Semester V (Third year) Branch/Course Civil Engineering

S.No	Sub Code	Category	Subject Name	L	T	P	C	I	E	TM
1	1965501	PCC	Structural analysis	2	1	-	3	30	70	100
2	1965502	PCC	Hydraulics and Hydraulic Machinery	3	1	-	4	30	70	100
3	1965503	PCC	Water Resources Engineering-I	2	1	-	3	30	70	100
4	1965504	PCC	Foundation Engineering	2	1	-	3	30	70	100
5	1965505	PCC	Reinforced concrete Structures	2	1	-	3	30	70	100
6	Professional Elective - I			3		-	3	30	70	100
	1965506A	PEC	Remote Sensing and GIS Applications							
	1965506B	PEC	Ground Improvement Techniques							
	1965506C	PEC	Sanitary Engineering							
	1965506D	PEC	Railway, Dock and Harbour Engineering							
7	1965507P	PCC	Transportation Engineering Lab	-	-	3	1.5	50	50	100
8	1965508P	PCC	Fluid Mechanics and Hydraulic Machines Lab	-	-	3	1.5	50	50	100
			Total	14	5	6	22	280	520	800

Semester VI (Third year] Branch/Course Civil Engineering

S.No	Sub Code	Category	Subject Name	L	T	P	C	I	E	TM
1	1965601	PCC	Estimation and Quantity Surveying	3	1	-	4	30	70	100
2	1965602	PCC	Design of Steel Structures	2	1	-	3	30	70	100
3	1965603	PCC	Water Resources Engineering-II	2	1	-	3	30	70	100
4	Professional Elective - II			3	-	-	3	30	70	100
	1965604A	PEC	Advanced Concrete Structures							
	1965604B	PEC	Watershed Management							
	1965604C	PEC	Air Pollution and control							
	1965604D	PEC	Finite Element Method							
5	Professional Elective - III			3	-	-	3	30	70	100
	1965605A	PEC	Rock Mechanics							
	1965605B	PEC	Pavement Construction and Management							
	1965605C	PEC	Advanced Structural Analysis							
	1965605D	PEC	Irrigation Engineering							
6	1965606	OEC	Open Elective-I	3	-	-	3	50		50
7	1965607P	PCC	Concrete Lab	-	-	3	1.5	50	50	100
8	1965608P	PCC	CAD Lab	-	-	3	1.5	50	50	100
			Total	16	3	6	22	300	450	750

Industrial Training To be held during summer vacation and evaluated@ in the 1st Semester of IV year

@ Assessment as indicated along with the requirements given in the syllabus part.

STRUCTURAL ANALYSIS

Subject code: 1965501	**Credits: 3**
Instruction: 2 Lecture &1 Tutorial / week	Sessional Marks: 30
End Exam: 3 Hours	End Exam Marks: 70

Course Objectives:

The objective of this course is:

1. Apply suitable methods for calculating deflections in statically determinate beams and trusses.
2. Apply suitable methods for analyzing statically indeterminate beams.
3. Analyze beams under moving loads.

Course Outcomes:

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

1. Analyze deflections in statically determinate beams and trusses.
2. Determine strain energy due to different types of forces and statically indeterminate beams
3. Analyze fixed and continuous beams.
4. Compute shear force and bending moment varying with application of moving loads.
5. Evaluate Stresses in columns and to study theories of failure.

UNIT-I

Deflections of Beams using (i) Moment area method, (ii) Conjugate beam method, (iii) Unit load method, (iv) Castigliano's theorm – I

Deflections of Statically Determinate Structures: (a)Single storey, single bay rectangular portal frames using (i) Unit load method, (ii) Castigliano's theorm –I. (b) Trusses (having 9 members or less) using (i) Unit load method, (ii) Castigliano's theorem-I.

UNIT-II

Strain – energy due to (i) Axial load, (ii) Shear force, (iii) Bending Moment and (iv) Torque;

Analysis of Statically indeterminate Structures (a) fixed beams, (b) three span continuous beams using (i) Theorem of three moments, (ii) Slope deflection method and (iii) Moment distribution method

UNIT-III

Moving loads: Maximum Shear force and Bending moment diagrams for different types of loads. Maximum Bending moment at a section under a wheel load and absolute maximum Bending moment in the case of several wheel loads. Equivalent uniformly distributed live load for Shear force and Bending moment

UNIT- IV

Thin Cylinders: Longitudinal and Hoop stresses in thin cylinders subjected to internal pressure. Wire wound thin cylinders

Thick cylinders: Lamme's theory, Compound tubes

UNIT-V

Theory of failure (i) Principal Stress theory, (ii) Principal Strain theory, (iii) Maximum Shear Stress theory and (iv) Maximum strain energy theory.

Columns and Struts: Combined bending and direct stresses – kern of a section – Euler's theory– end conditions. Rankine – Gordon formula – Eccentrically loaded columns.

TEXT BOOKS

1. Ramamrutham, "Theory of structures", 9th edition, Dhanpat rai Publishing company.
2. BC Punmia and Arun Kumar Jain and AK Jain, "Theory of Structures", 12th edition, Laxmi Publications

REFERENCES

1. S.P. Timoshenko and D.H. Young, "Theory of structures", 2nd Edition, McGraw Hill International Editions.
2. CS Reddy, "Basic Structural Analysis", 3rd edition, Tata McGraw Hill Education.
3. Vazirani and Ratwani, "Analysis and Design of structures", 17th edition , Vol 1, Khanna publishers.

HYDRAULICS & HYDRAULIC MACHINERY

Subject code: 1965502	**Credits : 4**
Instruction : 3 Lecture &1 Tutorial / week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to:

1. Apply dimensional analysis to predict formulas, which connect particular variables in given circumstances.
2. Make use of the concepts of the working principles and design of hydraulic turbines.
3. Understand the performance of centrifugal and reciprocating pumps under different operating conditions.
4. Design most economical channel sections.

Course Outcomes:

At the end of the Course, the Student will be able to:

1. Evaluate the similarities between model and prototype and their relations.
2. Understand the performance of impact of jets.
3. Explain the functioning of various turbines and their design, analyse the performance under different operating conditions and governing of turbines.
4. Determine the performance of centrifugal and reciprocating pumps under different operating conditions.
5. Determine discharge and design most economical channel section for uniform flow in open channels.

SYLLABUS:

UNIT I

Dimensional Analysis and Similitude:

Units and Dimensional Formulae for Various Engineering Quantities; Dimensional Homogeneity. Rayleigh's Method; Buckingham π method. Similarities– Geometric, Kinematic and Dynamic Similarities; Modeling Criteria; Similarity Laws – Important Dimensionless Numbers –Reynolds Number, Froude Number, Mach number, Euler Number, Weber Number. Distorted and undistorted Models.

UNIT II

Impact of jets:

Force exerted by fluid jet on stationary and moving flat, inclined and curved vanes, jet striking centrally and at tip, velocity triangles at inlet and outlet, expressions for work done and

efficiency, Torque and Work done by series of Moving Vanes.

UNIT III

Hydraulic Machines– Turbines:

Hydraulic Turbines: Introduction - Classification based on Head, Discharge, Hydraulic Action – Impulse and Reaction Turbines, Differences between Impulse and Reaction Turbine, Choice of Type of Turbine, Component Parts & Working principle of a Pelton Turbine, Francis Turbine - Velocity Triangles - Hydraulic and Overall efficiencies. **Performance of turbines**: Performance under Unit head, power and speed – Performance under specific conditions - Specific Speed and its importance. Performance Characteristic Curves – Operating Characteristic Curves – Cavitation - Draft Tube.

UNIT IV

Hydraulic Machines –Pumps:

Centrifugal Pumps: Types of Pumps – Selection Criterion – Comparison between Centrifugal & Reciprocating Pumps - Centrifugal Pumps – Component Parts & Working Principle – Classification of Centrifugal pumps - Cavitation – Maximum Suction lift – NPSH. Specific Speed of pumps – Performance Characteristics of Centrifugal Pumps - Constant efficiency curves of Centrifugal Pumps. **Reciprocating Pumps**: Component Parts – Working Principle of single acting and double acting reciprocating pumps – Discharge Co-efficient, Volumetric efficiency and Slip. Work done and Power Input – Indicator Diagram - Air Vessels.

