B.Tech & B.Tech. +M.Tech
III Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
CV3101	PC	Reinforced Concrete Structures	4	0	30	70	100	3
CV3102	PC	Steel Structures	4	0	30	70	100	3
CV3103	PC	Geotechnical Engineering-II	4	0	30	70	100	3
CV3104	PE	Professional Elective-I	4	0	30	70	100	3
CV3105	OE	Open Elective-I	4	0	30	70	100	3
CV3106	PC	Geotechnical Engineering - II Lab	0	3	50	50	100	1.5
CV3107	PC	Environmental Engineering Lab	0	3	50	50	100	1.5
CV3108	SC	Computer Applications in Civil Engineering Lab	1	2	50	50	100	2
CV3109	INT	Internship - I			50	50	100	2
							Total Credits	22

B.Tech & B.Tech. +M.Tech

III Year - II Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
CV3201	PC	Transportation Engineering	4	0	30	70	100	3
CV3202	PC	Engineering Economics Estimation and Costing	4	0	30	70	100	3
CV3203	PC	Structural Analysis-II	4	0	30	70	100	3
CV3204	PE	Professional Elective-II	4	0	30	70	100	3
CV3205	OE	Open Elective-II	4	0	30	70	100	3
CV3206	PC	Computer Aided Analysis and Design Lab	0	3	50	50	100	1.5
CV3207	PC	Fluid Mechanics - II Lab	0	3	50	50	100	1.5
CV3208	PC	Highway Materials Lab	0	3	50	50	100	1.5
CV3209	SC	Soft Skills	1	2	50	50	100	2
							Total Credits	21.5
					Internship - II			

CV310   **REINFORCED CONCRETE STRUCTURES**

(IS-456 code book is allowed for examination)

Course Objective

- Establish the basic principles of reinforced concrete structural member and system behaviour.
- Explain the basic design philosophy behind the working stress method and Limit State Method of design.
- Introduce the basic principles of the analytical methods and design procedures.
- Impart knowledge of basic structural elements such as slabs, beams, columns, staircases, and isolated footings in the design process.
- Understand the concepts of designing reinforced concrete structures for limit state of collapse.

Course Outcomes:

  After completion of this course, students will be able

- To understand the IS code of practice for the design of reinforced concrete structural elements.
- To understand the various design philosophies and their differences.
- To understand behaviour of RCC members under flexural and shear.
- Define design stages of reinforced concrete structures.
- To analyse and design basic structural elements like slabs, beams, columns, staircases & isolated footings.

SYLLABUS

General: Loading standards as per IS 875, Grades of steel and cement, Stress-Strain characteristics of concrete and steel, Introduction to working stress method and Limit State Method (L.S.D.) of design.

Limit State of Collapse of in Flexure: Central Value measures, Measures of distribution, Normal distribution curve. Introduction and Principles of L.S.D., Characteristic load and strengths, Design values, Partial safety factors, Factored loads.

Limit State of Collapse: Flexure of R.C.C. beams of rectangular section. Under reinforced, Balanced and over reinforced sections. Compression stress block, Estimation of ultimate

moment by strain compatibility. Guidelines for choosing width, depth and percentage of reinforcements in beams.

Analysis and design of singly reinforced rectangular beams and doubly reinforced beams, design by using SP 16 (Sessional Work Only).

Design of flanged beams (T and L), Effective flange width, Basis of analysis and design, Minimum and Maximum steel in flanged beams, SP 24 in design of beams.

Design of one way and two way slab: Simply supported slabs on all four sides, Moment in two way slabs with corners held down. Choosing slab thickness. Design of restrained slabs (with torsion at corners) I.S. code provisions. Detailing of reinforcement. Load from slabs on supporting beams. Different kinds of loads on slabs including partition walls, Shear in slabs.

Shear, Torsion and Bond: Limit state of collapse in shear, types of shear failures. Truss analogy, shear span / depth ratio. Calculation of shear stress, types of shear reinforcement. General procedure for design of beams for shear. Enhanced shear near supports. Shear in slabs, steel detailing. Analysis for torsional moment in a member. Torsional shear stress in rectangular and flanged sections. Reinforcement for torsion in RC beams. Principles of design for combined bending shear and torsion. Detailing of torsion reinforcement – Concept of bond, development length, anchorage, bond, flexural bond.

Columns: Short and Long columns, Minimum eccentricity, short column under axial compression, column with helical and tie reinforcement. Short columns subjected to uniaxial and biaxial moments.
Footings: Analysis and design of isolated square and rectangular footings. Design of staircase.

Text Books:
1. Limit State of Design of Reinforced Concrete by P. C. Vergheese, Prentice Hall India Learning.
2. Reinforced Concrete Limit state Design by A.K. Jain, Nem Chand & Brothers.
3. R.C.C Design by Unnikrishna Pillai and Devadas Menon, McGraw-Hill

Reference Books:
1. Limit State Design of Reinforced Concrete Structures by P. Dayaratnam, P.Sarah, Oxford and IBH Publishers.
2. Reinforced Concrete Structures by R.Park and T.Paulay, Wiley Publishers.

