IV Year - I Semester

S. No.	Subjects	L	T	P	Credits
1	Environmental Engineering - II	4	--	--	3
2	Water Resource Engineering - II	4	--	--	3
3	Geotechnical Engineering - II	4	--	--	3
4	Remote Sensing & GIS Applications	4	--	--	3
5	**Elective I** i. Finite Element Methods ii. Ground Improvement Techniques iii. Air Pollution & Control iv. Urban Hydrology v. Traffic Engineering	4	--	--	3
6	**Elective II** i. Advanced Structural Engineering ii. Advanced Foundation Engineering iii. Environmental Impact Assessment & Management iv. Ground Water Development v. Pavement Analysis and Design	4	--	--	3
7	IPR & Patents	--	2	--	--
8	GIS & CAD Lab	--	--	2	2
9	Irrigation Design & Drawing	--	--	2	2
	Total Credits				**22**

IV Year - II Semester

S. No.	Subjects	L	T	P	Credits
1	Estimation Specification & Contracts	4	--	--	3
2	Construction Technology & Management	4	--	--	3
3	Prestressed Concrete	4	--	--	3
4	**Elective III** i. Bridge Engineering ii. Soil Dynamics and Foundations iii. Solid and Hazardous Waste Management iv. Water Resources Systems Planning v. Urban Transportation Planning Engg	4	--	--	3
5	Seminar on Internship Project	--	3	--	2
6	Project	--	--	--	10
	Total Credits				**24**

Total Course Credits = 48+44 + 42 + 46 = 180

SYLLABUS

IV Year - I Semester

L	T	P	C
4	0	0	3

ENVIRONMENTAL ENGINEERING -II

Course Learning Objectives:

The objective of this course is:

- Outline planning and the design of wastewater collection, conveyance and treatment systems for a community/town/city
- Provide knowledge of characterisation of wastewater generated in a community
- Impart understanding of treatment of sewage and the need for its treatment.
- Summarize the appurtenance in sewerage systems and their necessity
- Teach planning, and design of septic tank and imhoff tank and the disposal of the effluent from these low cost treatment systems
- Effluent disposal method and realise the importance of regulations in the disposal of effluents in rivers

Course Outcomes:

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

- Plan and design the sewerage systems
- Select the appropriate appurtenances in the sewerage systems
- Analyze sewage and suggest and design suitable treatment system for sewage treatment
- Identify the critical point of pollution in a river for a specific amount of pollutant disposal into the river
- Suggest a suitable disposal method with respect to effluent standards.

SYLLABUS:

UNIT – I: **Introduction to Sanitation** – Systems of sanitation – relative merits & demerits – collection and conveyance of waste water – sewerage – classification of sewerage systems- Estimation of sewage flow and storm water drainage – fluctuations – types of sewers - Hydraulics of sewers and storm drains– design of sewers – appurtenances in sewerage – cleaning and ventilation of sewers

UNIT – II: **Pumping of wastewater**: Pumping stations – location – components– types of pumps and their suitability with regard to wastewaters.
House Plumbing: Systems of plumbing-sanitary fittings and other accessories– one pipe and two pipe systems – Design of building drainage

UNIT – III: **Sewage characteristics** – Sampling and analysis of wastewater - Physical, Chemical and Biological Examination-Measurement of BOD and COD - BOD equations
Treatment of sewage: Primary treatment-Screens-grit chambers-grease traps– floatation– sedimentation – design of preliminary and primary treatment units.

UNIT – IV: Secondary treatment: Aerobic and anaerobic treatment process-comparison.
Suspended growth process: Activated Sludge Process, principles, designs, and operational problems, modifications of Activated Sludge Processes, Oxidation ponds, Aerated Lagoons.
Attached Growth Process: Trickling Filters–mechanism of impurities removal- classification–design-operation and maintenance problems. RBCs, Fluidized bed reactors

UNIT V: Miscellaneous Treatment Methods: Nitrification and Denitrification – Removal of Phosphates –UASB–Membrane reactors-Integrated fixed film reactors. Anaerobic Processes: Septic Tanks and Imhoff tanks- working Principles and Design–Reuse and disposal of septic tank effluent, FAB Reactors.

UNIT – VI: **Bio-solids (Sludge) management**: Characteristics-SVI, handling and treatment of sludge-thickening – anaerobic digestion of sludge, Sludge Drying Beds. Centrifuge.

Disposal of sewage: Methods of disposal – disposal into water bodies-Oxygen Sag Curve-Disposal into sea, disposal on land- sewage sickness.

Text Books

4. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, Tata McGraw-Hill edition.
5. Industrial Water and Wastewater Management, K.V.S.G. Murali Krishna.
6. Elements of Environmental Engineering, K. N. Duggal, S. Chand & Company Ltd. New Delhi, 2012.

References

7. Environmental Engineering, Howard S. Peavy, Donald R. Rowe, Teorge George Tchobanoglus – Mc-Graw-Hill Book Company, New Delhi, 1985
8. Wastewater Treatment for Pollution Control and Reuse, Soli. J Arceivala, Sham R Asolekar, Mc-GrawHill, NewDelhi; 3rd Edition
9. Environmental Engineering –II: Sewage disposal and Air Pollution Engineering, Garg, S. K., Khanna Publishers
10. Sewage treatment and disposal, P. N. Modi & Sethi.
11. Environmental Engineering, Ruth F. Weiner and Robin Matthews – 4th Edition Elsevier, 2003

Environmental Engineering, D. Srinivasan, PHI Learning Private Limited, New Delhi, 2011.