UNIT V

Flow through Open Channels:

Flow through Open Channels: Classification of open channels, Uniform Flow: Chezy's and Manning's formula, Hydraulic mean depth, hydraulic radius. Most economical trapezoidal and rectangular channel section – Specific energy, Critical Flow. Steady Rapidly Varied Flow: Hydraulic Jump in a horizontal rectangular channel.

TEXT BOOKS:

1. Modi, P.N. & Seth, S.M. (2009), "Fluid Mechanics and Hydraulic Machinery", Standard Book House, New Delhi, 19th Edition.

2. Jain, A.K. (2008), "Fluid Mechanics", Khanna Publishers, New Delhi, 4th Edition.

REFERENCES:

1. Kumar, K.L., Chand, S. & Co. (2008), "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd, New Delhi, 8 th Edition.

2. Subramanya, K. (2008), "Flow in Open Channels", McGraw Hill Education, New Delhi, 3 rd Edition.

3. Chow, V.T. (2009), "Open-Channel Hydraulics", The Blackburn Press, Caldwell, NJ USA, 1st Edition.

WATER RESOURCES ENGINEERING – I

Subject code: 1965503	**Credits : 3**
Instruction : 2 Lecture & 1 Tutorial /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Pre-requisites: Geotechnical Engineering-I, Environmental Engineering -I

Course Objectives:

The objective of this course is to:

1. Extend the concept of hydrology as a prerequisite for the irrigation engineering and for design of hydraulic structure.
2. Illustrate the distribution of water flow and planning of a reservoir.
3. Develop distribution systems for canal irrigation, design of unlined and lined irrigation canals design sediment problems associated with canal.

Course Outcomes

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

1. Explain various components of hydrologic cycle that affect the movement of water in the earth. Necessary investigations required for planning of a reservoir.
2. Illustrate the concepts of movement of ground water beneath the earth.
3. Interpret necessary investigations required for planning of a reservoir.
4. Categorize the basic requirements of irrigation and various irrigation techniques, requirements of the crops.
5. Evaluate the distribution systems for canal irrigation and the basics of design of unlined and lined irrigation canals design.

UNIT 1

Introduction and Hydrological Aspects: Hydrology in water Resources Planning, Importance of Precipitation, Types, Measurement of rainfall. Average depth of rainfall over an area, Mean annual rainfall, Analysis of Rainfall Data Consistency of rainfall record, Double mass curve, Depth – Intensity, Depth-Area-Duration curves, frequency of point rainfall Intensity-Duration-Frequency (IDF) curves. Infiltrometers; Evaporation and Evapotranspiration Pan Evaporation; Runoff – Factors affecting Runoff, Methods of determination of Runoff, Hydrograph Analysis, Base flow separation, Unit Hydrographs, Hydrograph of different durations, Applications of Unit Hydrograph; S- hydrograph, Synthetic Unit Hydrograph.

UNIT II

Ground Water Flow: Definitions, subsurface distribution of water, ground water movement; Darcy's law; Permeability – Intrinsic permeability; Well hydraulics – Steady flow in different types of aquifers and wells; Determination of hydraulic properties of aquifer; Well losses;

Specific capacity of well; Well efficiency – Pumping tests – Recuperation test method for determination of well yield. Methods of construction of open well yield of an open well – Methods of construction of Tube Wells, well shrouding and well development, Spacing of tube wells, Design of tube well.

UNIT III

Reservoir Planning And Flood Routing: Types of reservoir – Investigations for reservoir planning, Selection of site for a reservoir, Zones of storage in a reservoir; Purpose of reservoir, Reservoir yield, Mass curve and Demand curve, Determination of reservoir capacity, Yield from a reservoir of given capacity; Reservoir Losses – Measures to reduce evaporation loss in reservoirs sedimentation, Control of reservoir sedimentation. Flood Routing – Hydraulic and Hydrologic routing, Channel and reservoir routing, Channel routing by Muskingum method(Concept only).

UNIT IV

Irrigation: Definition of irrigation, Types of irrigation systems-methods of application of irrigation water –Irrigation efficiencies – Soil moisture – Irrigation relationship – Estimating depth and frequency of irrigation on the basis of soil moisture regime concept; Water requirements of crops, Duty, Delta and Base period – Their relationship, Crops – Seasons, Factors affecting duty and methods of improving duty, Consumptive use of water, Assessment of irrigation water charges.

UNIT V

Canal Systems: Classification of irrigation canals – Canal alignment, Design of unlined canals, Regime theories – Kennedy's and Lacey's theories, Balancing depth – L.S. of a channel Cross section of an irrigation channel – Maintenance of irrigation channel. Regulation of channel system – Canal outlets, Requirements of a good outlet – Types of outlets; Water logging – Causes and control Canal lining, Design of lined canals (concept only), Canal navigation.

TEXT BOOKS

1. Punmia, B.C. and Lal Pande B.B. (1992), "Irrigation and Water Power Engineering",16th Edition, Laxmi Publications Pvt. Ltd., New Delhi, 12th edition.
2. Garg, S.K. (1999), Irrigation Engineering and Hydrology Structures, Khanna Publishers, Delhi, 14th Edition.

REFERENCES

1. Modi, P.N. "Irrigation, Water Resources and Water Power Engineering", 6 th Edition.Standard Book House, Delhi, 2004.
2. Jayarami Reddy, P. "A Text book of Hydrology", 3 rd Edition Laxmi Publication, Delhi.1999.
3. Subramanya, KEngineering Hydrology, Tata-Mc Graw Hill Publishing, Delhi, 1 st Revised Edition,1994.

FOUNDATION ENGINEERING

Subject code: 1965504	**Credits : 3**
Instruction : 2 Lecture & 1 Tutorial /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course learning objectives:

The objective of this course is to:

1. Ability to analyze and interpret results for various Slope stability analysis.
2. Provide civil engineering students with a basic knowledge of Foundation engineering practice.
3. Ability to understand, formulate, and solve the problems related to Foundation engineering.

Course Outcomes

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

1. Analyze soil exploration.
2. Analyze finite and infinite slopes.
3. Analyze the Earth pressure theories.
4. Estimate the bearing capacity and settlement of shallow foundations.
5. Estimate load carrying capacity of piles and theory aspects of well foundations.

UNIT I

Subsoil Exploration: Methods of subsoil exploration Direct, semi direct and indirect methods, Soundings by Standard, Dynamic cone and static cone penetration tests, Types of Boring, Types of samples, Criteria for undisturbed samples, Transport and preservation of samples, Borelogs, planning of exploration programms, report writing.

UNIT II

Stability Analysis of Slopes: Infinite and Finite Slopes, Stability Analysis of Infinite Slopes, different factors of safety, Types of Slope Failures. Stability Analysis of Finite slopes – Swedish Circle method, Friction Circle method, Taylor's stability number. Retaining walls: Types and Stability Analysis.

UNIT III

Earth Pressure: Types of Earth pressure, Rankines Active and passive earth pressure, Smooth Vertical wall with horizontal and inclined backfills. Coloumbs wedge theory, Culmanns and Rebhanns graphical method for active earth pressure.

UNIT IV

Bearing Capacity: General and local shear failures, Terzaghi's bearing capacity equations, Factors affecting bearing capacity of Soil, IS Code method for Bearing capacity of footings, Bearing capacity from plate load tests. Shallow Foundations: Factors effecting locations of foundation, choice of type of foundations, Settlement Analysis: Causes of settlement, Computation of settlement, allowable settlement. Measures to reduce settlement.

UNIT V

Pile Foundations: Types, Construction, load carrying capacity of single pile – Dynamic Formula, Static formula, Pile load tests, Load carrying capacity of pile groups, settlement of pile groups,

Negative skin friction, under reamed pile.

Caissons: Types of caissons, pneumatic caissons, Different shapes of well foundations, Relative advantages and disadvantages, Different Components of well and their function, Grip length, problems in well sinking and remedial measures.

