. (L4)
CO5: Develop different types of Columns. (L4)
CO6: Develop different types of Footings.(L4)

Mapping of CO's and PO's:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	3	-	2	-	-	-	-	-	-
CO2	3	3	3	-	-	3	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	3	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	3	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	3	-	-	-	-	-	-	-	-
CO6	3	3	3	-	-	3	-	-	-	-	-	-	-	-

Text books:

1. Limit state design of reinforced concrete P.C.Vargheese Prentice Hall of India , New Delhi.
2. Reinforced concrete design by N.KrishnaRaju and R.N.Pranesh, Newage International publishers New Delhi.
3. Reinforced concrete design by S.UnnikrishnaPillai and DevadaMenon Tata MC Graw hill new Delhi.
4. Limit State Design by A.K. Jain

References:

1. Fundamentals of Reinforced concrete design by M.L.Gambhir, Prentice hall of india Pvt.Ltd. New Delhi.
2. Reinforced Concrete Structures by Park and Pauley, John Wiley and Sons.
3. Design of Concrete Structures by Arthus H.Nilson, David Darwin and Chorles W. Dolar, Mc GrawHill, 3rd Edition, 2005.

IS CODES:

1. IS-456-2000 (Permitted to use in examination Hall)
2. IS-875
3. SP-16

Note: Question paper consists of Part-A and Part-B.

i. Part-A consists of two questions from Unit-II and Unit-III and one has to be answered which carries 25 marks.

ii. Part-B consists of 3 questions from remaining Unit-I, IV, V which carries 15 marks each.

GROUND WATER HYDROLOGY

(Professional Elective – I)

Subject Code: UGCE5T0522	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**0**	**0**	**3**

Prerequisites: The student should have learnt Mathematics and Fluid Mechanics.

Course Objectives:

1. Introduction to ground water and its occurrence in different types of soil and rocks.
2. The study and determination of different types of aquifer properties.
3. The study of steady and unsteady flow in ground water.
4. Details about different types of ground water exploration and recharge of ground water

Syllabus

UNIT-I **(8 hours)**

INTRODUCTION: Importance. Vertical distribution of sub-surface water. Occurrence in different types of rocks and soils. Definition of aquifer, Aquifuge, Aquitard and Aquiclude, Confined and unconfined aquifers.

AQUIFER PROPERTIES: Aquifer parameters – Specific yield, Specific retention, Porosity, Storage coefficient, derivation of the expression. Determination of specific yield. Land subsidence due to ground water withdrawals.

UNIT-II **(8 hours)**

DARCY'S LAW AND HYDRAULIC CONDUCTIVITY: Introduction. Darcy's law. Hydraulic conductivity. Coefficient of permeability and Intrinsic permeability, Transmissibility, Permeability in Isotropic, Unisotropic layered soils. Steady one dimensional flow, different cases with recharge.

WELL HYDRAULICS – STEADY FLOW: Introduction. Steady radial flow in confined and unconfined aquifers. Pumping tests.

UNIT-III **(8 hours)**

WELL HYDRAULICS – UNSTEADY FLOW: Introduction. General equation derivation; Theis method, Cooper and JaCob method, Chow's method. Solution of unsteady flow equations.

UNIT-IV **(10 hours)**

GROUND WATER DEVELOPMENT: Types of wells. Methods of constructions. Tube well design. Dug wells. Pumps for lifting water: Working principles, Power requirements.

GROUND WATER EXPLORATION: Seismic method, Electrical resistivity method, Bore hole geo-physical techniques; Electrical logging, Radioactive logging, Induction logging, Sonic logging and Fluid logging.

UNIT-V **(8 hours)**

GROUND WATER RECHARGE AND RUNOFF: Recharge by vertical leakage. Artificial recharge. Ground water runoff. Ground water budget.

Course outcomes

Upon the completion of the course, the students will be able to

CO1: Identify the types of aquifers and their properties (L2)

CO2: Analyze hydraulic conductivity and determine the steady and unsteady flow in aquifers (L4)

CO3: Classify the types of wells and working principles of tube wells (L3)

CO4: Evaluate ground water resources using surface and sub-surface geophysical methods (L4)

CO5: Understand the concepts of Ground water recharge and runoff (L2)

Mapping of CO's and PO's

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	-	-

Text books:

1. Ground Water- H.M. Raghunath, - Wiley Eastern Limited, New Delhi.
2. Ground Water Hydrology- K. Todd, - Wiley and Sons, New Delhi.
3. Numerical Ground Water Hydrology- A.K. Rastogi, - Penram, International Publishing (India), Pvt. Ltd., Mumbai.

References:

1. Ground Water Hydrology- Bower H.- McGraw Hill, New Delhi.
2. Ground Water and Tube Wells- Garg Satya Prakash, - Oxford and IBH, New Delhi.

3. Ground Water Resource Evaluation- W.C. Walton, - McGraw Hill - Kogakusha Ltd., New Delhi.
4. Water wells and Pumps – Michel D.M., Khepar. S.D., Sondhi. S.K., McGraw Hill Education – 2nd Edition

DISASTER PREPAREDNESS AND PLANNING

(Professional Elective – I)

Subject Code: UGCE5T0622	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**0**	**0**	**3**

Prerequisite: Nil

Course Objectives:

1. To provide an exposure to disasters, their significance and types.
2. To familiarize with impacts of disaster key skills.
3. To impart the knowledge on different approaches of Disaster risk reduction.

Syllabus

UNIT-I **(6 hours)**

Introduction: Concepts and definitions: disaster, disaster Management, hazard, vulnerability, risk, capacity, mitigation. Types of Disasters, five priorities for action, relationship between disaster and human development, Disaster Management cycle

UNIT-II **(8 hours)**

Disasters classification: Disasters classification; Natural disasters –floods, Drought, earthquake, cyclone, landslide. Manmade disasters –industrial pollution, nuclear radiation, chemical spills, bio terrorism, transportation accidents. Hazard and vulnerability profile of India

UNIT-III **(7 hours)**

Disaster Impacts: Introduction, Life and livestock loss, Habitation, agricultural and livelihood loss, Additional health hazards, Contamination of drinking water sources, impact on children, Environmental loss. Impacts of climate change, greenhouse gases.

UNIT-IV **(8 hours)**

Disaster risk reduction: Disaster management cycle- its phases, prevention, mitigation, preparedness, relief & recovery; structural and non-structural measures, basic strategies and practices of disaster risk reduction, global policies and practices, risk management framework, vulnerability and capacity assessment.

UNIT-V **(7 hours)**

Role of Technology in Disaster Management: Disaster management for infra structures, mitigation program for earthquakes – flowchart, geospatial information in agriculture drought assessment-multimedia technology in disaster risk management and training- transformable indigenous knowledge in disaster reduction.

Course outcomes

Upon the completion of the course, the students will be able to

CO1: Differentiate the types of disasters, causes and their impact on environment and society. (L2)

CO2: Analyze relationship between development and disasters. (L4)

CO3: Explain the process of risk management. (L2)

CO4: Assess vulnerability and various methods of risk reduction measures as well as mitigation. (L5)

CO5: Apply the technology in disaster management. (L3)

Mapping of CO's and PO's:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	-	-	-	-	2	3	-	-	-	-	2	-	2
CO2	2	-	-	-	-	2	-	-	-	-	-	-	-	2
CO3	2	-	-	2	-	3	3	-	-	3	-	-	-	-
CO4	2	3	2	3	2	2	3	2	-	3	-	-	-	2
CO5	2	3	3	3	3	2	-	2	-	3	-	2	-	2

Text books:

1. Ghosh G.K., Disaster Management, APH Publishing Corporation 2006.
2. Pradeep Sahni, Disaster Risk Reduction in South Asia, Prentice Hall 2004.
3. Singh B.K Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication. 2008.

References:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.
4. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental

Health and Psychosocial Support in Emergency Settings. Geneva: IASC

SOLID AND HAZARDOUS WASTE MANAGEMENT

(Professional Elective – I)

Subject Code: UGCE5T0722	**L**	**T**	**P**	**C**
III Year / I Semester	**3**	**0**	**0**	**3**

Prerequisite: Knowledge on chemistry and environmental science is necessary.

Course Objectives:

1. To impart the knowledge of sources, collection and characteristics of solid waste
2. To acquire working knowledge on the management of solid wastes of all aspects of municipal, refuse generation, source reduction.
3. Understand transportation, recycling and resource recovery, burial in landfills.
4. To know the various disposal methods with minimum effects on environment
5. Study the various treatment methods of Solid Waste.
6. Illustrate about hazardous waste, biomedical waste, E waste and their transportation, Disposal & impacts on Environment.

Syllabus

UNIT-I **(7 hours)**

INTRODUCTION TO SOLID WASTE: Solid Waste and their Handling: Definitions of solid wastes, types of Municipal solid wastes, Sources Industrial, mining, agricultural and domestic - Characteristics. Solid waste Problems - impact on environment and Human health

UNIT-II **(10 hours)**

SOLID WASTE HANDLING MUNICIPAL SOLID WASTES: Handling and segregation, Collection and storage of municipal solid wastes; analysis of Collection systems. Transfer stations – labeling, handling and transportation of solid wastes Solid waste processing technologies- Mechanical and thermal volume reduction, Biological and chemical techniques for energy recovery.