IV Year - I Semester

L	T	P	C
4	0	0	3

WATER RESOURCES ENGINEERING–II

Course Learning Objectives:

The course is designed to

- introduce the types of irrigation systems
- introduce the concepts of planning and design of irrigation systems
- discuss the relationships between soil, water and plant and their significance in planning an irrigation system
- understand design methods of erodible and non-erodible canals
- know the principles of design of hydraulic structures on permeable foundations
- know the concepts for analysis and design principles of storage and diversion head works
- learn design principles of canal structures

Course Outcomes

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

- estimate irrigation water requirements
- design irrigation canals and canal network
- plan an irrigation system
- design irrigation canal structures
- plan and design diversion head works
- analyse stability of gravity and earth dams
- design ogee spillways and energy dissipation works

SYLLABUS:

UNIT-I Irrigation: Necessity and importance, principal crops and crop seasons, types, methods of application, soil-water-plant relationship, soil moisture constants, consumptive use, estimation of consumptive use, crop water requirement, duty and delta, factors affecting duty, depth and frequency of irrigation, irrigation efficiencies, water logging and drainage, standards of quality for irrigation water, crop rotation.

UNIT-II Canals: Classification, design of non-erodible canals - methods of economic section and maximum permissible velocity, economics of canal lining, design of erodible canals -Kennedy's silt theory and Lacey's regime theory, balancing depth of cutting.

UNIT III Canal Structures:
Falls: Types and location, design principles of Sarda type fall and straight glacis fall.
Regulators: Head and cross regulators, design principles
Cross Drainage Works: Types, selection, design principles of aqueduct, siphon aqueduct and super passage.
Outlets: types, proportionality, sensitivity and flexibility
River Training: Objectives and approaches

UNIT-IV Diversion Head Works: Types of diversion head works, weirs and barrages, layout of diversion head works, components. causes and failures of weirs on permeable foundations, Bligh's creep theory, Khosla's theory, design of impervious floors for subsurface flow, exit gradient.

UNIT-V Reservoir Planning: Investigations, site selection, zones of storage, yield and storage capacity of reservoir, reservoir sedimentation.
Dams: Types of dams, selection of type of dam, selection of site for a dam.
Gravity dams: Forces acting on a gravity dam, causes of failure of a gravity dam, elementary profile and practical profile of a gravity dam, limiting height of a dam, stability analysis, drainage galleries, grouting.

UNIT-VI Earth Dams: Types, causes of failure, criteria for safe design, seepage, measures for control of seepage-filters, stability analysis-stability of downstream slope during steady seepage and upstream slope during sudden drawdown conditions.
Spillways: Types, design principles of Ogee spillways, types of spillways crest gates. Energy dissipation below spillways-stilling basin and its appurtenances.

Text Books:

1. Irrigation and Water Power Engineering, B. C. Punmia, Pande B. B. Lal, Ashok Kumar Jain, Arun Kumar Jain, Lakshmi Publications (P) Ltd.
2. Irrigation Engineering and Hydraulic Structure, Santosh Kumar Garg, Khanna Publishers.

References:

1. Irrigation and Water Resources Engineering, Asawa G L (2013), New Age International Publishers
2. Irrigation Water Resources and Water Power Engineering, Modi P N (2011), Standard Book House, New Delhi

IV Year - I Semester

L	T	P	C
4	0	0	3

GEOTECHNICAL ENGINEERING – II

Course Learning Objectives:

The objective of this course is:

- To impart to the student knowledge of types of shallow foundations and theories required for the determination of their bearing capacity.
- To enable the student to compute immediate and consolidation settlements of shallow foundations.
- To impart the principles of important field tests such as SPT and Plate bearing test.
- To enable the student to imbibe the concepts of pile foundations and determine their load carrying capacity.

Course Outcomes:

Upon the successful completion of this course:

- The student must be able to understand the various types of shallow foundations and decide on their location based on soil characteristics.
- The student must be able to compute the magnitude of foundation settlement to decide the size of the foundation.
- The student must be able to use the field test data and arrive at the bearing capacity.
- The student must be able to design Piles based on the principles of bearing capacity.

SYLLABUS:

UNIT – I Stability of Slopes: Infinite and finite earth slopes in sand and clay – types of failures – factor of safety of infinite slopes – stability analysis by Swedish arc method, standard method of slices – Taylor's Stability Number-Stability of slopes of dams and embankments - different conditions.

UNIT – II Earth Retaining Structures: Rankine's & Coulomb's theory of earth pressure – Culmann's graphical method - earth pressures in layered soils.

UNIT-III 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. 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 Pile Foundations: Types of piles – Load carrying capacity of piles based on static pile formulae – Dynamic pile formulae– Pile load tests - Load carrying capacity of pile groups in sands and clays.

UNIT-V Well Foundations: Types – Different shapes of well – Components of well – functions – forces acting on well foundations - Design Criteria – Determination of steining thickness and plug - construction and Sinking of wells – Tilt and shift.

UNIT – VI Soil Exploration: Need – Methods of soil exploration – Boring and Sampling methods – Field tests – Penetration Tests – Pressure meter – planning of Programme and preparation of soil investigation report.

Text Books:

1. Principles of Foundation Engineering, Das, B.M., (2011), 6th edition Cengage learning
2. Basic and Applied Soil Mechanics, Gopal Ranjan & A.S.R. Rao, New Age International Pvt. Ltd, (2004).