TEXT BOOKS:

1. Gopal Ranjan and A.S.R. Rao, "Basic and Applied Soil Mechanics", 3rd edition, New age international , 2016

2. K.R. Arora , Soil Mechanics and Foundation Engineering 7th re print edition, Standard Publisher 2019,

References:

1. Varghese. P.C., "Foundation Engineering", 1st Edition, Prentice Hall of India, 2005.
2. B.M. Das, Principles of Foundation Engineering, 7th Edition, Cengage Learning, 2011.
3. Bowles, "Foundation analysis and design" 5th edition, Mc Graw Hill,
4. Wayne C Teng, "foundation design", 13th print, Prentice Hall, 1962.

REINFORCED CONCRETE STRUCTURES

Subject code: 1965505	**Credits : 3**
Instruction : 2 Lecture & 1 Tutorial / week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

1. The objective of this course is:
2. Learn the recommendations of IS: 456-2000, loading standards as per IS 875
3. Understand the concepts of Working Stress Method, Ultimate Load Method and Limit State Method
4. Learn how to design various types of columns, beams, slabs and footings

Course Outcomes:

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

1. Design singly reinforced beams, doubly reinforced beams
2. Design flanged beams and shear, torsion and bond reinforcement in beams.
3. Design of one way and two way slabs
4. Design of columns,
5. Design of footings and Stair case.

UNIT – I

Loading standards as per IS 875, Grades of steel and cement, Stress-Strain characteristics of concrete and steel**. Design Philosophies –** Working Stress Method, Ultimate Load Method and Limit State Method.

Introduction to Limit State Design: Concepts of limit state design- Characteristic loads- Characteristic strength -Partial loads and Material Safety factors- Representative stress- Strain curves- Assumptions in limit state design – Stress block parameters – Limiting moment of resistance.

Singly and Doubly Reinforced Beams: Limit state analysis and design of singly reinforced, doubly reinforced beams.

UNIT – II

Flanged Sections: Design of T and L beam sections.

Shear, Torsion and Bond: Limit state analysis and design of sections for shear and torsion – Concept of bond, anchorage and development length, I.S Code provisions. Design examples in simply supported and continuous beams.

UNIT – III

Slabs: Design of one way slabs – Two way slabs –Continuous slabs using IS coefficients.

UNIT – IV

Columns: Short and Long columns, Minimum eccentricity, short column under axial

compression, column with helical and tie reinforcement. Short columns subjected to uniaxial bending - Short columns subjected to biaxial bending.

UNIT – V

Footings: Introduction: Different types of footings–Design of isolated square and rectangular footings.Design of stair case.

TEXT BOOKS :

1. Varghese, P.C., **"**Limit State Design of Reinforced Concrete", Prentice Hall of India Private Limited", 2nd Edition, New Delhi, 2009
2. Reinforced Concrete Limit state Design – A.K. Jain, 7th edition, Nem Chand and Brother Roorkee, 2012

REFERENCES

1. Pillai, S.U., & Devdas Menon, "Reinforced concrete design", Tata McGraw Hill. New Delhi, (3rd Edition, 2009)
2. Ramamrutham, S., "Design of Reinforced Concrete Structures", Dhanpat Rai Publishing Company (P) Ltd. New Dlehi(17th Edition, 2016)
3. R.C.C Design – Unnikrishna Pillai and Vasudeva Menon, 3rd edition, McGraw Hill.
4. B.I.S. 456-2000 "Code of practice for Plain and Reinforced Concrete"

PE I: REMOTE SENSING AND GIS

Subject code: 1965506A	**Credits : 3**
Instruction : 3 Lecture / week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Pre-requisites: Surveying

Course Objectives:

1. Learn about the principles of remote sensing and Electromagnetic radiations
2. Know about satellites, satellite parameters and satellite sensors.
3. Learn about the image interpretation and post processing techniques.
4. Study about GIS and various data models.
5. Applications of remote sensing and GIS in civil engineering projects

Course Outcomes

1. Recognize principles of remote sensing and GIS process.
2. Identify digital data in different formats.
3. Manipulate various image interpretation techniques and image classification techniques.
4. Categorize RS and GIS data integration and overlay functions.
5. Illustrate various applications of remote sensing and GIS in civil engineering projects.

Unit I

Remote Sensing: Principle - Electro-magnetic energy, spectrum - EMR interaction with atmosphere – Atmospheric Windows and its Significance – EMR interaction with Earth Surface Materials, Sensors- types and characteristics, passive sensor, active sensor, platforms-airborne remote sensing, space borne remote sensing, data pre-processing, Important Remote Sensing Programmes.

Unit II

Geographic Information System: Introduction, key components, spatial data, raster data models, vector data models, raster versus vector, data input methods and editing, non-spatial data, map projections.

Unit III

Image analysis: Elements of visual interpretations, digital image processing- digital image data formats-band interleaved by pixel, band interleaved by line, band sequential, image Preprocessing, image rectification, image enhancement, image classification,

Unit IV

GIS analysis: Digital elevation models, RS and GIS data integration, overlay Function- vector Over lay operations, raster over lay operations, arithmetic operators, comparison and logical operators, conditional expressions, overlay using a decision table, some neighborhood operations.

Unit V

RS and GIS applications in Civil Engineering: Land cover and land use, urban applications, Hydrological studies, flood zone delineation and mapping, groundwater prospects and recharge, reservoir storage estimation, water management, irrigation planning, drought monitoring, environmental impact assessment and other watershed studies.

TEXT BOOKS:

1. Thomas M. Lillesand and Ralph W. Kiefer, Remote sensing and image interpretation, John Wiley and Sons Inc, 5th edition,
2. Textbook of Remote sensing and GIS by M Anji Reddy, BS Publications/BSP Books, 4th Edition

REFERENCES:

1. Joseph, George, (2003), Fundamental of Remote Sensing, 2 nd Edition, University Press (India) Pvt. Ltd,Orient Longman Pvt. Ltd., Hyderabad, India .
2. C.P.Lo and Albert K.W.Yeung 2005 "Concepts and Techniques of Geographic Information Systems". Prentice Hall of India, New Delhi.
3. Burrough, Peter A. and Rachael McDonnell, 1998, 'Principles of Geographical Information Systems' Oxford University Press, New York.

PE-I: GROUND IMPROVEMENT TECHNIQUES

Subject code: 1965506B	**Credits : 3**
Instruction : 3 Lecture /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Pre-requisites: Geotechnical engineering, Foundation engineering

Course Objectives:

The objective of this course is to:

1. Classify the different in situ densification methods.
2. Design the Stone Columns.
3. Understand the grouting technology and principles of reinforced earth walls.
4. Identify the various types of Geo Synthetics.
5. Understand the various stabilization Techniques.

Course Outcomes:

At the end of the Course, the Student will be able to:

1. Identify dewatering techniques according to field conditions
2. Design Stone columns for improving soils.
3. Recommend grouting methods and design principles of reinforced earth walls.
4. Explain applications of Geo Synthetics.
5. Understand various soil stabilization techniques.

UNIT I

In-situ densification Methods

Granular Soils: Introduction of Vibration at the ground surface, Impact at the Ground surface, Vibration at depth, Impact at depth.

Cohesive soils: introduction, preloading or dewatering, drain walls, sand drains, sand wicks, geo drains/band drains, stone and lime columns, and forced vacuum preconsolidation, thermal methods.

UNIT II

Stone columns: introduction, construction practice, design principles, Vibrofloatation techniques and other techniques like dynamic replacement etc.

UNIT III

Grouting and Reinforced Soil

Grout injections, suspension and solution grouts, grouting equipment and methods, Applications. Reinforced Soil: Principles, components of reinforced soil, factors governing design of reinforced soil walls.

UNIT IV

Geo synthetics

Geotextiles-types of geotextiles; Functions and their application, tests for Geotextile materials,

Geogrids and Geo membranes- functions and applications.

UNIT V

Stabilization

Mechanical stabilization: Soil aggregate mixture, properties and proportioning techniques, soft aggregate stabilization, compaction, field compaction control. Cement stabilization, Mechanism, factors affecting and properties, use of additives, design of soil cement mixtures, construction techniques. Lime and Bituminous Stabilization: Types of admixtures, mechanism, factors affecting, design of mixtures, construction methods.