UNIT-III **(8 hours)**

SOLID WASTE TERATMENT AND DISPOSAL: Composting - types, vermin-composting, term gradation, fermentation other resource recovery, Incineration of solid wastes.

DISPOSAL IN LANDFILLS: site selection, design and operation of sanitary landfills; Leachate and landfill gas management; landfill closure and post-closure environmental monitoring; landfill remediation. Regulatory aspects of municipal solid waste management.

UNIT-IV **(10 hours)**

HAZARDOUS WASTE MANAGEMENT

Hazardous Waste and Management: Hazardous waste definition. Sources and characterization. Sampling and analysis of hazardous wastes -proximate analysis, handling, collection, storage and transport of hazardous Waste Hazardous waste treatment-technologies TSDF concept - Physical, chemical and thermal treatment of hazardous waste: solidification, chemical fixation, encapsulation, pyrolysis and incineration. Hazardous waste

landfills - Site selections, design and operation HW reduction, recycling and reuse, Regulatory aspects of HWM/HWM rules.

UNIT-V **(10 hours)**

BIOMEDICAL WASTE MANAGEMENT: Classification, collection, segregation - Biomedical Waste Management-Treatment and disposal.

Radioactive waste: Definition, Low level and high-level radioactive wastes and their management, Radiation standards.

E WASTE MANAGEMENT: E-Waste Management: Waste characteristics, generation, collection, transport and disposal, regulatory aspects of e waste global strategy, recycling.

Course outcomes

Upon the completion of the course, the students will be able to

CO1: Summarize the characteristics of Solid waste (L2)
CO2: Analyze the fundamental elements involved in solid waste management. (L4)
CO3: Select sustainable waste processing techniques and disposal methods (L3)
CO4: Identify the Hazardous wastes and its disposal methods (L2)
CO5: Analyzing Biomedical & E-waste (L3)

Mapping of CO's and PO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3		-	-	-	-	2	-	-	-	-	-	-	-
CO2	3	3	-	-	-	3	3	-	-	-	-	-	-	-
CO3	3	3	-	-	-	3	3	-	-	-	-	-	-	-
CO4	3	3	-	-	-	3	3	-	-	-	-	-	-	-
CO5	3	3	3	2	-	3	2	-	-	-	-	3	-	-

Text books:

1. Solid Waste Management, K.Sasikumar, Sanoop Gopi Krishna-PHI 2009
2. Integrated solid waste management George Tchobanoglous, Hilary Theisen & Sammuel A. Vigil,1993, Irwin MC Graw Hill
3. Hazardous waste management Charles A.Wentz. Second edition 1995.,McGraw Hill International.

References:

Criteria for hazardous waste and fills - CPCB guidelines.

1. Standard handbook of Hazardous waste treatment and disposal by Harry M. Freeman, McGraw Hill.
2. Management of Solid waste in developing countries by Frank Flint off, WHO regional

STRUCTURAL ENGINEERING SOFTWARE LABORATORY

(Professional course Lab)

Subject Code: UGCE5P0822	**L**	**T**	**P**	**C**
III Year / I Semester	**0**	**0**	**3**	**1.5**

Prerequisites: Reinforced concrete structures, steel structures, building materials and building construction. Basic knowledge of structural engineering concepts

Course Objectives:

1. Analysis and design of frame structure, truss and water tank using design software.
2. Use the latest software tools for Modeling, Analysis and Design of Civil Engineering Systems.
3. To make the students learn from the start of design conception through the production of schematic drawings and use ETABS to integrate every aspect of the engineering design process.

LIST OF EXPERIMENTS:

EXP-1: Introduction to STAAD Pro. software

EXP-2: Simple beam Analysis and Design

EXP-3: Indeterminate beam Analysis and Design

EXP-4: 2-D frame Analysis and Design

EXP-5: 3-D frame Analysis and Design

EXP-6: 3-D frame Analysis and Design for wind and seismic loadings

EXP-7: Multistoried Apartment Complex Analysis and Design

EXP-8: Steel Tabular Truss Analysis and Design

EXP-9: Analyze a seven storey building – 3.0 m typical height – bottom story – 2.5 m with the following specifications

- X direction: 4 Spans – 5.0, 6.0, 5.0, 5.0 m and Y direction: 4 Spans – 5.0, 5.5, 6.0, 5.5 m
- Fck – 25 MPa; Fy- 500 Mpa
- Beam Section – 250 x 500 mm and Column Section – 300 x 500 mm
- Slab – 150mm thick
- Additional floor load; Dead load – 1.5 kN/m2 ; Live load – 2.5 kN/m2, Wall loads on beams (only on periphery)- 12.0 kN/m

EXP-10: Analyze the five storey building – 3.0 m typical height – bottom story – 3 m with the following specifications

- X - direction: 6 Spans – 5.0, 6.0, 5.0, 5.0, 4.5, 5.0m and Y – direction :5 Spans – 5.0, 5.5, 6.0, 5.5, 5.0m
- Fck – 25 MPa; Fy- 500 Mpa
- Beam Section – 250 x 450 mm and Column Section – 250 x500 mm
- Slab – 120 mm thick, Wall – 250 mm thick (2.0m each direction 2 walls on periphery)
- Additional floor load; Dead load–1.5 kN/m2; Live load – 2.5 kN/m2, Wall load on beams (only on periphery) - 12 kN/m.
- Mass source : Dead – 100%

Live – 25%

- Seismic: z = 0.16, R = 5, I = 1, Site type = I, Time period = program calculated

Course outcomes

Upon the completion of this course, the students will be able to:

CO1: Identify the importance of tools in STAAD Pro. While performing analysis and design of civil engineering structures. (L2)

CO2: Experiment with different tools to operate the STAAD Pro. Software and to develop error free output. (L3)

CO3: Design and interpret a multi storied building by giving all inputs like loads and design parameters. (L4)

CO4: Create models using intuitive drawing commands that allow for the rapid generation of floor and elevation framing. (L5)

CO5: Work with the models, make changes in it according to the design requirements (L5)

Mapping of CO's and PO's:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	-	-	-	3	2	-	-	-	-	-	3	-	-
CO2	3	3	3	-	3	3	-	-	-	-	-	3	-	-
CO3	3	3	3	-	3	3	-	-	-	-	-	3	-	-
CO4	3	-	3	-	3	3	-	-	-	-	-	3	-	-
CO5	3	-	-	-	3	2	-	-	-	-	-	3	-	-

Text books:

1. Limit state design of reinforced concrete P.C.Vargheese Prentice Hall of India , New Delhi.
2. Analysis of Structures-Vol I & Vol II by V.N. Vazirani & M.M.Ratwani, Khanna Publications, New Delhi.
3. 'Steel Structures Design and Practice' by N.Subramanian, Oxford University Press.

References:

1. Reinforced concrete design by N.KrishnaRaju and R.N.Pranesh,Newage International publishers New Delhi.
2. Strength of Materials and Mechanics of Structures- by B.C.Punmia, Khanna Publications, New Delhi.
3. 'Design of Steel Structures' by P. Dayaratnam; S. Chand Publishers
4. Theory of structures' by Ramamuratam, Dhanpatrai Publications.
5. Relevant IS codes and steel tables.

GEOTECHNICAL ENGINEERING LABORATORY

(Professional Course Lab)

Subject Code: UGCE5P0922	**L**	**T**	**P**	**C**
III Year / I Semester	**0**	**0**	**3**	**1.5**

Prerequisite: Geotechnical Engineering, Mathematics

COURSE OBJECTIVES:

1. To impart knowledge for determination of index properties required for classification of

soils

2. Discuss the difference between compaction & consolidation from relevant lab tests
3. Understand the flow of water through soils through permeability tests
4. Analyze the shear parameters of soil through different laboratory experiments

LIST OF EXPERIMENTS:

Exp-1: Specific gravity

Exp-2: Atterberg's Limits.

Exp-3: Grain size analysis by dry sieving

Exp-4: Field density by Core cutter

Exp-5: Field density by Sand replacement methods

Exp-6: Compaction test

Exp-7: Hydrometer Analysis Test

Exp-8: Differential free swell (DFS)

Exp-9: Permeability of Soil by Constant head method

Exp-10: Permeability of Soil by Variable head method

Course outcomes:

Upon the completion of this course, the students will be able to:

CO1: Determine the index properties and classify the soils (L3)

CO2: Perform Compaction tests and determine the OMC and MDD of soil samples(L3)

CO3: Analyze the coefficient of permeability for different soils(L4)

Mapping of CO's and PO's:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	3	-	-	-	-	3	3	2	-	3	-	3
CO2	3	3	2	3	-	-	-	3	3	2	-	2	-	2
CO3	3	2	2	-	-	-	-	3	3	3	-	-	-	2

References:

1. 'Basic and Applied Soil Mechanics' by Gopal Ranjan and A.S.R.Rao, New Age International Publishers.