References:

1. Foundation Analysis and Design, Bowles, J.E., (1988), 4th Edition, McGraw-Hill Publishing Company, Newyork.
2. Analysis and Design of Substructures by Swami Saran, Sarita Prakashan, Meerut.

IV Year - I Semester

L	T	P	C
4	0	0	3

REMOTE SENSING AND GIS APPLICATIONS

Course Learning Objectives:

The course is designed to

- introduce the basic principles of Remote Sensing and GIS techniques.
- learn various types of satellite sensors and platforms
- learn concepts of visual and digital image analyses
- understand the principles of spatial analysis
- appreciate application of RS and GIS to Civil engineering

Course outcomes

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

- be familiar with ground, air and satellite based sensor platforms.
- interpret the aerial photographs and satellite imageries
- create and input spatial data for GIS application
- apply RS and GIS concepts in water resources engineering
- applications of various satellite data

SYLLABUS:

UNIT – I Introduction to remote sensing: Basic concepts of remote sensing, electromagnetic radiation, electromagnetic spectrum, interaction with atmosphere, energy interaction with the earth surfaces, Characteristics of remote sensing systems
Sensors and platforms: Introduction, types of sensors, airborne remote sensing, spaceborne remote sensing, image data characteristics, digital image data formats-band interleaved by pixel, band interleaved by line, band sequential, IRS, LANDSAT, SPOT, MODIS, ASTER,RISAT and CARTOSAT

UNIT – II Image analysis: Introduction, elements of visual interpretations, digital image processing- image preprocessing, image enhancement, image classification, supervised classification, unsupervised classification.

UNIT – III Geographic Information System: Introduction, key components, application areas of GIS, map projections.
Data entry and preparation: spatial data input, raster data models, vector data models.

UNIT – IV Spatial data analysis: Introduction, overlay function-vector overlay operations, raster overlay operations, arithmetic operators, comparison and logical operators, conditional expressions, overlay using a decision table, network analysis-optimal path finding, network allocation, network tracing and buffer analysis.

UNIT – V RS and GIS applications General: Land cover and land use, agriculture, forestry, geology, geomorphology, urban applications,

UNIT – VI Applications of Hydrology, Water Resources and Disaster Management: Flood zoning and mapping, groundwater prospects and potential recharge zones, watershed management and disaster management with case studies.

TEXT BOOKS:

1. Remote sensing and GIS, Bhatta B (2008) , Oxford University Press
2. Remote Sensing and Image Interpretation, Lillesand, T.M, R.W. Kiefer and J.W. Chipman (2013), Wiley India Pvt. Ltd., New Delhi
3. Fundamentals of Geographic Information Systems, Demers, M.N, Wiley India Pvt. Ltd, 2013.

REFERENCES:

1. Fundamentals of Remote Sensing, George Joseph, Universities Press, 2013.
2. Concepts and Techniques of Geographical Information System, Chor Pang Lo and A K W Yeung, Prentice Hall (India), 2006
3. Remote Sensing and its Applications, Narayan LRA, Universities Press, 2012.
4. Introduction to Geographic Information Systems, Kand Tsung Chang, McGraw Hill Higher Education, 2009.
5. Basics of Remote sensing & GIS, Kumar S, Laxmi Publications, New Delhi, 2005.
6. Principals of Geographical Information Systems, Burrough P A and R.A. McDonnell, Oxford University Press, 1998.
7. Remote Sensing, Schowenger, R. A (2006), Elsevier publishers.

IV Year - I Semester

L	T	P	C
4	0	0	3

FINITE ELEMENT METHODS

(Elective – I)

Course Learning Objectives:

The objective of this course is:

- Equip the students with the fundamentals of Finite Element Analysis
- Enable the students to formulate the design problems into FEA.
- Enable the students to solve Boundary value problems using FEM

Course Outcomes:

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

- Solve simple boundary value problems using Numerical technique of Finite element method
- Develop finite element formulation of one and two dimensional problems and solve them.
- Assemble Stiffness matrices, Apply boundary conditions and solve for the displacements
- Compute Stresses and Strains and interpret the result.

SYLLABUS:

UNIT-I Introduction: Review of stiffness method- Principle of Stationary potential energy- Potential energy of an elastic body- Rayleigh-Ritz method of functional approximation.

UNIT-II Principles of Elasticity- Equilibrium Equations- Strain Displacement relationships- Constitutive relationship for plane stress, plane stain and axi symmetric bodies of revolution with axi symmetric loading.

UNIT-III Finite Element formulation of truss element: Stiffness matrix- properties of stiffness matrix –Selection of approximate displacement functions- solution of a plane truss- transformation matrix- Galerkin's method for 1-D truss – Computation of stress in a truss element.

UNIT-IV Finite element formulation of Beam elements: Beam stiffness- assemblage of beam stiffness matrix- Examples on Analysis of beams Subjected to Concentrated and Distributed loading.

UNIT-V Finite element formulation for plane stress and plane strain problems- Derivation of CST and LST stiffness matrix and equations-treatment of body and surface forces

UNIT-VI Iso-parametric Formulation: An isoparametric bar element- plane bilinear isoparametric element – quadratic plane element - shape functions, evaluation of stiffness matrix, consistent nodal load vector - Gauss quadrature for performing numerical integrations.