TEXT BOOKS:

1. Purushothama Raj. P, "Ground Improvement Techniques", 2nd ed., Laxmi Publications (p) Ltd., New Delhi, 2016.
2. Satyendra Mittal, "An Introduction to Ground Improvement Engineering", 1st edition, Medtech, 2013

REFERENCES:

1. Nihar Ranjan Patra, Ground Improvement Techniques, 1st edition, 2012, Vikas publishing house.
2. Vikas Chandra Chattopadhyay, Joyanta maity, Ground Improvement Techniques, 1st edition, PHI learning Publisher, 2017

PE-I: SANITARY ENGINEERING

Subject code: 1965506C	**Credits : 3**
Instruction : 3 Lecture/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Pre-requisites:

Course Objectives:

The objective of this course is to:

1. Understand and explain the role of sanitation in the urban water cycle and its relation to public health and environment;
2. Develop rational approaches towards sustainable wastewater management via pollution prevention, appropriate treatment, and resource recovery and re-use at both centralized and decentralized levels.
3. Understand the relevant physical, chemical, and biological processes and their mutual relationships within various sanitation components;
4. Define and critically analyse, assess, and evaluate various urban drainage and sewerage
5. Contribute to the development of innovative approaches to the provision of adequate and sustainable sanitation services in developing countries and countries in transition.

Course Outcomes:

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

1. Understanding of various sewerage systems and their suitability
2. Design sewer and drainage systems layout for communities.
3. Determine waste water quality parameters and their characteristics.
4. Identify the aerobic treatment process of waste water.
5. Identify the anaerobic treatment process of waste water and sewage disposal methods.

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 – materials for sewers- appurtenances in sewerage – cleaning and ventilation of sewers—safety of sewer workers.

UNIT II

Storm sewers- design: Pumping of wastewater – Pumping stations – location – components parts– types of pumps and their suitability with regard to wastewaters. House Plumbing: plumbing systems of drainage-sanitary fittings and other accessories– single stack system- one pipe and two pipe systems – Design of building drainage.

UNIT III

Bacteriology of sewage: Sewage characteristics – Physical, Chemical and Biological Examination– decomposition- cycles of decomposition-– Sampling and analysis of wastewater

– BOD-COD-Treatment of sewage - Primary treatment: Screens-grit chambers – grease traps – floatation – sedimentation – design of primary and pretreatment 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, Attached Growth Process: Trickling Filters – mechanism of impurities removal-classification–filter problems – design and operation-recirculation, sewage disposal methods.

UNIT V

Anaerobic Processes: Septic Tanks and Imhoff Tanks-Principles and Design-sludge treatment and Disposal-. Bio solids (Sludge): Characteristics- thickening – digestion, drying and sludge disposal. miscellaneous methods, Oxidation ponds, Oxidation ditches, Aerated Lagoons, RBCs, Fundamentals of UASB.

TEXT BOOKS

1. S.K.Garg, Sewage disposal and Air Pollution Engineering, Khanna publications, revised 10 th edition.
2. Dr. P.N. Modi , Sewage treatment disposal and waste water engineering, 17th edition, Raj sons publication, 2020

REFERENCES

1. Metcalf & Eddy ,Wastewater Engineering Treatment and Reuse, 3rd edition Tata McGraw-Hill edition
2. Peavy, H.S., Rowe, D.R., and Tchobanoglous, H.S., Rowe, D.R., and Tchobanoglous, G. McGraw-Hill international edition, 1985.
3. B.C Punmia , Jain and Jain, Waste water Engineering, Lakshmi publications , 2nd edition re print, 2005.

PE-I: RAILWAY, DOCK AND HARBOUR ENGINEERING

Subject code: 1965506D	**Credits : 3**
Instruction : 3 Lecture /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Pre-requisites: Transportation Engineering

Course Objectives:

The objective of this course is to:

1. Know the basics and design of various components of railway engineering.
2. Study about the types and functions of track, junctions and railway stations.
3. Study about the types and components of dock and harbour.
4. Learn about the Techniques in tunneling

Course Outcomes:

At the end of the Course, the Student will be able to:

1. Illustrate the importance of railway infrastructure planning and design
2. Design of track Geometrics
3. Design and analyze the railway track system
4. Design components of dock and harbour
5. Plan different cross sections of tunnel

UNIT-I

Introduction to Railway Engineering: Historical development of railways in India – Advantages of Railways – Classification of Indian Railways – Permanent way – Components and their Functions.

UNIT-II

Rail joints – Welding of Rails – Creep of Rails – Rail fixtures & Fastenings, Track Geometric design -Points & Crossings

UNIT-III

Track drainage –Layout of Railway stations and yards – Signals – Interlocking – Track circuiting – Track Maintenance.

UNIT-IV

Dock & Harbour Engineering: Layout of Port components – Functions Classification of Ports – Site selection – Natural Phenomenon – Tides, Winds, Waves, Currents – Drift – Navigational aids.

UNIT-V

Tunnel Engineering: Alignment of tunnels – Cross-section of tunnels – Construction methods of Tunnels – Tunnel lining – Ventilation – Drainage – Muck disposal.

Text Books:

1. S.C. Saxena & S. Arora “Railway Engineering”, 8th Edition, Dhanpat Rai Publications, 2014.

2. R.Srinivasan “Harbour, Dock and Tunnel Engineering”, 37th Edition Charotar Publication, 2015.

References:

1. Rangwala “Railway Engineering”, 26th Edition, Charotar Publication, 2016.
2. Dr. S.P.Bindra “Dock & Harbour”, 5th Edition, Dhanpat Rai Publications, 2015.
3. Rangwala “Railway Bridge and Tunnelling”, 2nd Edition, Charotar Publication, 2016.

TRANSPORTATION ENGINEERING LABORATORY

Subject code: 1965507P	**Credits : 1.5**
Instruction : 3 Practical /week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Pre-requisites: Transportation Engineering

Course Objectives:

The objective of this course is to:

1. Determine the aggregate properties.
2. Determine the bitumen properties.

Course Outcomes:

At the end of the Course, the Student will be able to:

1. Perform quality control tests on aggregates.
2. Perform quality control tests on Bitumen.
3. Perform bearing capacity test for subgrade.

List of Experments

1. Determine the specific gravity and water content of Aggregate
2. To determine the fineness modulus of the given aggregate sample
3. Find the flakiness index of the given sample of aggregate.
4. Find the elongation index of the given sample of aggregate
5. Determination of angularity number of coarse aggregates.
6. Determine the aggregate crushing value of coarse aggregate.
7. Determine the impact value of the road aggregates.
8. Determine the Los Angeles abrasion value.
9. Determine the soundness value of aggregate.
10. Determine the Specific gravity of given Bituminous material.
11. Determine the consistency and further grading of the given bituminous material.
12. Determine the penetration value of a given bituminous material as per IS: 1206.
13. Determine the softening point of the given sample of bitumen.
14. Measure the ductility of a given sample of bitumen.
15. Determine the flash point and the fire point of asphaltic bitumen
16. Determine the amount of bitumen by Bitumen Extraction test

17. Determine the Marshall stability value of bituminous mix
18. Determine the California bearing ratio of given soil sample.

References:

1. S.K. Khanna Highway material testing, C.E.G. Justo and A. Veeraragavan, Nem Chand & Brothers.

Fluid Mechanics and Hydraulic Machinery Lab

Subject code: 1965508P	**Credits : 1.5**
Instruction : 3 Practical / week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Course Objectives:

The objective of this course is to:

1. To verify the principles of channel flow in laboratory by conducting experiments.
2. Calculate the discharge if various types of notches and weirs.

Course Outcomes:

At the end of the course Students will be able to

1. Illustrate Flow Measuring Devices used in pipes, channels and Tanks
2. Determine the characteristics of Notch.
3. Compare sharp crested full width and contracted weirs.