2. 'Soil Mechanics and Foundation Engineering' by V.N.S.Murthy , CBS publishers.

ENGINEERING GEOLOGY

(Skill Oriented Course)

Subject Code: UGCE5K1022	**L**	**T**	**P**	**C**
III Year / I Semester	**1**	**0**	**2**	**2**

Prerequisite: Physics and Chemistry

Course objectives:

1. To introduce the Engineering Geology as a subject in Civil Engineering.
2. To enable the student to use subject in civil engineering applications.

Syllabus:

UNIT-I: (2 hours)

Introduction: Branches of Geology, Importance of Geology in Civil Engineering with case studies.

Mineralogy: Definitions of mineral, Different methods of study of minerals, and the study of physical properties of minerals. The megascopic study of rock-forming minerals and ore-forming minerals.

Petrology: Definitions of rock, Different methods of study of rocks, and the study of physical properties of rocks. Classification, structures, textures and forms of Igneous rocks, Sedimentary rocks, Metamorphic rocks.

UNIT- II: (6 hours)

STRUCTURAL GEOLOGY: Strike, Dip and Outcrop study of common geological structures associating with the rocks such as Folds, Faults, Joints and Unconformities- parts, types, mechanism and their importance in Civil Engineering. Classification of Landslides, Causes and Effects, measures to be taken prevent their occurrence at Landslides.

EXP: Simple Structural Geology Problems.

EXP: Interpretation and drawing of sections for geological maps showing tilted beds, faults, unconformities

UNIT III: (5 hours)

Ground water: Water table, Cone of depression, Geological controls of Ground Water Movement, Ground Water Exploration Techniques.

Earthquakes: Terminology, Classification, causes and effects, Shield areas and Seismic bells, Richter scale intensity, Precautions of building constructions in seismic areas.

UNIT IV: (5 hours)

EXP: Physical and Engineering properties of minerals: Megascopic identification of Rock-forming minerals – Quartz group, Feldspar group, Garnet group, Mica group & Talc

EXP: Physical and Engineering properties of minerals: Mega-scopic identification of Ore forming minerals – Magnetite, Hematite, Pyrite, Pyralusite, Graphite, Chromite, etc

UNIT-V: (6 hours)

EXP: Megascopic description and identification of Igneous rocks – Types of Granite, Pegmatite, Gabbro, Dolerite, Syenite, Granite Poryphery, Basalt.

EXP: Megascopic description and identification of Sedimentary rocks – Sand stone, Lime stone, Shale, Laterite, Conglomerate etc.

EXP: Megascopic description and identification of Metamorphic rocks – Biotite – Granite Gneiss, Slate, Muscovite, Biotite, schist, Marble etc.

Course outcomes:

Upon the completion of this course, the students will be able to:

CO1: Identify and classify the geological minerals and rocks. (L2)

CO2: Judge the strength & suitability of various rocks for civil engineering use. (L3)

CO3: Capable to draw the sections for geological maps showing faults & unconformities. (L3)

CO4: Identify subsurface information for groundwater. (L2)

CO5: Understand the concepts of earthquake and landslides (L2)

Mapping of CO's and PO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	-	-	-	3	-	-	2	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	3	-	-	-	-	-	-	-	3

Text books:

1. 'Engineering Geology' by Subinoy Gangopadhay, Oxford University press.
2. 'Engineering Geology' by D. Venkat Reddy, Vikas Publishing House pvt. Ltd, 2013.
3. 'Engineering Geology' by N. Chenn Kesavulu, Trinity Press (Laxmi Publications), 2nd Edition, 2014.
4. 'Engineering Geology' by Vasudev Kanithi, University Press.

References:

1. Engineering Geology for Civil Engineers' by P.C. Varghese,PHI learning pvt. Ltd.
2. 'Geology for Engineers and Environmental Society' by Alan E Kehew, person publications, 3rd edition
3. 'Fundamentals of Engineering Geology' by P.G. Bell, B.S.P. Publications, 2012.
4. 'Engineering Geology' by V.Parthesarathi et al., Wiley Publications
5. 'Environmental Geology' by K.S. Valdiya, McGraw Hill Publications, 2nd ed.

INTELLECTUAL PROPERTY RIGHTS & PATENTS

(Mandatory Course)

Subject Code: UGMB5A0122	**L**	**T**	**P**	**C**
III Year / I Semester	**2**	**0**	**0**	**0**

Course Objectives: This course introduces about intellectual property laws, trademarks, copyrights and patents.

Syllabus:

UNIT-I: **(6 hours)**

Intellectual Property Law: Basics, Types, Agencies Responsible for IP Registration, International Organizations, Agencies and Treaties, Importance of IPR.

Trademark Law: Purpose of Trademarks, Types, Acquisition, Common Law Rights, Laws and Treaties Governing Trademarks, Categories, Trade Names and Business Names, Protectable Matter, Exclusions from Trademark Protection, Selecting and Evaluating a Mark, Trademark Search.

UNIT-II: **(5 hours)**

Copyright Law: Common Law Rights, Originality of Material, Fixation of Material, Works of Authorship, Exclusions, Compilations, Collections and Derivative Works.

Rights Afforded by Copyright Law: Rights of Reproduction, Derivative Works, Distribution and the First Sale Doctrine, Work Publicly, Rights to Display the Work Publicly, Other Limitations on Exclusive Rights, Moral Rights and the Visual Artists Rights, Compulsory Licenses.

UNIT-III: **(7 hours)**

Copyright Ownership and Transfers: Ownership Issues, Joint Works, Ownership in Derivative or Collective Works, Works Made for Hire, Transfers, Termination of Transfers and Duration.

Copyright Infringement: Elements, Contributory and Vicarious Infringement, Defences to Infringement, Infringement Actions.

New Developments: Protection for Computer Programs and Automated Databases, Copyright in the Electronic Age, Entertainment Notes, Recent Developments, Terms of the Trade, Semiconductor Chip Protection.

UNIT-IV: **(6 Hours)**

Patent Law: Introduction, Patentability, Design Patents, Plant Patents, Double Patenting.

Patent Searches and Application: Searching, Application Process, Prosecuting the Application, Post-issuance Actions, Term and Maintenance of Patents.

Patent Ownership and Transfer: Ownership Rights, Sole and Joint Inventors, Disputes, Inventions made by Employees and Independent Contractors, Assignment of Rights, Licensing, Invention Developers and Promoters.

UNIT-V: **(6 hours)**

Patent Infringement: Direct Infringement, Inducement to Infringe, Contributory Infringement, First Sale Doctrine, Indirect Infringement, Infringement Abroad, Claims Interpretation, Defences, Remedies, Resolving a Dispute and Litigation.

New Developments: International Patent Protection, Patent Cooperation Treaty, European Patent Organization, Patent Prosecution Highway, Agreement on Trade-Related Aspects of IPR, Patent Law Treaty, Foreign Filing Licenses.

Intellectual Property Audits: Practical Aspects of Intellectual Property Audits, Conducting the Audit, Postaudit Activity.

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1: Understand the intellectual property law.

CO2: Understand the need of trademark and its use.

CO3: Familiar with copyright laws and its rights, ownership, transfers and copyright Infringement.

CO4: Acquire the knowledge on various aspects of patents.

Mapping of COs to POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	3	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	3	-	3	-	-	-	-
CO4	3	3	3	-	-	3	3	3	-	3	-	-	-	-

Text books:

1. Deborah E. Bouchoux, "Intellectual Property", Cengage Learning
2. Asha Vijay, Durafe Dhanashree and K. Toradmalle, "Intellectual Property Rights", Wiley India
3. Neeraj Pandey and Khushdeep Dharni, "Intellectual Property Rights", PHI Learning, 2014.

References:

1. Kompal Bansal & Parishit Bansal, "Fundamentals of IPR for Engineers", BS Publications.
2. Prabhuddha Ganguli, "Intellectual Property Rights", Tata Mc-Graw Hill, New Delhi.
3. R. Radha Krishnan, S. Balasubramanian, "Intellectual Property Rights", Excel Books. New Delhi.
4. M. Ashok Kumar and Mohd. Iqbal Ali, "Intellectual Property Right", Serials Pub.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
6. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand.