Text Books

1. A first course in the Finite Element Method, Daryl L. Logan, Thomson Publications.
2. Introduction to Finite Elements in Engineering, Tirupati R. Chandrupatla, Ashok D. Belgundu, PHI publications.,
3. Introduction to Finite Element Method, Desai & Abel CBS Publications

References:

1. Concepts and applications of Finite Element Analysis, Robert D. Cook, Michael E Plesha, John Wiley & sons Publication

GROUND IMPROVEMENT TECHNIQUES

Course Learning Objectives:

The objective of this course is:

- To make the student appreciate the need for different ground improvement methods adopted for improving the properties of remoulded and in-situ soils by adopting different techniques such as in situ densification and dewatering methods.
- To make the student understand how the reinforced earth technology and soil nailing can obviate the problems posed by the conventional retaining walls.
- To enable the students to know how geotextiles and geosynthetics can be used to improve the engineering performance of soils.
- To make the student learn the concepts, purpose and effects of grouting.

Course Outcomes:

- By the end of the course, the student should be able to possess the knowledge of various methods of ground improvement and their suitability to different field situations.
- The student should be in a position to design a reinforced earth embankment and check its stability.
- The student should know the various functions of Geosynthetics and their applications in Civil Engineering practice.
- The student should be able to understand the concepts and applications of grouting.

SYLLABUS:

UNIT- I 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.

UNIT –II Dewatering – sumps and interceptor ditches – single and multi stage well points – vacuum well points – horizontal wells – criteria for choice of filler material around drains – electro osmosis

UNIT- III 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.

UNIT- IV Reinforce earth – principles – components of reinforced earth – design principles of reinforced earth walls – stability checks – soil nailing.

UNIT- V Geosynthetics – geotextiles – types – functions , properties and applications – geogrids , geomembranes and gabions - properties and applications.
UNIT-VI Grouting – objectives of grouting – grouts and their applications – methods of grouting – stage of grouting – hydraulic fracturing in soils and rocks – post grout tests

Text Books:

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

Reference:

1. Ground Improvement, M.P. Moseley, Blackie Academic and Professional, USA.
2. Designing with Geosynethetics, R. M Koerner, Prentice Hall

AIR POLLUTION AND CONTROL

Course Learning Objectives:

The course will address the following:

- To know the analysis of air pollutants
- To know the Threshold Limit Values (TLV) of various air pollutants
- To acquire the design principles of particulate and gaseous control
- To learn plume behaviour in different environmental conditions
- To learn carbon credits for various day to day activities

Course Learning Outcomes:

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

- Decide the ambient air quality based on the analysis of air pollutants
- Design particulate and gaseous control measures for an industry
- Judge the plume behaviour in a prevailing environmental condition
- Estimate carbon credits for various day to day activities

SYLLABUS:

UNIT – I Air Pollution: Sampling and analysis of air pollutants, conversion of ppm into $\mu g/m^3$. Definition of terms related to air pollution and control - secondary pollutants - Indoor air pollution – Ozone holes and Climate Change and its impact - Carbon Trade.

UNIT-II Thermodynamics and Kinetics of Air-pollution: Applications in the removal of gases like SOx, NOx, CO and HC - Air-fuel ratio- Computation and Control of products of combustion, Automobile pollution. Odour pollution control, Flares.

UNIT – III Meteorology and Air Pollution: Properties of atmosphere: Heat, Pressure, Wind forces, Moisture and relative Humidity, Lapse Rates - Influence of Terrain and Meteorological phenomena on plume behaviour and Air Quality - Wind rose diagrams and Isopleths Plume Rise Models

UNIT-IV Ambient Air Quality Management: Monitoring of SPM - RPM SO2; NOx and CO - Stack Monitoring for flue gases - Micro-meteorological monitoring – Noise Monitoring - Weather Station. Emission Standards- Gaussian Model for Plume Dispersion

UNIT-V Air Pollution Control: Control of particulates – Control at Sources, Process Changes, Equipment modifications, Design and operation of control Equipments – Settling Chambers, Cyclone separators –Fabric filters–Scrubbers, Electrostatic precipitators

UNIT – VI Air Pollution Control Methods: Control of NOx and SOx emissions – Environmental friendly fuels - In-plant Control Measures, process changes, methods of removal and recycling. Environmental criteria for setting industries and green belts.

Text Books:

1. Air Pollution and Control, K.V.S.G. Murali Krishna, Laxmi Publications, New Delhi, 2015
2. Air Pollution, M. N. Rao and H. V. N. Rao, Tata McGraw Hill Company.

Reference:

1. An Introduction to Air pollution, R. K. Trivedy and P.K. Goel, B.S. Publications.
2. Air Pollution by Wark and Warner - Harper & Row, New York.

URBAN HYDROLOGY

Course Learning Objectives:

The course is designed to:

- appreciate the impact of urbanization on catchment hydrology
- understand the importance of short duration rainfall runoff data for urban hydrology studies.
- learn the techniques for peak flow estimation for storm water drainage system design.
- understand the concepts in design of various components of urban drainage systems
- learn some of the best management practices in urban drainage.
- understand the concepts of preparation master urban drainage system

Course Outcomes

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

- develop intensity duration frequency curves for urban drainage systems
- develop design storms to size the various components of drainage systems.
- apply best management practices to manage urban flooding.
- prepare master drainage plan for an urbanized area.