List of experiments

1. Study of Small orifice, mouthpiece by constant head method and variable head method.
2. Study of floating body and determination of Metacentric Height.
3. Study of Venturimeter & Orifice meter.
4. Study of Flow nozzle meter.
5. Study of Sharp – crested full width and contracted weirs.
6. Study of V-notch and Trapezoidal notch.
7. Analyze the flow through a pipe with friction and determine the friction factor in Darcy-Weisbach equation.
8. Determination of coefficient of impact on a flat plate and curved vane by comparing the theoretical and actual forces by impact.
9. Analyze the working of the centrifugal pump and reciprocating pump develop the characteristics of power input, head and efficiency under various discharges and plot the characteristic curves.
10. Determine the performance characteristics of Pelton wheel turbine and Francis turbine develop the characteristic curves of unit discharge, unit power and unit head under varying unit speed.
11. Reynold's experiment- demonstration of types of flows.
12. Performance of impact of jet on vanes.

References

1.Modi, P.N. & Seth, S.M. (2009), "Fluid Mechanics and Hydraulic Machinery", Standard Book House, New Delhi, 19th Edition

ESTIMATION AND QUANTITY SURVEYING

Subject code: 1965601	**Credits : 4**
Instruction : 3 Lecture/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Pre-requisites: Building Materials and Building Construction, Building Planning and Drawing

Course Objectives:

The objective of this course is to:

1. Learn how to measure different items of work and specifications
2. Learn detail estimation of the building
3. Estimate the Earthwork, cost analysis and valuation of the building.

Course Outcomes:

At the end of the course Students will be able to:

1. Compare different types of estimates and units of measurements.
2. Analyse the specifications of items and rates of different items of work
3. Estimate the quantities and evaluate the cost for different types of buildings by long wall and short wall method and centre line method.
4. Estimate the quantities of earthwork for road works.
5. Analyse valuation and bar bending schedule for various buildings.

UNIT-I

Introduction: Standard units, Units of measurement of different items of work. Meaning of estimating. Errors in estimation, Different types of estimates. Contingencies and related terms in the estimate, different types of approvals. Plinth area and related terms used in the estimation of various structures, rules and methods of measurements of different works.

UNIT-II

Specializations: Meaning, purpose, types of specializations, Method of preparation of specification, general specification, detailed specifications of different items of buildings and other structures – Rate analysis – Data sheet for materials and various items of work in buildings and other structures, schedule of rates, abstract estimate of buildings.

UNIT-III

Detailed estimate of buildings: Different items of work in building; Principles of taking out quantities, detailed measurement form; long wall and short wall method of building estimate, Centre line method of building estimate. Estimate of RCC building, sloped roof buildings; G.I. and A.C. Sheet, Detailed estimate of different types of doors and windows, electricity and water supply. Sanitation works etc.

UNIT-IV

Estimate of earth work; different formulae for calculations, estimate of metal road, Tar road, concrete road, Railway tract, Estimate of culverts and bridges etc.

UNIT-V

Valuation of buildings; purpose, different method of building valuation; different terms used in valuation and their meaning, bar bending schedule.

Text books:

1. B.N. Dutta, Estimating and Costing in Civil Engineering, 27th revised edition, UBS Publishers and distributers.
2. M. Chakraborti,Estimation, Costing, Specifications and Valuation in civil Engineering, M. Chakraborti. 29th revised edition, 2006

REFERENCES

1. G.S. Birdie, Textbook of estimating and costing, Danpath Rai Publications, 2014.
2. D.D. Kohli and R.C. Kohli, Textbook on Estimating, Costing and Accounts, S Chand, 2013.

DESIGN OF STEEL STRUCTURES

Subject code: 1965602	**Credits : 3**
Instruction : 2 Lecture & 1 Tutorial /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

COURSE OBJECTIVES:

The objective of this course is to:

1. Familiarize Students with different types of Connections and relevant IS codes.
2. Equip student with concepts of design of tension members.
3. Understand Design Concepts of compression members.
4. Appraise the design concepts of Beams.
5. Familiarize students with purlin design and different types of column bases and their design.

COURSE OUTCOME:

At the end of the course Students will be able to

1. Design of connections
2. Design of tension members.
3. Design of compression members
4. Design of Beams
5. Design of purlin and column bases

UNIT I

CONNECTIONS:

Fundamental Concepts of limit state design of structures, Different types of rolled steel sections available to be used in steel structures. Stress – Strain relationship for mild steel. Behavior of bolted joints, Design strength of ordinary black bolts, high strength friction grip bolt and Simple, Moment resistant Bolted connections. Types of welds and weld joints weld specifications Design of welded joints subjected to axial load, Eccentric welded connections.

UNIT II

TENSION MEMBERS:

Types of tension members, Design of strands, slenderness ratio, displacement of tension members, behavior of tension members, modes of failure, factors affecting strength of tension members, angles under tension, design of tension members, Lug angles, splices.

UNIT III

COMPRESSION MEMBERS:

Possible failure modes, classification of cross-section, behavior of compression members, Effective length, radius of gyration and slenderness of compression members, Allowable stresses in compression, Design of axially loaded compression members, built up compression members, Laced and Battened columns, eccentrically loaded columns, Column splices.

UNIT IV

BEAMS:

Beam types, section classifications, lateral stability of beams, Allowable stress in bending, Shear and Bearing stresses, Effective length of compression flange, Laterally supported and unsupported beams, Design of built up beams.

UNIT V

ROOF TRUSSES AND COLUMN BASES:

Types of trusses, Economical spacing of roof trusses, loads on roof trusses, Estimation of wind load on roof trusses as per IS : 875. Design of purlins. Design of Slab base, Gusset base.

TEXT BOOKS

1. N.Subramanian, Steel Structures Design and Practice, 6th edition, Oxford University Press, 2013.
2. Dr. Ramachandra and Virendra Gehlot, Design of Steel Structures-1, 13th edition, Scientific Publishers.

REFERENCES

1. S.K. Duggal, Design of steel structures, 3rd edition, Tata Mcgraw Hill, New Delhi
2. Dr.P. Dayaratnam and P.Sarah, Design of Steel Structures, 5th edition, Med Tech
3. S.S. Bhavikatti, Design of steel structures by Limit State Method as per IS: 800-2007, 3rd edition, IK International Publishing House Pvt.Ltd

IS Codes:

1. Indian Standard code of Practice for general Construction Steel, IS:800 – 2007
2. Code of Practice for Design loads IS: 875
3. Steel Tables.

WATER RESOURCES ENGINEERING-II

Subject code: 1965603	**Credits : 3**
Instruction : : 2 Lecture & 1 Tutorial /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

The objective of this course is to:

1. Introduce students to the structure of the dams, earth dam, canals, and spillways and cross drainage works.
2. Develop design the principle of Sarda type, trapezoidal notch, straight glacis fall.
3. Necessity and importance of diversion, storage head works, weir and barrages.
4. Understand the different river training works and Water power engineering.

Course Outcomes:

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

1. Create a new technology for construction of dams, it can also deal the causes of failure of the dams.
2. Demonstrate the Essential requirements of Spillway and design of Spillways.
3. Demonstrate Diversion Head Works and its application, which have designed in the all cases.
4. Explain the types of canal, distributaries, canal head works, cross-drainage and canal regulator works.
5. Explain different river training works and Water power engineering

UNIT-1

Storage Works: Classification of dams, Factors governing selection of types of dam, Selection of site, Preliminary investigation.

Gravity Dams: Forces acting on a gravity dam, Stability criteria, Modes of failure – Elementary and Practical Profiles, Stability analysis, Principal and shear stress – Construction joints, Openings in dams-Galleries, Foundation treatment of gravity dam.

UNIT-II

Earth Dams: Types, Foundation for earth dams, design of earth dams, Causes for failure of earth dams, Criteria For safe design, phreatic line, Seepage analysis – Seepage control through body and foundation.

Spillways: Essential requirements, Spillway capacity, Components, Types of spillways and their working, Design of ogee spillway, Energy dissipation below spill way, Scour protection, Use of hydraulic jump as energy Dissipater; Spillway crest gates – Different types.

UNIT-III

Diversion Head Works: Types, Location and components, effects of construction of weirs on permeable Foundation, Bligh's, Lanes and Khosla's theories, Method of independent variables, Design of weirs on permeable foundations, Design of vertical drop weir, Silt control devices.