8. Dr. A. Srinivas, "Intellectual Property Rights (Patents & Cyber Law)", Oxford University Press, New Delhi.

SUMMER INTERNSHIP

Subject Code: UGCE5I1122	**L**	**T**	**P**	**C**
III Year / I Semester	**0**	**0**	**0**	**1.5**

Summer Internship (after second year)/ Certification Course with UNCC

III-II

DESIGN AND DETAILING OF STEEL STRUCTURES

(Professional Course)

Subject Code: UGCE6T0122	**L T P C**
III Year / II Semester	**3 0 0 3**

Prerequisites: The student should have knowledge in Mathematics, Building materials and building construction

Course objectives: The course is designed to -

1. Familiarize Students with different types of Connections and relevant IS codes
2. Equip student with concepts of design of flexural members
3. Understand Design Concepts of tension and compression members in trusses
4. Familiarize students with different types of Columns and column bases and their Design
5. Familiarize students with Plate girder, Gantry Girder and their Design

Syllabus

UNIT – I **(8 hours)**

Connections: Riveted connections – definition, rivet strength and capacity, Welded connections: Introduction, Advantages and disadvantages of welding, Strength of welds-Butt and fillet welds: Permissible stresses – IS Code requirements. Design of fillet weld subjected to moment acting in the plane, Design of fillet weld subjected to moment acting right angles to the plane of the joints

NOTE: Problems to be given only from Welding

UNIT– II **(10 hours)**

Beams: Allowable stresses, design requirements as per IS Code-Design, simple and compound beams, Curtailment of flange plates, Beam to beam connection, check for deflection, shear, buckling, check for bearing, laterally supported beams, check for deflection, shear, buckling, check for bearing, laterally unsupported beams

UNIT-III **(12 hours)**

Tension members and compression members: General Design of members subjected to direct tension and bending, effective length of columns. Slenderness ratio – permissible stresses, Design of compression members, struts etc. Roof Trusses: Different types of trusses – Design loads –Design of simple roof trusses design of purlins

Design of columns: Built up compression members, Design of lacings and battens, Design Principles of Eccentrically loaded columns, Splicing of columns.

UNIT-IV **(8 hours)**

Design of column foundations: Design of slab base, Design of gusseted base, Column bases subjected moment.

UNIT-V **(10 hours)**

Design of plate girder and gantry girder: Design consideration – IS Code recommendations, Design of plate girder -Welded, Curtailment of flange plates, stiffeners – splicing and connections, Design of Gantry Girder: impact factors -longitudinal forces, Design of Gantry girders.

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO1: Apply the IS code for practice for the design of various steel structural elements. (L2)

CO2: Familiarize with different types of connections used in steel structures. (L2)
CO3: Analyze and design the flexural members. (L4)
CO4: Design compression and tension members using simple and built up sections. Calculate forces on various members of truss and design them. (L4)
CO5: Design eccentrically loaded compression members and their base plates. (L4)
CO6: Design welded plate girder, gantry girder and their components. (L5)

Mapping of CO's and PO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	-	2	2	-	-	-	-	3	-	-
CO2	3	3	3	3	-	2	2	-	-	-	-	3	-	-
CO3	3	3	3	3	-	2	2	-	-	-	-	3	-	-
CO4	3	3	3	3	-	2	2	-	-	-	-	3	-	-
CO5	3	3	3	3	-	2	2	-	-	-	-	3	-	-
CO6	3	3	3	3	-	2	2	-	-	-	-	3	-	-

Text books:

1. 'Steel Structures Design and Practice' by N.Subramanian, Oxford University Press.
2. 'Design of Steel Structures' by Ramachandra, Vol – 1, Universities Press.
3. 'Design of steel structures' by S.K. Duggal, Tata Mcgraw Hill, and New Delhi

References:

1. 'Structural Design in Steel' by Sarwar Alam Raz,New Age International Publishers, New Delhi
2. 'Design of Steel Structures' by P. Dayaratnam; S. Chand Publishers
3. 'Design of Steel Structures' by M. Raghupathi, Tata Mc. Graw-Hill
4. 'Structural Design and Drawing' by N. Krishna Raju; University Press,

IS Codes:

1) IS 800:2007 General construction in steel- Code of practice
2) IS 875: Part -III
3) Steel Tables.

These codes and steel tables are permitted to use in the examinations

Note: Question paper consists of Part-A and Part-B.

i. Part-A consists of two questions from Unit-IV and Unit-V and one has to be answered which carries 25 marks.
ii. Part-B consists of 3 questions from Unit-I, II, III which carries 15 marks each.

STRUCTURAL ANALYSIS - II

(Professional Core course)

	L	T	P	C
Subject Code: UGCE6T0222				
III Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: The student should have learnt mathematics, strength of materials and structural analysis - I

Course objectives: The objective of this course is to

1. Familiarize Students with Different types of Structures

2. Equip student with concepts of Arches
3. Understand Concepts of lateral Load analysis
4. Familiarize Cables and Suspension Bridges
5. Understand the Analysis methods like Moment Distribution, Kanis Method and Matrix methods.

Syllabus:

UNIT-I **(10 hours)**

Three hinged arches: Elastic theory of arches – Eddy's theorem – Determination of horizontal thrust, bending moment, normal thrust and radial shear – effect of temperature.
Two hinged arches: Determination of horizontal thrust, bending moment, normal thrust and radial shear – Rib shortening and temperature stresses, tied arches – fixed arches–(No analytical question).

UNIT-II **(9 hours)**

Lateral load analysis using approximate methods: application to building frames. (i) Portal method (ii) Cantilever method.

UNIT – III **(12 hours)**

Moment distribution method: Stiffness and carry over factors – Distribution factors – Analysis of continuous beams with and without sinking of supports – Portal frames – including Sway-Substitute frame analysis by two cycles.

Kani's method: Analysis of continuous beams – including settlement of supports and single bay portal frames with and without side sway.

UNIT – IV **(8 hours)**

Cable structures and suspension bridges: Introduction, characteristics of cable, analysis of cables subjected to concentrated and uniformly distributed loads, anchor cable, temperature stresses, analysis of simple suspension bridge, three hinged and two hinged stiffening girder suspension bridges.

UNIT – V

Introduction to matrix methods: **(10 hours)**

Flexibility methods: Introduction, application to continuous beams (maximum of two unknowns) including support settlements.

Stiffness method: Introduction, application to continuous beams (maximum of two unknowns) including support settlements.

Course outcomes Upon the completion of this course, the students will be able to:

CO1: Identify the internal forces of three hinged and two hinged arches. (L4)
CO2: Build the SFD and BMD diagrams for frames by Concept of lateral Load analysis. (L4)

CO3: Solve the Cables and Suspension Bridges problems with different loadings. (L3)
CO4: Draw the SFD and BMD diagrams for frames with different loadings by Moment Distribution and Kani's Method. (L4)
CO5: Analyze continuous beams by flexibility and stiffness method. (L4)

Mapping of CO's and PO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	3	3	-	2	-	2	-	-	-	-	-	-
CO2	2	3	3	3	-	2	-	2	-	-	-	-	-	-
CO3	2	3	3	3	-	2	-	2	-	-	-	-	-	-
CO4	2	3	3	3	-	2	-	2	-	-	-	-	-	-
CO5	2	3	3	3	-	2	-	2	-	-	-	-	-	-

Text books:

1. 'Structural Analysis' by T.S.Thandavamoorthy, Oxford university press, India.
2. 'Structural Analysis' by R.C. Hibbeler, Pearson Education, India
3. 'Theory of Structures – II' by B.C.Punmia, Jain & Jain, Laxmi Publications, India.
4. 'Structural Analysis' by C.S. Reddy, Tata Mc-Graw hill, New Delhi.

References:

1. 'Intermediate Structural Analysis' by C. K. Wang, Tata McGraw Hill, India.
2. 'Theory of structures' by Ramamuratam, Dhanpatrai Publications.
3. 'Analysis of structures' by Vazrani & Ratwani – Khanna Publications.
4. Comprehensive Structural Analysis-Vol.I&2' by Dr. R. Vaidyanathan & Dr. P. Perumal-Laxmi Publications Pvt. Ltd., New Delhi.

ENVIRONMENTAL ENGINEERING

(Professional Core course)

Subject Code: UGCE6T0322 **L T P C**
III Year / II Semester **3 0 0 3**

Prerequisites: Student should have knowledge in Water Resources Engineering, Fluid Mechanics and Mathematics

Course objectives: The course is designed to -

1. Study the approach to safe drinking water, wastewater and its treatment.
2. Understand the working & design aspects of every units in water & Wastewater

treatment plant, various plumbing systems in the dwellings

3. Recognize Air Pollution & Solid Waste sources, management and its effects

SYLLABUS:

UNIT-I : (**7 hours)**

Water supply system: Factors affecting fluctuations, fire demand, storage capacity, drinking water standards, sources of water, drinking water standards. Comparison from quality and quantity and other considerations, intakes, infiltration galleries, Population estimation.

UNIT-II : (**10 hours)**

Water treatment: Layout and general outline of water treatment units – sedimentation, design factors, jar test-optimum dosage of –coagulant-coagulation, flocculation, clarifier, feeding arrangement Filtration- theory- working of slow and rapid gravity filters disinfection –types of disinfection –theory of chlorination chlorine demand. Distribution systems-types of lay outs of distribution systems –Hardy Cross method.

UNIT-III : (**8 hours)**

Conservation and water carriage system: Sewage and storm water estimation- time of concentration, characteristics of sewage –examination of sewage, B.O.D-C.O.D equations, Design of sewers- shapes and materials, SEWER appurtenances manholes-inverted siphon-catch basins-flushing tanks, ejectors pumps and pumps houses, house drainage-components requirements, One pipe and two pipe systems of plumbing.