SYLLABUS:

UNIT I Introduction: Urbanisation and its effect on water cycle – urban hydrologic cycle – trends in urbanisation – Effect of urbanisation on hydrology

UNIT II Precipitation Analysis: Importance of short duration of rainfall and runoff data, methods of estimation of time of concentration for design of urban drainage systems, Intensity-Duration -Frequency (IDF)curves, design storms for urban drainage systems.

UNIT III Approaches to urban drainage: Time of concentration, peak flow estimation approaches , rational method, NRCS curve number approach, runoff quantity and quality, wastewater and stormwater reuse , major and minor systems.

UNIT IV Elements of drainage systems: Open channel, underground drains, appurtenances, pumping, source control.

UNIT V Analysis and Management: Stormwater drainage structures, design of stormwater network- Best Management Practices–detention and retention facilities, swales, constructed wetlands, models available for stormwater management.

UNIT VI Master drainage plans: Issues to be concentrated upon – typical urban drainage master plan, interrelation between water resources investigation and urban planning processes, planning objectives, comprehensive planning , use of models in planning

Text Books:

1. Manual on Drainage in Urbanised area, Geiger W. F., J Marsalek, W. J. Rawls and F. C. Zuidema, (1987 - 2 volumes), UNESCO,
2. Urban Hydrology, Hall M J (1984), Elsevier Applied Science Publisher.
3. Hydrology – Quantity and Quality Analysis, Wanielista M P and Eaglin (1997), Wiley and Sons
4. Urban Hydrology, Hydraulics and Stormwater Quality: Engineering Applications and Computer Modelling, Akan A.O and R.L. Houghtalen (2006), Wiley International.

References:

1. Stormwater Detention for Drainage, Stahre P and Urbonas B (1990), Water Quality and CSO Management, Prentice Hall.
2. Urban water cycle processes and interactions, Marsalek et. al. (2006), Publication No. 78, UNESCO, Paris(http://www.bvsde.paho.org/bvsacd/cd63/149460E.pdf)
3. Frontiers in Urban Water Management – Deadlock or Hope, by Maksimovic C and J A Tejada-Guibert (2001), IWA Publishing

TRAFFIC ENGINEERING

Course Learning Objectives:

The objective of this course is:

- To know various components and characteristics of traffic.
- To know various traffic control devices and principles of highway safety.
- To understand the detrimental effects of traffic on environment
- To know highway capacity and level of service concepts.
- To learn about intelligent vehicle highway systems.

Course Outcomes:

At the end of course, Student can

- Determine traffic speed, volume, travel time and density.
- Design traffic signals
- Determine highway capacity

SYLLABUS:

UNIT- I Components Of The Traffic System: Human-Vehicle–Environment System; characteristics of Road users, Vehicles, Highways and their classification, Traffic Studies: Inventories, Volume studies; Speed, Travel time and Delay studies, Intersection studies, Pedestrian studies; Parking studies; Accident studies.

UNIT- II Traffic Characteristics: Microscopic and macroscopic flow characteristics: Time headways; Temporal, spatial and model flow patterns; Interrupted and Un interrupted traffic. Microscopic and macroscopic speed characteristics: Vehicular speed Trajectories; Speed characteristics – Mathematical distribution; Speed and travel time variations; Travel time and delay studies. Microscopic and Macroscopic density characteristics: Distance headway characteristics; Car-following theories; Density measurement techniques; Density contour maps

UNIT- III Traffic Control Devices & Highway Safety: Traffic signs & Markings; Signal Warrants; Signal phasing and Development of phase plans; Fixed and Vehicle activated signals; Webster method; ARRB method; Drew's Method; IRC method; Signal coordination; Area Traffic control. Accident characteristics – Road – Driver – Vehicle; Accident recording and Analysis; Highway Safety Improvement Program; Safety Audit.

UNIT-IV Environmental Considerations: Air pollution: Kinds of pollutants; Air pollution standards; Measures of air quality; modelling and control. Noise pollution: Measurement of sound levels; Acceptable limits, Prediction of noise levels, Traffic noise control.

UNIT- V Highway Capacity And Level Of Service: Capacity and level of service; Factors affecting Capacity and LOS; Capacity of Rural Highways, Capacity of Urban Roads; HCM and IRC standards.

UNIT- VI Intelligent Vehicle – Highway Systems: Traffic surveillance and monitoring; IVHS programs, Role of IVHS, IVHS categories, Benefits and Costs of IVHS

Text Books

1. Traffic Engineering: Theory and Practice, Pignataro LJ., Prentice hall, Inc
2. Traffic and Transport planning, Kadiyali L.R., Khanna Publishers

References:

1. Traffic Engineering Hand Book, Institute of Transportation Engineers, 4 Ed., Prentice Hall
2. Traffic Engineering, Mc Shane, WR and RP Roess, Prentice Hall
3. Highway Traffic analysis and design, Salter RJ and NB Hounsell, 3rd ed., Macmillan
4. Traffic Planning and Engineering, Hobbs FD., Pergamon press
5. Traffic flow fundamentals, May, A.D., Prentice Hall

IV Year - I Semester

L	T	P	C
4	0	0	3

ADVANCED STRUCTURAL ENGINEERING

(Elective-II)

Course Learning Objectives:

The objective of this course is:

- Familiarize Students with Raft Foundations and Retaining walls
- Equip student with concepts of design of different types of RCC water tanks
- Understand Concepts of flat slabs
- Familiarize different types of Bunkers, Silos and Chimneys
- Understand different types of transmission towers

Course Outcomes:

At the end of this course the student will be able to

- Design raft foundations and different types of RCC retaining walls
- Carryout analysis and design of different types of RCC water tanks
- Solve the problems design of RCC Bunkers, Silos and Chimneys
- Understand various types of transmission towers and loading on them.