UNIT-IV

Regulation Works: Canal falls – Definition, Necessity and location, Classification of falls, Design principles of syphon well drop, Notch fall, Sarada fall, Straight glacis fall; Cross regulator and Distributary head regulator

Cross Drainage Works: Types, Factors affecting the suitability of each types, Classification of aqueducts, Design principles of different types of aqueducts.

UNIT-V

River Training Works: River Training and its objectives, Classification of river training works, Marginal embankment, Guide banks, Groynes, cutoffs, Bank pitching, Launching aprons, Miscellaneous types of river training works.

Water Power engineering: Development of hydro power in India, Assessment of available power, Utilization factor, Load factor, Diversity factor, Storage and Pondage; Types of hydro power schemes; Components of hydel schemes – Fore bay, Intake structure, Trash racks, Surge tanks; Water hammer pressure, Substructure and Superstructure of power house.

TEXT BOOKS

1. Punmia, B.C. and Lal Pande B.B. (1992), "Irrigation and Water Power Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 12th edition.
2. Garg, S.K. (1999), Irrigation Engineering and Hydrology Structures, Khanna Publishers, Delhi, 14th Edition.

REFERENCES

1. K.R.Arora, "Irrigation, Water Power and Water Resources Engineering", Standard Publishers Distributors, 2010, 3rd Edition.
2. Varshney R.S., S. C. Gupta & R.L. Gupta, "Theory and Design of Hydraulic structures", Nemchand and Brothers, 1992, 2nd Edition.
3. Satyanarayana Murthy C, "Water Resources Engineering", New Age International Pvt. Ltd. Publishers, 1997, 1st Edition.

PE2: ADVANCED CONCRETE STRUCTURES

Subject code: 1965604 A	**Credits : 3**
Instruction : 3 Lecture /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course objectives:

1. Learn different types of retaining wall and design of retaining walls.
2. Determine the Stress in concrete and steel in water tanks and design of water tanks
3. Learn basic concept and design of bridges.
4. learn different types of piles and design of piles and pile caps
5. Brief explanation basic concepts of prestressed concrete.

Course Outcomes:

1. Design of cantilever & counterfort retaining walls.
2. Analyses and design of various parts of underground and overhead water tanks.
3. Analyses and design solid slab and T-beam bridges.
4. Design of piles and pile caps
5. Summarize the basic concepts of prestressed concrete.

Unit – I

Staircase: Introduction - Classification of staircase - Design of dog-legged staircase - design of open well staircase with quarter span landing

Unit – II

Retaining Walls: Types of retaining walls, forces on retaining walls, Rankine and Coloumb earth pressure theories (c and φ soils). Passive earth pressure, Drainage of retaining walls. Stability requirements. Preliminary proportioning of cantilever retaining walls. Design of cantilever and counterfort retaining walls.

Unit – III

Water Tanks: Stress in concrete and steel in water tanks, Modular ratio, Impermeability requirements, Underground rectangular tanks, Elevated rectangular and circular tanks, Design of these tanks for strength and cracking, Design of staging of rectangular tanks.

Unit – IV

Piles and pile caps

Piles and Pile caps: Design of bored cast in situ piles (bearing and friction types), under reamed piles. Pile Caps design; bending and truss methods.

Unit – V

Prestressed Concrete

Prestresed Concrete – Reinforced Concrete Versus Prestressed Concrete. – Prestressing Systems (Fressinet, Gifford Udal, Magnel Blatten) – Prestressing Losses – Steel and Concrete for Prestressing – Homogeneous Beam Concept, limiting eccentricities, Pressure line, Elastic Stress distribution across the depth due to D.L. eccentric prestress and L.L.

Text Books:

1. S.Ramamrutham, Design of reinforced concrete structures, Dhanpath rai Publishing Company, 2016
2. N. Krishnam Raju, Advanced reinforced concrete structures, 3rd edition, CBS Publishers.

REFERENCES

1. Design of reinforced concrete structures by N. Subramanian, Oxford publisher
2. Reinforced concrete structures by Robert Park, Willey India

- I.S 456 – 2000 “Code of practice for Plain and Reinforced Concrete” 4th Revision, Bureau of Indian Standards, New Delhi, April 2007
- Relevant I.S. Codes.

PE2: WATERSHED MANAGEMENT

Subject code: 1965604 B	**Credits : 3**
Instruction : 3 Lecture /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Pre-requisites: Environmental Engineering, Water Resources Engineering-I & Engineering Geology.

COURSE OBJECTIVE:

1. Familiarize on the concept of watershed development.
2. Explain the principles and types of erosion
3. Infer on water harvesting and explain Watershed management
4. Review on land and Eco system management
5. Discuss watershed planning

COURSE OUTCOMES:

1. Understand the concept of watershed development
2. List the principles and types of erosion
3. Classify water harvesting and discuss Watershed management
4. Describe land and Eco system management
5. Summarize watershed planning

UNIT I

INTRODUCTION:

Concept of watershed development, need for watershed development in India, integrated and multidisciplinary approach for watershed management. Characteristics of Watershed: size, shape, physiography, slope, Climate drainage, land use, vegetation, geology and soils, hydrology, socio-economic characteristics, basic data on watersheds.

Unit II

EROSION

Principles of Erosion: Types of erosion, factors affecting erosion, effects of erosion on land fertility and land capability, estimation of soil loss due to erosion, Universal soil loss equation. Measures to Control Erosion: Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control, rockfall darns, brushwood darn, Gabion.

UNIT III

WATER HARVESTING

Rainwater harvesting, catchment harvesting, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds, percolation tanks

WATERSHEDMANAGEMENT

Participatory watershed Management – run off management – Factors affecting runoff – Temporary and Permanent gully control measures – Water conservation practices in irrigated lands – Soil and moisture conservation practices in dry lands

UNIT IV

LAND AND ECO SYSTEM MANAGEMENT

Land use and land capability classification, management of forest, agricultural, grassland and wild land. Reclamation of saline and alkaline soils.

Role of ecosystem, crop husbandry, soil enrichment, inter, mixed and strip cropping, cropping pattern, sustainable agriculture, bio mass management, dry land agriculture, Silvi pasture, horticulture, social forestry and afforestation.

UNIT V

WatershedPlanning

Planning principles – collection of data – present land use – Preparation of watershed development plan – Estimation of costs and benefits – Financial plan – selection of implementation agency - Monitoring and evaluation system

Text Books:

1. J. V. S. Murty, "Watershed Management", 2ndEdition, New Age International Publishers, 2013.
2. R.A. Wurbs and WP James, "Water Resource Engineering", 3rdEdition Prentice Hall of India, 2002

References:

1. V.V.N. Murthy and Madan K Jha. "Land and Water Management", 6thEdition, Kalyani Publishers, 2015.
2. D.K. Majumdar, "Irrigation Water Management", 3rdEdition, Prentice Hall of India, 2004.
3. Suresh, R. Soil and Water Conservation Engineering, 5^{TH} Edition, Standard Publishers and Distributors, New Delhi, 2005.

PE2: AIR POLLUTION AND CONTROL

Subject code: 1965604 C	**Credits : 3**
Instruction : 3 Lecture /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives

1. The Course Objectives of this course are:
2. To create awareness about air pollution and its magnitude
3. To emphasize environmental implications of air pollution on all life forms
4. To enhance knowledge on air emission monitoring and control

Course Outcomes

At the end of the course the student should be able to:

1. Define Air Pollution, sources, effects and explain factors influencing air pollution
2. Explain wind effects and estimate pollutants and their behavior
3. Demonstrate knowledge on air pollution effects on life forms and implications of episodes.
4. Apply knowledge of air emissions on monitoring processes
5. Apply knowledge of monitoring equipment in control, reduce and remove air pollutants

UNIT I

Definition of Air Pollution

Air Pollution and its definition – Sources of pollution - Classification of pollutant particulates - Factors influencing air pollution – Location of Industries and Air pollution effects on all life forms.

UNIT II

Spread of Air Pollution

Meteorology – Wind roses – lapses rates – mixing depth atmospheric dispersion – plume behavior accumulation - estimation of pollutants – Effective stack height.