UNIT-IV: (**10 hours)**

Waste water treatment: Layout and general outline of various units in a wastewater treatment plan- primary treatment design of screens–Grit Chambers-skimming tanks – sedimentation tanks, principal of biological treatment, trickling filters-standard and high rate Filter.

Waste water disposal: Construction of Oxidation Ponds, sludge treatment – sludge digestion, sludge disposal by drying –septic tanks-working principles & design of septic tank soak pits. Ultimate disposal of waste water, sewage farming.

UNIT-V: (**10 hours)**

Environmental pollution control: Causes of air pollution, Sources of air pollution, Primary and secondary pollutants

Noise pollution: Basic concept, Measurement & various control methods, government authorities and their role in pollution control Types, Municipal solid waste- Sources, Composition, Chemical & physical parameters. Government authorities and their role in Solid waste management.

Course outcomes: Upon the completion of this course, the students will be able to:

CO1: Identify the components of water supply systems and analyze the characteristics of wastewater. (L3)

CO2: Design water treatment plant for a given size of population. (L3)

CO3: Design wastewater treatment plant for given size of population(L3)

CO4: Distinguish the various wastewater disposal methods. (L4)

CO5: Describe the sources of Air pollution and its effects on environment. (L2)

CO6: Describe the noise pollution and various control methods. (L2)

Mapping of CO's and PO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	2	3	3	-	2	2	-	-	-	-	-	3	-
CO2	-	2	-	3	-	2	-	-	-	-	-	-	3	-
CO3	-	-	3	3	-	-	-	-	-	-	-	-	3	-
CO4	-	2	-	-	-	3	-	-	-	-	-	-	3	-
CO5	-	-	-	-	-	2	3	-	-	-	-	-	-	-
CO6	-	-	-	-	-	2	3	-	-	-	-	-	-	-

Text books:

1. Water Supply and Sanitary Engineering by G.S.Birdie, J.S.Birdie 1980, Dhanpatrai Publication
2. Water Supply Engineering Vol-I and Waste Water Engineering Vol-II B.C.Punmia, Second Edition, 2005, Laxmi Publication
3. Water Supply Engineering Vol.I and Wastewater Engineering Vol.II, P.N. Modi, 2012, Standard Book Publishers
4. Environmental Studies by Anubha Kaushik and C.P Kaushik, Fifth Edition New age International Publishers

References:

1. Water and waste water technology by Mark J Hammer and Mark.j Hammer Jr, 2007, Sixth Edition, PHI
2. Waste Water treatment-concepts and design approach by G,L. Karia and R.A. Christian, PHI
3. Waste Water engineering by Met Calf and Eddy,1979, 5/e McGraw-Hill
4. Theory and practice of water and wastewater water treatment by Ronald L Drost, Second Edition 2018 Wiley India publishers.

FOUNDATION ENGINEERING

(Professional Elective – II)

Subject Code: UGCE6T0422	**L T P C**
III Year / II Semester	**3 0 0 3**

Prerequisite: Geotechnical Engineering and Mathematics

COURSE OBJECTIVES: The objective of this course is

1. Understand the importance of soil exploration
2. Equip student with concepts of stability of slopes, earth pressures and retaining walls

3. Based upon the soil condition student should be able to determine the bearing capacity of the foundation
4. Familiarize the concepts of Well foundations

Syllabus

UNIT -I **(6 hours)**

Soil exploration: Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advance soil exploration methods.

UNIT-II **(14 hours)**

Stability of slopes: Types of failures factor of safety of slopes- Infinite and finite earth slopes in sand and clay Swedish arc method, Standard method of slices Taylor's Stability Number Stability of slopes of dams and embankments - different conditions.

Earth pressure theories: Introduction- Rankine's & Coulomb's theory of earth pressure Culmann's graphical method - earth pressures in layered soils.

Retaining walls :– Different types - Type of Failures of Retaining Walls Stability requirements Drainage behind Retaining walls.

UNIT-III **(8 hours)**

Shallow foundations – bearing capacity criteria: Types of foundations and factors to be considered in their location – Bearing capacity – criteria for determination of bearing capacity factors influencing bearing capacity- analytical methods to determine bearing capacity – Terzaghi's theory –IS Methods.

Shallow foundations – settlement criteria: Safe bearing pressure based on N- value allowable bearing pressure; safe bearing capacity and settlement from plate load test, Types of foundation settlements and their determination allowable settlements of structures.

UNIT-IV **(7 hours)**

PILE FOUNDATION: Types of piles Load carrying capacity of piles based on static pile formulae – Dynamic pile formulae Pile load tests – Negative Skin Friction-Load carrying capacity of pile groups in sands Load carrying capacity of pile groups in clays.

UNIT-V **(5 hours)**

WELL FOUNDATIONS: Types – Different shapes of well – Components of well functions – forces acting on well foundations – Design Criteria –Construction and Sinking of wells – Tilt and shift

COURSE OUTCOMES: Upon the completion of this course, the students will be able to:

CO1: Classify the methods and importance of Soil exploration (L2)
CO2: Determine the stability of slopes and the earth pressure theories (L3)

CO3: Assess the bearing capacity and settlement of soils (L4)

CO4: Evaluate the factors considered for the deep foundation design. (L4)

CO5: Rectify the problems associated with well foundation (L2)

Mapping of CO's and PO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	2	-	-	-	-	-	-	-	-	-	2
CO2	2	2	2	2	-	-	-	-	-	-	-	-	-	2
CO3	-	2	2	2	-	-	-	-	-	-	-	-	-	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	-	2
CO5	2	-	2	-	-	-	-	-	-	-	-	-	-	2

Text books:

1. 'Principles of Foundation Engineering'by Das, B.M., - (2011) –6th edition (Indian edition) Cengage learning
2. 'Basic and Applied Soil Mechanics' by Gopal Ranjan & ASR Rao, New Age International Pvt. Ltd, (2004).
3. "Soil Mechanics & Foundation Engineering By Dr.K.R Arora, Standard Publishers
4. "Geotechnical Engineering" by C.Venkataramaiah ,New Age International Publishers

References:

1. Foundation Analysis and Design'by Bowles, J.E., (1988) – 4th Edition, McGraw-Hill Publishing Company, Newyork.
2. 'Theory and Practice of Foundation Design' by N.N.SOM & S.C.DAS PHI Learning Private limited.

GROUND WATER DEVELOPMENT AND MANAGEMENT

(Professional Elective – II)

Subject Code: UGCE6T0522 **L T P C**

III Year / II Semester **3 0 0 3**

Prerequisite: Basic knowledge on Ground water Hydrology

Course objectives:

The course is designed to

1. Appreciate groundwater as an important natural resource.
2. Understand flow towards wells in confined and unconfined aquifers.
3. Understand the principles involved in design and construction of wells.

4. Create awareness on improving the groundwater potential using various recharge techniques.
5. Know the importance of saline water intrusion in coastal aquifers and its control measures.
6. Appreciate various geophysical approaches for groundwater exploration.
7. Learn groundwater management using advanced tools.

Syllabus:

UNIT-I **(9 hours)**

Introduction: Groundwater in the hydrologic cycle, groundwater occurrence, Aquifer parameters and their determination, General groundwater flow equation.

Well Hydraulics: Steady radial flow, unsteady radial flow to a well in confined and unconfined aquifers, Theis solution, Jocob and Chow's methods, Leaky aquifers.

UNIT-II **(6 hours)**

Well design: Water well design-well diameter, well depth, well screen-screen length, slot size, screen diameter and screen selection, design of collector wells, infiltration gallery.

UNIT-III **(7 hours)**

Well construction and development: Water wells, drilling methods-rotary drilling, percussion drilling, Well construction-installation of well screens-pull-back method, open- hole, bail-down and wash-down methods, Well development-mechanical surging using compressed air, high velocity jetting of water, over pumping and back washing, well completion, well disinfection, well maintenance.

UNIT-IV **(9 hours)**

Artificial recharge: Concept of artificial recharge of ground water, recharge methods-basin, stream-channel, ditch and furrow, flooding and recharge well methods, recharges mounds and induced recharge.

Saline water intrusion: Occurrence of saline water intrusion, Ghyben- Herzberg relation, Shape of interface, control of saline water intrusion.

UNIT-V **(9 hours)**

Geophysics: Surface methods of exploration of groundwater – Electrical resistivity and Seismic refraction methods, Sub-surface methods – Geophysical logging and resistivity logging, Aerial Photogrammetry applications.

Groundwater modelling and management: Basic principles of groundwater modeling-Analog models-viscous fluid models and membrane models, digital models, Concepts of groundwater management, basin management by conjunctive use-case studies

COURSE OUTCOMES:

Upon successful completion of this course, the students will be able to:

CO1: Estimate aquifer parameters and yield of wells(L4)

CO2: Design using various construction methods and develop of well structures(L3)
CO3: Apply methods to recharge ground water and preventive measures of sea water intrusion(L4)
CO4: Interpret geophysical exploration data for scientific source of finding aquifers and Select appropriate measures for groundwater management(L4)

Mapping of COs to PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	-	2	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	2	-	-	-	-	-	-	-	-	2	2
CO3	2	2	-	2	-	-	-	-	-	-	-	-	2	2
CO4	2	2	-	2	-	-	-	-	-	-	-	-	2	2

Text books:
1. 'Groundwater' by Raghunath H M, New Age International Publishers, 2005.
2. 'Groundwater Hydrology'by Todd D.K., Wiley India Pvt Ltd., 2014.
3. 'Groundwater Hydrology'by Todd D K and L W Mays, CBS Publications, 2005.