SYLLABUS:

UNIT – I Analysis and Design of Raft Foundations – Design of RCC Retaining walls: Cantilever and Counter fort

UNIT – II Analysis and Design of RCC Water Tanks, Circular and Rectangular types- Intze tank including staging.

UNIT – III Analysis and Design of Flat Slabs- Direct Design and Equivalent Frame Methods- Check for Punching shear

UNIT – IV Analysis and Design of Bunkers and Silos- Concepts of Loading

UNIT-V Analysis and Design of Chimney, Concepts of loading

UNIT-VI Introduction to Transmission Towers- Principles and procedures

Text books:

1. Reinforced Concrete Structures' Vol-2, B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi, publications Pvt. Ltd., New Delhi
2. Reinforced Concrete Structures, N. Subrahmanian, Oxford Publishers
3. Design Drawing of Concrete and Steel Structures, N. Krishna Raju University Press 2005.

References:

1. Essentials of Bridge Engineering, D. Johnson Victor, Oxford and IBM publication Co., Pvt. Ltd.
2. Reinforced concrete design, S. U, Pillai and D. Menon, Tata Mc.Grawhill Publishing Company

Codes: Relevant IS: codes.

INTERNAL EXAMINATION PATTERN:

The total internal marks (30) are distributed in three components as follows:

1. Descriptive (subjective type) examination : 25 marks
2. Assignment : 05 marks

FINAL EXAMINATION PATTERN:

The end examination paper should consist of Part A and Part B. part A consist of two questions in Design and Drawing out of which one question is to be answered. Part B should consist of five questions and design out of which three are to be answered. Weightage for Part – A is 40% and Part- B is 60%.

ADVANCED FOUNDATION ENGINEERING

Course Learning Objectives:

The objective of this course is:

- To enable the student to appreciate how Meyerhof's general bearing capacity equations are important over Terzaghi's bearing capacity equation.
- To teach the student special methods of computation of settlements and the corrections to be applied to settlements.
- To enable the student to understand the advanced concepts of design of pile foundations.
- To teach the student the problems posed by expansive soils and the foundation practices appropriate to expansive soils.
- To enable the student to learn the difference between isolated and combined footings, the determination of bearing capacity of mats and proportioning of footings.

Course Outcomes:

Upon successful completion of this course, student will be able to

- compute the safe bearing capacity of footings subjected to vertical and inclined loads.
- understand the advanced methods of settlement computations and proportion foundation footings.
- appreciate the methods of computing the pull-out capacity and negative skin friction of piles and compute the settlements of pile groups in clays.
- appreciate the problems posed by expansive soils and the different foundation practices devised.
- appreciate the difference between isolated footings and combined footings and mat foundations.

SYLLABUS:

UNIT-I Bearing capacity of Foundations using general bearing capacity equation – Meyerhof's, Brinch Hansen's and Vesic's methods- Bearing capacity of Layered Soils: Strong layer over weak layer, Weak layer on strong layer – Bearing capacity of foundations on a top of slope – Bearing capacity of foundations at the edge of the slope.

UNIT-II Settlement analysis: Immediate settlement of footings resting on granular soils – Schmertmann & Hartman method – De Beer and Martens method - Immediate settlement in clays – Janbu's method – correction for consolidation settlement using Skempton and Bjerrum's method – Correction for construction period

UNIT-III Mat foundations – Purpose and types of isolated and combined footings – Mats/ Rafts – Proportioning of footings – Ultimate bearing capacity of mat foundations – allowable bearing capacity of mats founded in clays and granular soils – compensated rafts.

UNIT-IV Earth-retaining structures – cantilever sheet piles – anchored bulkheads – fixed and free earth support methods – design of anchors – braced excavations – function of different components – forces in ties – stability against bottom heave.

UNIT-V Pile foundations – single pile versus group of piles – load-carrying capacity of pile groups – negative skin friction (NSF) -settlement of pile groups in sands and clays – laterally loaded piles in granular soils – Reese and Matlock method – laterally loaded piles in cohesive soils – Davisson and Gill method – Broms' analysis.

UNIT-VI Foundations in expansive soils – definitions of swell potential and swelling pressure – determination of free swell index – factors affecting swell potential and swelling pressure – foundation practices – sand cushion method – CNS layer - drilled piers and belled piers – under-reamed piles – moisture control methods.

Text Books:

1. Principles of Foundation Engineering, BM Das, CENTAG Learning
2. Soil Mechanics and Foundation Engineering, VNS Murthy, CBS Publishers

Reference:

1. Foundation Analysis and Design, J.E. Bowles, John Wiley
2. Foundation Design, W.C. Teng, Prentice Hall Publishers

ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

Course Learning Objectives:

The objective of this course is:

- To impart knowledge on different concepts of Environmental Impact Assessment
- To know procedures of risk assessment
- To learn the EIA methodologies and the criterion for selection of EIA methods
- To pre-requisites for ISO 14001 certification
- To know the procedures for environmental clearances and audit
- To appreciate the importance of stakeholder participation in EIA

Course Learning Outcomes

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

- Prepare EMP, EIS, and EIA report
- Identify the risks and impacts of a project
- Selection of an appropriate EIA methodology
- Evaluation the EIA report
- Estimate the cost benefit ratio of a project
- Know the role of stakeholder and public hearing in the preparation of EIA

SYLLABUS:

UNIT – I Basic concept of EIA: Elements of EIA-factors affecting EIA-Initial environmental Examination-life cycle analysis preparation of Environmental Base map-Classification of environmental parameters – role of stakeholders in the EIA preparation – stages in EIA

UNIT – II E I A Methodologies: introduction, Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods, cost/benefit Analysis - EIS and EMP

UNIT-III Impact of Developmental Activities and Land use: Introduction and Methodology for the assessment of soil and ground water, Delineation of study area, Identification of actives- application of remote sensing and GIS for EIA.