UNIT III

Effects of Air pollution on life forms

Air Pollution effects on human beings, animals, plants and materials – Air Pollution Episodes in India and abroad.

UNIT IV

Air Pollution Monitoring

Need for Air Monitoring - Air emissions and types, Air qualities standards, Ambient air quality monitoring and stack monitoring.

UNIT V

Control of air pollution

Removal of pollutants – particulate and gaseous – Air pollution control equipment such as setting chamber, cyclones, wet scrubbers/collectors, scrubbers, centrifugal scrubbers spray towers, packed beds, electrostatic precipitators, after burners- absorption – adsorption – Diffusion.

Text Books:

1. M N Rao and HVN Rao, Air Pollution McGraw Hill Education, First Edition 2018.
2. Santosh Kumar Garg, Sewage Disposal and Air Pollution Engineering, Revised 33rd Edition Khanna Publishers, 2015

Reference:

1. K.V.S.G. Murali Krishna, Air Pollution Control, Lakshmi Publications, First Edition
2. B.S.N. Raju, Fundamentals of Air Pollution, First Edition, Oxford & I.B.H.
3. T. Shivaji Rao, Elements of Air Pollution and its control., Visalandhra Publishers, Hyderabad.

PE: 2 FINITE ELEMENT METHOD

Subject code: 1965604 D	**Credits : 3**
Instruction : 3 Lectures/week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives

1. To provide a fundamental knowledge on FEM.
2. To apply the concepts of Finite element method for solving structural Engineering problems.

COURSE OUTCOMES: Students will be able to

1. Derive the solution of the problems of 1D and 2D by stiffness method of FEM
2. Derive the solution of the problems of 1D and 2D by Flexibility method of FEM
3. Understand the fundamentals of Finite element method.
4. Understand the concept of shape function
5. Formulate and Solve axially loaded bar Problems.

UNIT I

Matrix methods of Analysis - Introduction, Analysis of beams and Portal Frames (One bay, one storey Two bay, two storey) by stiffness method.

UNIT II

Matrix methods of Analysis - Introduction, Analysis of beams and Portal Frames (One bay, one storey Two bay, two storey) by flexibility method.

UNIT III

Introduction: A brief history of F.E.M, Need of the method, Applications of FEM, Review of basic principles of solid mechanics, Basic equation in Elasticity Equations of equilibrium, Constitutive relationship, Concept of Plane Stress, Plain Strain, Concept of Axi-symmetric elements. Concept of Energy Principles and methods.

UNIT IV

Basic theory relating to the formulation of the finite element method, element shapes, nodes, nodal degree of freedom, node numbering, Coordinate system (local and global), Convergence requirements, Compatibility requirement, Geometric Invariance.

UNIT V

Finite element analysis of - single bar element (One –Dimensional problem) – Shape functions, derivation of stiffness matrix, stress-strain relations– All with reference to bar element and trusses under axial forces.

TEXT BOOKS :

1. G S Pandit and SP Gupta, "Structural Analysis – A matrix approach" Tata McGraw-Hill Publishing Company Limited, 2nd Edition, 2008
2. Bhavikatti S. S, "Matrix Method of Structural Analysis", Dreamtech Press 2019
3. C.S. Krishnamoorthy, "Finite Element Analysis", Tata McGraw Hill Publishing Co. Ltd. 2nd Edition

REFERENCE BOOKS :

1. C.S. Reddy, “Basic Structural Analysis”, McGraw Hill Education; 3rd edition,2017.
2. Dr. S.Senthil and R. Panneerdhass, “Finite Element Analysis”, Lakshmi Publications, Chennai,2016.

PE: 3 ROCK MECHANICS

Subject code: 1965605 A	**Credits : 3**
Instruction : 3 Lecture /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Pre-requisites: Engineering Geology, Geotechnical engineering, Foundation engineering

Course Objectives:

1. Classify the different rocks based on their properties.
2. Understand the different geo physical methods of rocks.
3. Classify the laboratory methods for different properties of rocks.
4. Utilization of the insitu testing methods.
5. Understand the various rock improvement techniques.

Course Outcomes:

At the end of the Course, the Student will be able to:

1. Classify rocks according to their properties.
2. Discuss different Geophysical methods of rocks.
3. Analyze permeability, physical and mechanical properties of rock using rock testing procedures.
4. Demonstrate in situ testing of rocks.
5. Understand the various improvement techniques for rock.

UNIT I

Introduction to Rock Mechanics

Geological formation of rocks, Structural Geology, classification of rocks, Defects in rock.

UNIT II

Methods of Rock Exploration

Introduction, methods of rock exploration, methods of geophysical prospecting- seismic methods, Gravity method, Magnetic methods. Exploration techniques – RQD and RMR,

UNIT III

Physical, Mechanical Properties of Rocks

Introduction, permeability, swelling, durability, strength- classification of strength- compressive strength and tensile strength. Laboratory tests for shear strength, tensile strength, flexural strength, elastic constants, Field tests– test for deformability, shear tests and strength tests.

UNIT IV

In-Situ Tests

Necessity of In-situ tests, Field tests– test for deformability, shear tests and strength tests.

UNIT V

Improvement Techniques for Rock

Grouting, Rock bolting, Rock reinforcement - Mechanism, types of reinforcement, steps involved in installation, Foundations on rock, Rock blasting explosives, Selection criteria for explosives, steps involved in blasting

TEXT BOOKS:

1. T. Ramamurthy "Engineering in Rocks for Slopes, Foundations and Tunnels", 3rd Edition, PHI Learning Pvt. Ltd 2014.
2. R K Goel, Bhawani Singh "Engineering Rock Mass Classification Tunnelling, Foundations and Landslides "Elsevier Science,2011.

REFERENCES:

1. Richard E. Goodman ,"Introduction to Rock Mechanics "Wiley India Pvt Ltd,2010.
2. Verma B.P, Rock mechanics for engineers, Khanna Publishers, 2nd Edition 1989, New Delhi.
3. Singh, B. and Goel, R. K. "Rock Mass Classification Systems – A Practical Approach in Civil Engineering "Elsevier Publisher.

PE: 3 PAVEMENT CONSTRUCTION AND MANAGEMENT

Subject code: 1965605 B	**Credits : 3**
Instruction : 3 Lecture /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Learning Objectives

1. To learn the concept of flexible pavement construction
2. To learn the concept of flexible pavement construction
3. To study about the stabilization, recycling and use of Geosynthetics
4. To study the structural and functions failure
5. To understand the concept of Pavement Management System

Course Outcomes

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

1. Carry out the construction of flexible pavements
2. Carry out the construction of rigid pavements and joints
3. Use different stabilization methods, recycling techniques and Geosynthetics
4. Evaluate of the pavements based on the functional and structural characteristics
5. Do develop pavement management systems

UNIT-I

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

UNIT-II

Cement Concrete Pavement Layers: Specifications and method of cement concrete pavement construction; Construction of interlocking block pavements, Quality control tests; Construction of various types of joints.

UNIT-III

Soil Stabilized Pavement Layers: Principles of gradation/proportioning of soil-aggregate mixes and compaction; mechanical, soil-cement, soil-bitumen and soil-lime stabilisation methods. Use of additives, Numerical problems on mix design and applications. Design and construction of surface and sub-surface drainage system for highways and airports, Recycling Techniques in Bituminous Pavements, Use of Geosynthetics in Highway Construction

UNIT-IV

Pavement Evaluation - Pavement Distress - Functional and structural condition of pavements, Pavement distress survey, Functional condition evaluation of pavements- Roughness, Skid Resistance. Structural evaluation of pavements - non-destructive testing, Benkelman beam and Falling Weight Deflectometer, Pavement strengthening based on deflection as per IRC, Maintenance and rehabilitation techniques.