References:
1. 'Groundwater Assessment and Management' by Karanth K R, Tata McGraw Hill Publishing Co., 1987.
2. 'Groundwater Hydrology' by Bouwer H, McGraw Hill Book Company, 1978.
3. 'Groundwater Systems Planning and Management' by Willis R and W.W.G. Yeh, Prentice Hall Inc., 1986.
4. 'Groundwater Resources Evaluation' by Walton W C, Mc Graw Hill Book Company, 1978

GROUND IMPROVEMENT TECHNIQUES

(Professional Elective – II)

Subject Code: UGCE6T0622 **L T P C**
III Year / II Semester **3 0 0 3**

Prerequisite: Geotechnical Engineering

Course objectives:
1. Understand the importance of soil in civil engineering
2. Knowing the importance of dewatering during construction by permeability and consolidation
3. Need of stabilizing the weak soil by knowing the structure and behavior of soil
4. Familiarize the concepts and stability of retaining wall
5. Adopting the applications of geosynthetics in constructions

6. Able to know and solve the problems in expansive soils

Syllabus:

UNIT-I: (7 hours)

Introduction: In situ densification methods in situ densification of granular soils- vibration at ground surface and at depth, impact at ground and at depth – in situ densification of cohesive soils pre loading – vertical drains – sand drains and geo drains – stone columns stability.

UNIT-II: (5 hours)

Dewatering: sumps and interceptor ditches –– single and multistage well points – vacuum well points – horizontal wells criteria for choice of filler material around drains – electro osmosis

UNIT-III: (6 hours)

Stabilization: Stabilization of soils methods of soil stabilization – mechanical – cement – lime – bitumen and polymer stabilization –– use of industrial wastes like fly ash and granulated blast furnace slag.

Grouting

Objectives of grouting – grouts and their applications ––. methods of grouting – Ascending, Descending and Stage Grouting in Soils hydraulic fracturing in soils and rocks – post grout tests

UNIT-IV: (8 hours)

Reinforced earth: principles –– components of reinforced earth – design principles of reinforced earth walls, stability checks – soil nailing.

UNIT-V (5 hours)

Geosynthetics: Geotextiles – types – functions, properties and applications – geogrids, geomembranes and gabions - properties and applications.

Course outcomes:

Upon successful completion of this course, the students will be able to:

CO1: Appreciate the various principles of science in the advanced equipments used for ground improvement (L2)

CO2: Understand the various methods of soil property improvements (L3)

CO3: Suggest solutions to attain the desirable safety and assurance of the projects in an economical way (L3)

CO4: Understand the geo synthetic properties and their applications (L3)

CO5: Able to know and solve the problems in expansive soils (L3)

Mapping of CO's and PO's:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	3	-	2		3	-	-	-	-	-	-	3
CO3	3	3	3	-	-		2	-	-	-	-	-	-	3
CO4	-	-	-	-	2	2	3	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	3

Text books:

1. Ground Improvement Techniques'by Purushotham Raj, Laxmi Publications, New Delhi.
2. 'Ground Improvement Techniques' by Nihar Ranjan Patro, Vikas Publishing House (P) Limited, New Delhi.
3. 'An introduction to Soil Reinforcement and Geosynthetics' by G.L.Siva Kumar Babu, Universities Press.

References:

1. Ground Improvement' by MP Moseley, Blackie Academic and Professional, USA.
2. 'Designing with Geosynthetics' by RM Koerner, Prentice Hall
3. Geo synthetics – An Introduction by Dr.G.V.Rao

ENVIRONMENTAL POLICY ANALYSIS

(Professional Elective – II)

Subject Code: UGCE6T0722 **L T P C**
III Year / II Semester **3 0 0 3**

Prerequisites: The student should have Knowledge on Environmental studies.

Course objectives:

1. To impart knowledge on the policies, legislations for environmental management
2. To inculcate skills on institutional frame work and enforcement Mechanisms.

Syllabus:

UNIT I **(10 hours)**

Introduction: Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration – Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act.

UNIT-II **(10 hours)**

Water (P&CP) act, 1974: Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation

UNIT – III **(8 hours)**

Air (P&CP) act, 1981: Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation

UNIT – IV **(8 hours)**

Environment (protection) act 1986: Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards.

UNIT – V **(8 hours)**

WIID LIFE (PROTECTION) ACT 1972 AND BIODIVERSITY ACT 2002: The Wildlife Protection Act 1972 - Sanctuaries and National Parks, Licensing of Zoos and Parks, State Monopoly in the Sale of Wild Life and Wild Life Articles, Offences against Wild Life. Biodiversity Conservation - Biological Diversity Act, 2002 and its Salient Features.

OTHER TOPICS Relevant: Provisions of Indian Forest Act, Public Liability Insurance Act, Cr PC, and IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

COURSE OUTCOMES: Upon successful completion of this course, the students will be able to:

CO1: Discuss the National Environmental legislation's and policies. (L2)

CO2: Plan programs to comply with the legal requirements related to organizations. (L3)
CO3: Utilize the laws, policies and institutions in the field of environment. (L2)
CO4: Summarize the responsibilities of PCB under the hazardous waste rules and list out the responsibilities of PCB's. (L2)
CO5: Evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution. (L3)
CO6: Explain the legal problems concerned with the environmental management. (L2)

Mapping of COs to PO's:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	2	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	2	2	-	3	-	2	2	-	-
CO3	-	-	-	-	-	2	-	2	3	-	-	-	-	-
CO4	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	2	-	-	-	2	-	-	-	-
CO6	2	-	-	-	-	-	-	-	-	-	-	-	-	-

Text books:

1. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001
2. Leela krishnan P. (2008) Environmental Law in India, 3rd ed., Lexis Nexis, India.

References:

1. CPCB "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997
2. Sands P. (2002) Principles of International Environmental Law, 2nd ed, Cambridge
3. Greger I.Megregor "Environmental law and enforcement", Lewis Publishers, London. 1994.
4. Upadhyay S. and Upadhyay V. (2002) Hand Book on Environmental Law- Forest Laws, Wild life Laws and the Environment; Vols. I, II and III, Lexis Nexis- Butterworths-India, New Delhi.

PAVEMENT ANALYSIS DESIGN AND EVALUATION

(Professional Elective-II)

	L	T	P	C
Subject Code: UGCE6T0822				
III Year / II Semester	**3**	**0**	**0**	**3**

Prerequisites: The student should have basic knowledge in mathematics and Transportation Engineering

Course Objectives:

The course is designed to -

1. Understand various factors affecting pavement design
2. Study various concepts for the stresses in pavements.
3. Understand material characterization and mix design concepts.
4. Acquire design principles of flexible and rigid pavements
5. Acquire design principles of shoulders, overlays and drainage

Syllabus

UNIT-I **(10 hours)**

Factors affecting pavement design: Variables Considered in Pavement Design, Types of Pavements, Functions of Individual Layers, Classification of Axle Types of Rigid Chassis and Articulated Commercial Vehicles, Legal Axle and Gross Weights on Single and Multiple Units, Tire Pressure, Contact Pressure, EAL and ESWL Concepts, Traffic Analysis: ADT, AADT, Truck Factor, Growth Factor, Lane, Directional Distributions & Vehicle Damage Factors, Effect of Transient & Moving Loads.

UNIT-II **(10 hours)**

Stresses in pavements: Vehicle-Pavement Interaction Transient, Random & Damping Vibrations, Steady State of Vibration, Experiments on Vibration, Stress Inducing Factors in Flexible and Rigid pavements;

Stress in Flexible Pavements: Visco-Elastic Theory and Assumptions, Layered Systems Concepts, Stress Solutions for One, Two and Three Layered Systems, Fundamental Design Concepts;

Stresses in Rigid Pavements: Westergaard's Theory and Assumptions, Stresses due to Curling, Stresses and Deflections due to Loading, Frictional Stresses, Stresses in Dowel Bars & Tie Bars, Introduction to DAMA, KENLAYER & KENSLABS Programs.

UNIT-III **(10 hours)**

Material characterization & mix design concepts: CBR and Modulus of Sub grade Reaction of Soil, Mineral aggregates – Blending of aggregates, binders, polymer and rubber modified bitumen, Resilient, Diametral Resilient and Complex (Dynamic) Moduli of Bituminous Mixes, Permanent
Deformation Parameters and other Properties, Effects and Methods of Stabilization and Use of Geo Synthetics; Marshall's and Hveem's Methods of Bituminous Concrete Mix Design, Field Implications of Stability and Flow Values, Introduction to Super Pave Mix Design, IRC Cement Concrete Mix Design.