UNIT-IV Procurement of relevant soil quality, Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures - E I A with reference to

surface water, Air and Biological environment: Methodology for the assessment of Impacts on surface water environment, Generalized approach for assessment of Air pollution Impact.

UNIT – V Assessment of Impact of development Activities on Vegetation and wildlife, environmental Impact of Deforestation.
Environmental Risk Assessment and Risk management in EIA: Risk assessment and treatment of uncertainty-key stages in performing an Environmental Risk Assessment-advantages of Environmental Risk Assessment

UNIT-VI EIA notification by Ministry of Environment and Forest (Govt. of India): Provisions in the EIA notification, procedure for environmental clearance, procedure for conducting environmental impact assessment report- evaluation of EIA report. Environmental legislation objectives, evaluation of Audit data and preparation of Audit report. Post Audit activities, Concept of ISO and ISO 14000.
Case studies and preparation of Environmental Impact assessment statement for various Industries.

Text Books:

1. Environmental Impact Assessment, Canter Larry W., McGraw-Hill education Edi (1996)
2. Environmental Impact Assessment Methodologies, Y. Anjaneyulu, B. S. Publication, Sultan Bazar, Hyderabad.

References:

1. Environmental Science and Engineering, J. Glynn and Gary W. Hein Ke – Prentice Hall Publishers
2. Environmental Science and Engineering, Suresh K. Dhaneja, S. K. , Katania & Sons Publication., New Delhi.
3. Environmental Pollution and Control, H. S. Bhatia, Galgotia Publication (P) Ltd, Delhi

GROUND WATER DEVELOPMENT

Course Learning Objectives:

The course is designed to

- appreciate groundwater as an important natural resource.
- understand flow towards wells in confined and unconfined aquifers.
- understand the principles involved in design and construction of wells.
- create awareness on improving the groundwater potential using various recharge techniques.
- know the importance of saline water intrusion in coastal aquifers and its control measures.
- appreciate various geophysical approaches for groundwater exploration.
- learn groundwater management using advanced tools.

Course Outcomes

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

- estimate aquifer parameters and yield of wells
- analyse radial flow towards wells in confined and unconfined aquifers.
- design wells and understand the construction practices.
- interpret geophysical exploration data for scientific source finding of aquifers.
- determine the process of artificial recharge for increasing groundwater potential.
- take effective measures for controlling saline water intrusion.
- apply appropriate measures for groundwater management.

SYLLABUS:

UNIT – I Introduction Groundwater in the hydrologic cycle, groundwater occurrence, aquifer parameters and their determination, general groundwater flow equation.
Well Hydraulics Steady radial flow and unsteady radial flow to a well in confined and unconfined aquifers, Theis solution, Jocob and Chow's methods, Leaky aquifers.

UNIT – II 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 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 Artificial Recharge Concept of artificial recharge of groundwater, recharge methods-basin, stream-channel, ditch and furrow, flooding and recharge well methods, recharge 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 Geophysics Surface methods of exploration of groundwater – Electrical resistivity and Seismic refraction methods, Sub-surface methods – Geophysical logging and resistivity logging. Aerial Photogrammetry applications

UNIT – VI Groundwater Modelling and Management Basic principles of groundwater modelling- Analog models-viscous fluid models and membrane models, digital models-Finite difference and finite element models, Concepts of groundwater management, basin management by conjunctive use-case studies.

Text Books:

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

References:

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

PAVEMENT ANALYSIS AND DESIGN

Course Learning Objectives:

The objectives of this course are:

- To know various factors affecting pavement design
- To know various concepts for the stresses in pavements.
- To understand material characterisation and mix design concepts.
- To acquire design principles of flexible and rigid pavements.
- To acquire design principles of shoulders, overlays and drainage.

Course Outcomes:

At the end of course, Student will be able to

- Determine stresses in pavements
- Design bituminous mixes
- Design flexible pavements using various methods
- Design rigid pavements using various methods
- Design shoulders, overlays and drainage.

SYLLABUS:

UNIT-I 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 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 Material Characterisation & Mix Design Concepts: CBR and Modulus of Subgrade 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 Stabilisation 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 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

UNIT-V Design Of Rigid Pavements: Calibrated Mechanistic Design Process, PCA, AASHTO & IRC Specifications, Introduction to Prestressed and Continuously Reinforced Cement Concrete Pavement Design, Rigid Pavement Design for Low Volume Rural Roads.

UNIT-VI 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

Text Books:

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

References:

1. Design of Functional Pavements, Nai C. Yang, McGraw Hill Publications
2. Pavement and Surfacings for Highway & Airports, MichealSargious, Applied Science Publishers Limited.
3. Principles of Transportation Engineering, Patha Chakroborty and Animesh Das, PHI Learning Private Limited, Delhi
4. Dynamics of Pavement Structures, G. Martineek, Chapmen & Hall Inc
5. Concrete Pavements, A.F. Stock, Elsevier, Applied Science Publishers
6. Pavement Evaluation Maintenance Management System, R Srinivas Kumar, Universities Press, Hyderabad.