UNIT-V

Pavement Management Systems - Pavement Management Systems- Components, structure, data requirements, Project level and Network level needs, Pavement performance prediction – concepts, modelling techniques, Budget forecasting for maintenance and rehabilitation, Ranking and optimization methodologies, life cycle costing

Text Books:

1. Dr. L. R. Kadyali & Dr. N. B. Lal "Principles and Practices of Highway engineering", 5th Edition, Khanna Publications, 2012.
2. Ralph C.G. Haas, W. Ronald Hudson and Zanieswki "Modern Pavement Management", Mc Graw Hill and Co,1994

References

1. Yang H. Huang "Pavement Analysis and Design", 2nd Edition, Pearson Prentice Hall, 2008.
2. Yoder and Witzech, "Pavement Design", 2nd Edition, McGraw-Hill, 1991.
3. S.K. Khanna, Justo, C.E.G and Veeraragavan, A," Highway Engineering", 10th edition New Chand & Bro,2017

PE3: ADVANCED STRUCTURAL ANALYSIS

Subject code: 1965605 C	**Credits : 3**
Instruction : 3 Lecture /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

Course Objectives:

1. Students understand the basics configuration and classification of structures.
2. Solve indeterminate structures.

Course Outcomes:

Students will be able to

1. Analyze indeterminate trusses
2. Analyze indeterminate frames
3. Analyze two and three hinged arches and its application.
4. Analyze suspension bridges with stiffening girders.
5. Analyze beams and trusses using matrix methods

UNIT-I

Analysis of statically indeterminate trusses (having not more than 7 members and 3 supports) containing (a) external redundant supports (b) internal redundant members using (i) method of consistent deformation of unit load method (ii) Castigliano's theorm – II.

UNIT-II

Analysis of statically indeterminate frames (single storey, single bay portal frames only) using (i) slope-deflection method (ii) moment distribution method (iii) Kani's method,

UNIT-III

Arches: Normal thrust, radial shear and bending moment in three hinged and two hinged parabolic and segmental arches. Effects of rib-shortening and temperature change.

UNIT-IV

Suspension bridges: Stresses in loaded cables with supports at the same and different levels. Length of cable; Two and Three hinged stiffening girders.

UNIT-V

Introduction to matrix methods of structural analysis (Very elementary treatment only) Static indeterminacy, Kinematic indeterminacy, Stiffness and flexibility method for two span continuous beams only – Truss with 3 supports and 7 members.

Text Books:

1. G.S. Pandit and S.P. Gupta, Structural analysis – A matrix approach, 2nd edition Mc Graw Hill.
2. Devdas Menon, Structural analysis, 2nd edition, Publishing House PVT.LTD

Reference Books:

1. C S Reddy, Basic structural Analysis, 3rd edition, McGraw Hill Education PVT.LTD
2. C.K. Wang, Statically indeterminate structures – 1st edition Mc Graw Hill Education PVT.LTD
3. R.C Pearson, Structural analysis, Education Asia Publication, 9th Edition,

PE3: IRRIGATION ENGINEERING

Subject code: 1965605 D	**Credits : 3**
Instruction : 3 Lecture /week	Sessional Marks : 30
End Exam : 3 Hours	End Exam Marks : 70

COURSE OBJECTIVE:

1. Familiarize on the concept of Irrigation in Agriculture.
2. Explain the principles Soil Water Potential relationship
3. Infer on water harvesting and explain Watershed management
4. Describe Surface Irrigation Methods
5. Discuss Irrigation Water Quality

COURSE OUTCOMES:

1. Understand the concept of Water Resources of India
2. Explain Soil Water Plant Relationship
3. Demonstrate Irrigation Requirement and Irrigation Scheduling
4. Describe Combined irrigation and drainage systems
5. Summarize Water quality for irrigation

UNIT-I

Development Of Irrigation : Water Resources of India - Importance of Irrigation in Agriculture - Historical evolution of irrigation in India – Irrigation development during pre-colonisation – Colonisation and post-colonization - National Water Policy- Inadequacy of Irrigation Management- Criteria for good Irrigation management.

UNIT-II

Soil Water Plant Relationship : Soil physical properties influencing Soil-water relationship-Forms and occurrence of Soil Water- Classification of Soil Water- Soil Water Constants- Energy concept of Soil Water-Forces acting on Soil Water- Soil Water Potential concept- Soil Water retention- Soil Moisture Measurement.

UNIT-III

Crop Water Requirement: Water requirement of crops- Evapotranspiration and Consumptive use- Methods of estimating Evapotranspiration- Effective Rainfall- Irrigation Requirement-Duty of Water- Irrigation Efficiencies- Irrigation Scheduling- Irrigation measurement.

UNIT-IV

Surface Irrigation Methods: Canal network and canal design- Surface irrigation methods- Types- Border irrigation, Furrow irrigation and Strip irrigation- Specifications, Hydraulics and Design.

Drip And Sprinkler Irrigation Method: Sprinkler and Drip- History and development, Types, Components, Design and Layout, Operation and Maintenance.

Drainage Principles And Criteria : Factors to be considered in land drainage – Combined irrigation and drainage systems - Water balance – Equations for water balance – Drainage surveys – Agricultural drainage criteria .

UNIT-V

Irrigation Water Quality: Water quality for irrigation – Salinity and permeability problem – Root zone salinity - Irrigation practices for poor quality water – Saline water irrigation – Future strategies

TEXT BOOKS

1. Asawa, G.L., "Irrigation Engineering", New Age International Publishers, 2000
2. Punima B.C. & Pande B.B .Lal Irrigation and Water Power Engineering, Laxmi Publishing, New Delhi 2007

References

1. Michael, A.M, Irrigation Theory and Practical, Vikas Publishing Pvt Ltd, 2006
2. Gupta, B.L, & Amir Gupta, "Irrigation Engineering", Satya Praheshan, New Delhi

CONCRETE LABORATORY

Subject code: 1965607P	**Credits : 1.5**
Instruction : 3 Practical / week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Course Objectives:

The objective of this course is to:

1. Tests to identify the physical properties of cement, sand and aggregate.
2. Tests to identify the initial and final setting of cement.
3. Tests to identify workability of concrete.
4. Tests to identify mechanical characteristics of concrete.

Course Outcomes:

At the end of the course Students will be able to

1. Determine physical properties of cement, sand and aggregate.
2. Classify fine aggregate and coarse aggregate as per IS 383
3. Determine workability of concrete.
4. Determine mechanical properties of concrete

List of Experiments

1. Specific gravity and unit weight of cement
2. Specific gravity and unit weight of coarse and fine aggregates.
3. Determination of normal consistency of cement
4. Determination of initial and final setting time
5. Fineness of cement.
6. Determination of compressive strength of cement (for different grades of cement).
7. Bulking characteristics of sand.
8. Sieve analysis of coarse and fine aggregates and classification as per IS 383.
9. Workability tests on green concrete by using: Slump cone, Compaction factor apparatus, Flow table, Vee-Bee Consistometer.
10. Tests on Hardened concrete.
11. Compressive Strength
12. Split tensile strength
13. Modulus of rupture
14. Design of concrete mix by using IS code method (for class work only)
15. Case studies on a) framed structures and b) plate girder bridge

TEXT BOOKS:

1. A.M. Neville, Properties of Concrete, Longman 1995.
2. P.K. Mehta, J.M. Monteiro, Concrete micro-structure, Properties and Materials, Printice Hall INC & McGraw hill, USA.

3. M.S. Shetty, Concrete Technology Theory and Practice, M.S. Shetty, S. Chand & Company Ltd.

CAD Lab

Subject code: 1965608P	**Credits : 1.5**
Instruction : 3 Practical / week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Objectives: To develop skill to use software to create 2D and 3D models.

Outcomes:

1. Ability to use the software for drafting and modeling
2. Ability to create 2D and 3D models of civil Engineering.

List of experiments:

1. Introduction to CAD, built environment
2. CAD BASICS: Elements of drawing, Draw commands, editing command and 3D functions.
3. 2D – FIGURES for practice
4. Plan of residential building

a) Plan of a Single Storied building

b) Plan of a Multi Storied building

c) Section and Elevation of a roof, staircase and reinforcement details of beams

5. ISOMETRIC DRAWING for practice
6. 3-D SOLID FIGURES

Reference Books:

1. Engineering graphics with Auto CAD- R.B. Choudary/Anuradha Publishes