UNIT-IV **(6 hours)**

Design of flexible pavements: Flexible Pavement Design Concepts, Asphalt Institute's Methods with HMA and other Base Combinations, AASHTO, Road Note No 29 & IRC Methods, Design of Runways & Taxiways, Design of Low Volume Rural Roads
Design of rigid pavements: Calibrated Mechanistic Design Process, PCA, AASHTO & IRC Specifications, Introduction to Pre-stressed and Continuously Reinforced Cement Concrete Pavement Design, Rigid Pavement Design for Low Volume Rural Roads

UNIT-V **(10 hours)**

Design of shoulders, overlays & drainage: Shoulder Design
Considerations, Traffic Prediction, Parking, Regular & Encroaching Traffic, Thickness Design Specifications for Flexible & Rigid Shoulders; Types & Design of Overlays: AI's Principal Component Analysis & IRC Methods of Overlay Design, Importance of Profile Correction Course; Pavement Drainage Concepts, Drainage Related Failures, Inflow-Outflow Concepts, Condition of Continuity, Surface and Sub Surface Drainage Design Specifications.

Course outcomes Upon the completion of this course, the students will be able to:

CO1: Identify the various components involved in the pavement design.(L2)
CO2: Calculate the stresses in Flexible and Rigid pavements. (L3)
CO3: Illustrate the concepts of material characterization and mix design in flexible pavements. (L2)
CO4: Design rigid and flexible pavements following IRC/AASHTO specifications and evaluate the pavements. (L3)
CO5: Design the shoulder, overlays and drainage for rigid and flexible pavements(L3)

Mapping of CO's and PO's:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	2	-	-	-	-	2	-	-	-	-	-
CO2	3	3	-	2	-	-	-	-	2	-	-	-	-	-
CO3	3	3	3	2	-	-	-	-	2	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	2	-	2	-	-	-
CO5	3	3	3	2	-	2	-	-	-	-	-	2	-	-

Text books:

1. 'Pavement Analysis and Design' by Yang H. Huang, Pearson Education, Second Edition.
2. 'Principles of Pavement Design' by Yoder.J. & Witczat Mathew, W. John Wiley & Sons Inc.
3. 'Pavement Design' by Srinivasa Kumar R, Universities Press, Hyderabad.

References:

1. 'Design of Functional Pavements' by Nai C. Yang, McGraw Hill Publications.
2. 'Concrete Pavements' by AF Stock, Elsevier, Applied Science Publishers.
3. 'Pavement and Surfacings for Highway & Airports' by Micheal Sargious, Applied Science Publishers Limited.
4. 'Dynamics of Pavement Structures' by G. Martineek, Chapmen & Hall Inc.
5. IRC: 37-2001 "Code of guideline for the design of flexible pavement", Indian Road Congress, New Delhi 2001.
6. IRC: 58-2002 "Code of guideline for the design of plain jointed rigid pavement for highway", Indian Road Congress, New Delhi 2002

GEO INFORMATICS ENGINEERING

(Job Oriented Elective)

Subject Code: UGCE6T0922 **L T P C**
III Year / II Semester **2 0 2 3**

Prerequisite: Nil.

Course objectives: The course is designed –

1. To introduce the basic concepts and principles of Remote Sensing.
2. To familiarize with structure and function of Geographic Information Systems.
3. To illustrate the multidisciplinary nature of Geospatial applications.

Syllabus:

UNIT –I: (8 hours)

Electro-magnetic radiation (emr), its interaction with atmosphere & earth: Definition of remote sensing and its components – Electromagnetic spectrum, wavelength regions important to remote sensing, wave theory, particle theory, Stefan-Boltzmann and Wien's Displacement Law – Atmospheric scattering, absorption, atmospheric windows, spectral signature concepts, typical spectral reflective characteristics of water, vegetation and soil.

UNIT –II: (8 hours)

Platforms and sensors: Types of platforms, orbit types, Sun-synchronous and Geosynchronous – Passive and Active sensors, resolution concept, payload description of important Earth Resources and Meteorological satellites – Airborne and Space-borne TIR (Thermal Infrared Radiation) and microwave sensors.

UNIT –III: (8 hours)

Image interpretation and analysis: Types of Data Products – types of image interpretation, basic elements of image interpretation, visual interpretation keys – Digital Image Processing, pre-processing, image enhancement techniques – multispectral image classification, supervised and unsupervised.

UNIT –IV: (10 hours)

Geographic information system: Introduction to Maps, definitions, map projections, types of map projections, map analysis – GIS definition, basic components of GIS, standard GIS software's – Data types, spatial and non-spatial (attribute) data - Data models – Data input - measurement scales – Data Base Management Systems (DBMS).

UNIT –V: (10 hours)

RS and GIS applications: Land cover and land use classification, crop productivity and crop monitoring, Smart city applications, Forest fire detection using image analysis.

Course outcomes: Upon completion of the course, the student will be able to

CO1: Relate the scientific theories to the behaviour of electromagnetic spectrum.(L3)

CO2: Distinguish between different types of satellites and identify appropriate remote sensing data products for mapping, monitoring and management applications. (L2)

CO3: Interpret Satellite images and processed outputs for extracting relevant information. (L4)

CO4: Structure the concept of a spatial decision support system in its analog and digital forms.(L4)

CO5: List and elaborate applications of Remote Sensing and GIS in various fields.(L3)

Mapping of CO's and PO's:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3	-	2	-	-	-	-	2	-	-	-	-	-
CO2	3	3	-	2	-	-	-	-	2	-	-	-	-	-
CO3	3	3	3	2	-	-	-	-	2	-	-	2	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO5	-	2	-		3	-	-	-	-	-	-	-	-	-

Text books:

1. Thomas. M. Lillesand and Ralph. W. Kiefer, Remote Sensing and Image Interpretation, John Wiley and Sons, 7th Edition, 2015.
2. Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, Oxford Publication, 3rd Edition, 2016.

References:

1. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2nd Edition.
2. M. Anji Reddy, Remote Sensing and Geographical Information Systems, B.S. Publications, 4th Edition.

FOUNDATION ENGINEERING LABORATORY

(Professional Course Lab)

Subject Code: UGCE6P1022	**L T P C**
III Year / II Semester	**0 0 3 1.5**

Prerequisite: Geotechnical Engineering, Mathematics

COURSE OBJECTIVES:

1. To impart knowledge for determination of index properties required for classification of soils
2. Discuss the difference between compaction & consolidation from relevant lab tests
3. Understand the flow of water through soils through permeability tests
4. Analyze the shear parameters of soil through different laboratory experiments

LIST OF EXPERIMENTS:

EXP-1: Direct shear test
EXP-2: Tri-axial Compression test (UU Test)
EXP-3: Vane Shear test
EXP-4: Unconfined Compression test
EXP-5: Consolidation test
EXP-6: CBR Test
EXP-7: Auger boring
EXP-8: Standard penetration test
EXP-9: Proctor needle penetration test
EXP-10: Relative Density of cohesion less soil
EXP-11: Plate load test
EXP-12: Improving the strength of soil using admixtures

COURSE OUTCOMES: Upon the completion of this course, the students will be able to:

CO1: Determine the engineering properties of soil (L3)
CO2: Experiment with CBR and find values of different soils (L3)
CO3: Determine the relative density of cohesion less soil and density of cohesive soil (L3)
CO4: Experiment to improve the strength of soil (L4)

Mapping of CO's and PO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	-	-	-	3	3	2	-	-	-	3
CO2	3	2	3	-	-	-	-	3	3	3	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3	3	3	3	-	-	-	3	3	3	-	-	-	3

References:

1. 'Basic and Applied Soil Mechanics' by Gopal Ranjan and A.S.R.Rao, New Age International Publishers.
2. 'Soil Mechanics and Foundation Engineering' by V.N.S.Murthy, CBS publishers.

GEO INFORMATICS (GI) LABORATORY

(Professional Course Lab)

Subject Code: UGCE6P1122	**L T P C**
III Year / II Semester	**0 0 3 1.5**

Prerequisite: Nil.

Course objectives: The course is designed –

1. Understand the process of digitization
2. Creation of various features thematically
3. Develop the DEM
4. Learn external data linkages to internal features
5. Learn GIS analysis.
6. Learn GIS data base quarries

List of Experiments

EXP-1: Digitization of Toposheet or Satellite Map.

Exp-2: Creating Attributes to Vector quantities.

Exp-3: Calculating Geometry for Vector quantities.

Exp-4: Handling Symbolizes and Labels

Exp-5: Preparation of thematic maps.

Exp-6: Buffers creation for (Point, line, and polygon) Features

Exp-7: Vector to raster Conversion

Exp-8: Rater to vector Conversion.

Exp-9: Creation of Digital Elevation Model.

Exp-10: Identification of features from Satellite image.

Exp-11: Generation of Land Parcel Map.