IV Year - I Semester

L	T	P	C
0	2	0	0

IPR & PATENTS

Objectives:

***To know the importance of Intellectual property rights, which plays a vital role in advanced Technical and Scientific disciplines.**

***Imparting IPR protections and regulations for further advancement, so that the students can familiarize with the latest developments.**

UNIT I: Introduction to Intellectual Property Rights (IPR)

Concept of Property - Introduction to IPR – International Instruments and IPR - WIPO - TRIPS – WTO -Laws Relating to IPR - IPR Tool Kit - Protection and Regulation - Copyrights and Neighboring Rights – Industrial Property – Patents - Agencies for IPR Registration – Traditional Knowledge –Emerging Areas of IPR - Layout Designs and Integrated Circuits – Use and Misuse of Intellectual Property Rights.

UNIT II: Copyrights and Neighboring Rights

Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of Performers – Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Case Law - Semiconductor Chip Protection Act.

UNIT III: Patents

Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Compulsory Licensing — Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related Innovations.

UNIT IV: Trademarks

Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark and Property Mark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Deceptive Similarities - Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing Off Action.

UNIT V: Trade Secrets

Introduction to Trade Secrets – General Principles - Laws Relating to Trade Secrets - Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee

Confidentiality Agreements – Breach of Contract –Law of Unfair Competition – Trade Secret Litigation – Applying State Law.

Unit VI: Cyber Law and Cyber Crime

Introduction to Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions - E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention and Punishment – Liability of Network Providers.

- Relevant Cases Shall be dealt where ever necessary.

Outcome:

*** IPR Laws and patents pave the way for innovative ideas which are instrumental for inventions to seek Patents.**

***Student get an insight on Copyrights, Patents and Software patents which are instrumental for further advancements.**

References:

1. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.
2. Deborah E.Bouchoux: Intellectual Property, Cengage Learning, New Delhi.
3. PrabhuddhaGanguli: Intellectual Property Rights, Tata Mc-Graw –Hill, New Delhi
4. Richard Stim: Intellectual Property, Cengage Learning, New Delhi.
5. Kompal Bansal &Parishit Bansal Fundamentals of IPR for Engineers, B. S. Publications (Press).
6. Cyber Law - Texts & Cases, South-Western's Special Topics Collections.
7. R.Radha Krishnan, S.Balasubramanian: Intellectual Property Rights, Excel Books. New Delhi.
8. M.Ashok Kumar and MohdIqbal Ali: Intellectual Property Rights, Serials Pub.

IV Year - I Semester

L	T	P	C
0	0	3	2

GIS & CAD LAB

Course Learning Objectives:

The course is designed to

- Introduce image processing and GIS software
- familiarize structural analysis software
- understand the process of digitization, creation of thematic map from toposheets and maps
- learn to apply GIS software to simple problems in water resources and transportation engineering
- learn to analyze 2 D and 3D frame steel tubular truss using structural analysis software
- learn to analyze and design retaining wall and simple towers

Course outcomes

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

- work comfortably on GIS software
- digitize and create thematic map and extract important features
- develop digital elevation model
- use structural analysis software to analyze and design 2D and 3D frames
- design and analyze retaining wall and simple towers using CADD software.

SYLLABUS:

GIS:

SOFTWARES:

1. Arc GIS 9.0
2. ERDAS 8.7
3. Mapinfo 6.5

Any one or Equivalent.

EXCERCISES IN GIS:

1. Digitization of Map/Toposheet
2. Creation of thematic maps.
3. Estimation of features and interpretation

4. Developing Digital Elevation model

5. Simple applications of GIS in water Resources Engineering & Transportation Engineering.

COMPUTER AIDED DESIGN AND DRAWING:

SOFTWARE:

1. STAAD PRO / Equivalent/
2. STRAAP

3. STUDDS

EXCERCISIES:

1. 2-D Frame Analysis and Design
2. Steel Tabular Truss Analysis and Design
3. 3-D Frame Analysis and Design
4. Retaining Wall Analysis and Design
5. Simple Tower Analysis and Design

TEXT BOOK:

1. 'Concept and Techniques of GIS' by C.P.L.O. Albert, K.W. Yong, Printice Hall Publishers.

IV Year - I Semester

L	T	P	C
0	0	3	2

IRRIGATION DESIGN AND DRAWING

Course Learning Objectives:

To understand design principle of various irrigation structures

Course Outcomes:

At the end of the course the student will be able to To design various irrigation structures.

SYLLABUS:

Design and drawing of

1. Surplus weir
2. Tank sluice with a tower head
3. Canal drop-Notch type
4. Canal regulator
5. Under tunnel
6. Syphon aqueduct type III

Final Examination pattern: Any two question of the above six designs may be asked out of which the candidated has to answer one question. The duration of the examination is three hours.

Text Books:

1. Water Resources Engineering – Principles and Practice by C. Satyanarayana Murthy, New age International Publishers.

Reference :

1. Irrigation Engineering and Hydraulic Structures, S. K. Garg, Standard Book House.
2. Irrigation and Water Power Engineering, B. C Punmia & Lal, Lakshmi Publications Pvt. Ltd., New Delhi.