(Any 10 experiments)

Course outcomes: Upon completion of the course, the student will be able to

CO1: Create thematic maps (L3)
CO2: Analyze vector data (L4)
CO3: Calculate the geometrics of spatial data(L4)
CO4: Create Elevation models(L5)
CO5: generate data for different applications(L5)

Mapping of COs to POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	2	3	2	2	2	3	3	2	2	2	3
CO2	3	2	2	2	3	-	-	-	-	-	-	-	3	3
CO3	3	3	-	-	3	-	-	-	3	-2	-	2	2	3
CO4	3	3	-	2	3	-	2	-	-	-	2	3	3	2
CO5	3	3	3	-	3	2	3	3	3	3	-	3	3	3

Text books:

1. Thomas. M. Lilles and and Ralph. W. Kiefer, Remote Sensing and Image Interpretation, John Wiley and Sons, 7th Edition, 2015.
2. Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, Oxford Publication, 3rd Edition, 2016.

References:

1. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2nd Edition.
2. M. Anji Reddy, Remote Sensing and Geographical Information Systems, B.S. Publications, 4th Edition.

ENVIRONMENTAL ENGINEERING LABORATORY

(Professional Core Courses LAB)

Subject Code: UGCE6P1222 **L T P C**
III Year / II Semester **0 0 3 1.5**

Prerequisite: Student should have knowledge in Chemistry and Environmental Engineering

Course objectives: The course is designed to

1. Estimate the important characteristics of water & waste water
2. Study optimum coagulant dose
3. Understand some physical parameters like color, temperature, turbidity etc.

List of experiments:

EXP-1: Determination of pH and Electrical Conductivity (Salinity) of Water

EXP-2: Determination and estimation of Total Hardness–Calcium Magnesium

EXP-3: Determination of Alkalinity/Acidity

EXP-4: Determination of Chlorides in water

EXP-5: Determination and Estimation of total solids, organic solids and inorganic solids and Settable solids by Imhoff Cone

EXP-6: Determination of Iron

EXP-7: Determination of Dissolved Oxygen with D.O. Meter & Winkler Method

EXP-8: Determination of Biological Oxygen Demand (BOD)

EXP-9: Determination of Turbidity in the given water sample

EXP-10: Determination of Chemical Oxygen Demand (C.O.D)

EXP-11: Determination of Optimum coagulant dose

EXP-12: Determination of Chlorine demand

EXP-13: Determination of Available Chlorine in Bleaching Powder

Course outcomes: Upon the completion of this course, the students will be able to:

CO1: Show the Total Solids present in the given water sample.(L3)

CO2: Utilize the techniques if DO meter for measuring DO present in the given water sample.(L3)

CO3: List out the coagulants used in the jar test.(L3)

CO4: Estimate the pH of given water sample and Total Hardness.(L3)

Mapping of COs to PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	2	2	-	-	-	-	-	-	-	-	3	-	-
CO2	-	3	2	-	-	-	-	-	-	-	2	3	-	-
CO3	-	3	2	2	-	-	-	-	-	-	-	3	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	3	-	3

Text books:

1. Water Supply and Sanitary Engineering by G.S.Birdie, J.S.Birdie 1980, Dhanpatrai Publication
2. Water Supply Engineering Vol-I and Waste Water Engineering Vol-II B.C.Punmia, Second Edition, 2005, Laxmi Publication

References:

1. Water Supply Engineering Vol.I and Wastewater Engineering Vol.II, P.N. Modi, 2012, Standard Book Publishers

ADVANCED COMMUNICATION SKILLS

Subject Code: UGBS6K0122	**L**	**T**	**P**	**C**
III Year / II Semester	**1**	**0**	**2**	**2**

Prerequisite: Basic competency skills in English for effective communication at work place.

Course Objectives:

1. To expose students to LSRW skills at an advanced level.
2. To prepare students to acquire correct body language for better oral communication.
3. To prepare students to develop debatable skills, presentation as well as interview skills.

Syllabus:

UNIT-I :	Business E-mail Writing	(9 Hours)
UNIT-II :	Presentation skills	(9 Hours)
UNIT-III :	Group Discussion	(9 Hours)
UNIT-IV :	Resume Writing	(9 Hours)
UNIT-V :	Interviews	(9 Hours)

Course Outcomes:

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

CO1: Develop the skill of writing business e-mails. (L3)

CO2: Apply presentation skills for effective presentations. (L3)

CO3: Employ various aspects of group discussion and apply in discussions. (L3)

CO4: Develop the skill of writing resumes contextually and effectively. (L3)

CO5: Discover techniques for various types of interview for facing career interviews. (L3)

Mapping of COs to POs:

POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	3	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	3	3	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-	-	-

Text books:

1. Soft Skills – Key to Success in Workplace and Life – Meenakshi Raman & Shalini UpadhyayCengage publications
2. Interact – Orient BlackSwan

References:

1. Fluency Development Course – Kev Nair (Kerala)
2. Speaking English Effectively – Krishna Mohan & N P Singh – Macmillan Indian Ltd. Group Discussion for Admissions & Jobs – Anand Ganguly – Pustak Mahal Publishers, New Delhi

Internet sources:

1. BBC Learning English at work:
   http://www.bbc.co.uk/learningenglish/features/english-at-work/18-writing-an-email
2. Talkenglish.com:
   https://www.google.com/search?client=firefox-b-&q=talk+english.com
   Actual English – Jennifer (Video lessons)

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

(Common to all branches)

Subject Code: UGBS6A0222	**L**	**T**	**P**	**C**
III Year / II Semester	**2**	**0**	**0**	**0**

Course Objectives:

This course offers an introduction to Indian philosophy, tradition of Indian Science and Mathematics, holistic approach to health and gender sensitization.

Syllabus:

UNIT-I: INDIAN PHILOSOPHY

Origin of Indian philosophy- philosophy of Charvaka, Samkhya, Nyaya, Mimensa, Buddist and Jaina.

UNIT-II: TRADITION OF INDIAN SCIENCE

Historical evolution of medical tradition in ancient India.
Ayurveda: Principles of Ayurvedic Healing -Treating diseases to restore health.
Environmental Knowledge: Nature, flora and fauna, Manusmriti.

UNIT-III: TRADITION OF INDIAN MATHS

Early Historical period, Classical period, Vedic mathematics, Baskaracharya, Lilavati Bijaganitha, Srinivasa Ramanujan - Magic squares.

UNIT-IV: HOLISTIC HEALTH

History, Holistic approach: Enhance living – Mind fullness skills- Spirituality and Healing, Stress Management - Food—Work and Life style.
Yoga –Healthy Body: Introduction to Yoga, - Pranayamam, Surya Namaskara and Personality Development.

UNIT-V: GENDER SENSITIZATION

Basic Gender concepts and terminology, exploring attitudes towards Gender, Making Women, Making Men, Preparing for Womanhood.
Struggles with discrimination, Gender Roles and Relations, Gender and Human Rights, Types of Gender-based violence, Gender-based violence from a Human Rights perspective, Sexual Harassment, Gender and Media.

Course Outcomes:

Upon completion of this course, the students will be able to:

CO 1. Summarize the essence of Indian philosophy.
CO 2. Outline the tradition of Indian Science and Mathematics.
CO 3. Make use of holistic health practices, spirituality, stress management techniques for healthy life Style and Yoga practices to attain good personality.
CO 4. Develop awareness with regard to issues of gender.

Mapping of COs to POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	-	-	-	-	3	-	3	-	-	-	-	-	-
CO2	-	-	-	-	-	3	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	3	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	3	-	3	-	-	-	-	-	-

Text books:

1. "Traditional Knowledge System in India" by Amit Jha, 2009.
2. "Traditional Knowledge System and Technology in India", Basanta Kumar Mohantra, Vipin Kumar Singh, Pratibha Prakashan publisher, 2012.
3. "Towards a World of Equals: A Bilingual Textbook on Gender" written by A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu and published by Telugu Akademi.
4. "Gender Sensitization" by C. Rajya Lakshmi Kalyani, D.S. Vittal, published by Himalaya Publishing House Pvt. Ltd.

References:

1. "Knowledge Traditions and Practices of India", Kapil Kapoor, Michel Danino.
2. S. Radhakrishna, Indian Philosophy, Vol. 1 (London: George Allen and Unwin,1962), 287.
3. J. P. Jain, Religion and Culture of the Jains (Delhi: Bhartiya Jnanpith, 1977) 168
4. D. P. Sen Gupta, Current Science, 78 (12), 1569 (2000)
5. C. N. Srinivasa Iyengar, History of Indian Mathematics, World Press, Calcutta, 1967.
6. G. H Hardy, Ramanujan (Cambridge, 1940).
7. Nutritive Value of Indian Foods, C. Gopalan, B. V. Raman Sastri & S.C. Balasubramanian.
8. George Feuerstein: The Yoga Tradition (Its history, literature, philosophy and practice)
9. Swami Sivananda, Practice of Karma Yoga (The Divine Life Society, Shivananda Nagar, P.O., U.P., Himalayas, India)
10. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
11. IGNOU: Gender Sensitization: Society, Culture and Change (2019) BGSE001, New Delhi IGNOU
12. Jane Pilcher and Imelda Whelehan (2005): Fifty Key Concepts in Gender Studies.