CV3102   STEEL STRUCTURES

Course Objective
- To enable the students regarding types of steel material, properties of steel and various tests on steel like yield strength, ultimate strength and breaking strength tests.
- To impart knowledge on various types of rolled steel sections and their classifications.
- To familiarize the students with the concepts of limit state method.
- To make the students to understand code of practice of steel structure which is IS-800:2007.
- To prepare the students in solving different types of numerical problems of steel structures.

Course Outcomes
- Students will be having sufficient knowledge on different topics of steel structures.
- Understand concepts on different types of connections in steel structures like bolted and welded connections.
- Can do the problems on different topics of steel structures.
- Can understand advantages of steel structures.

SYLLABUS

Note: All the designs should be taught in the limit state design method as per IS 800-2007

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.

Bolted connections: Behavior of bolted joints, Design strength of ordinary black bolts, high strength friction grip bolts, Simple connections, Moment resistant connections.
Welded Connections: Advantages of welding, Types and prosperities of welds, Types of joints, weld specifications Design of welded joints subjected to axial load, Eccentric welded connections.

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.

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.

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.

Roof trusses: 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 members of roof truss and joints, Design of purlins.

Column bases and Foundations: Allowable stress in bearing, Slab base, Gusset base and Grillage foundations.

Introduction to pre-engineered structures, concepts and advantages, disadvantages.

Text Books
1. Limit State Design of steel structures by S.K.Duggal, McGraw-Hill Education Private Ltd.
2. Design of steel structures by K.S.Sai Ram, Pearson Education India.
3. Limit State Design of steel structures by Ramchandra and Virendra Gehlot, Scientific Publishers (India).

Reference Books
1. Design of Steel structures by N. Subramanian, Oxford University Press.
2. Design of steel structures by Limit State Method as per IS: 800-2007 – S.S. Bhavikatti, IK International Publishing House.

CE3103   GEOTECHNICAL ENGINEERING – II

Course Objectives
- To understand methods of explorations for assessing subsoil characteristics
- To study different methods used for determination of shear strength characteristics of soil.
- To impart knowledge of design of shallow and deep foundation systems and their suitability depending on type of soil and loading conditions.
- To understand various earth pressure theories used for design of earth retaining structures
- To analyse and evaluate stability of soil slopes

Course Outcomes:

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

- Plan soil exploration programme and prepare a detailed soil investigation report
- Estimate allowable bearing pressure and settlement of soils
- Evaluate stability of various earth retaining structures.
- Gain diverse knowledge on various shallow and deep foundations adopted in field
- Select and design appropriate foundations based on soil characteristics

SYLLABUS

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 programmes, report writing.

Bearing Capacity: Safe bearing capacity and allowable bearing pressure, Terzaghi's bearing capacity equations its modifications for square, rectangular and circular foundation, General and local shear failure conditions. Factors affecting bearing capacity of Soil. Allowable bearing pressure based on N-values. Bearing capacity from plate load tests.

Shallow Foundations: Factors effecting locations of foundation and design considerations of shallow foundations, choice of type of foundations. Foundations on expansive soils.
Settlement analysis: causes of settlement, Computation of settlement, allowable settlement. Measures to reduce settlement.

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.

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.

Stability Analysis of Slopes: Finite Slopes Fellinius slip circle method, Friction Slip circle method and Taylor's stability numbers, types of failure of finite slopes – Toe slope and Base failure. Infinite slope, factors of safety.

Earth Pressure: Types of Earth pressure. Rankines Active and passive earth pressure, Smooth Vertical wall with horizontal backfill. Extension to Soil Coloumbs wedge theory, Culmans and Rebhanns graphical method for active earth pressure. Bulkheads – Classifications, Cantilever

sheet Piles in Sandy soils and clay soils. Analysis of Anchored bulkheads – free earth support and fixed earth support methods.

Text Books
1. Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, New Age International Publishers
2. Soil Mechanics and Foundation Engineering by K.R. Arora, Standard Publishers.

Reference Books
1. Foundation Engineering by P.C. Varghese, Prentice Hall of India
2. Foundation Analysis and Design by J. E. Bowles, Mc Graw-Hill Publishing Co.

CV3104   PROFESSIONAL ELECTIVE-ICV

3105   OPEN ELECTIVE -I

CV 3106   GEOTECHNICAL ENGINEERING - II LABORATORY

Course Objectives
- To develop skills to identify and classify different types of soils
- To impart knowledge about different methods of determination of insitu density of soils
- To study the necessity of sedimentation analysis for classifying fine grained soils
- To assess the drainage capacity of different soils
- To understand laboratory methods used for determining density of soil

Course Outcomes
Upon successful completion of the course student will be able to
- Perform suitable tests for assessing grain size distribution and classify the soil accordingly
- Select appropriate method for determining field density of soil for a given soil
- Determine specific gravity of coarse and fine grained soils3
- Evaluate Permeability of given soil
- Estimate compaction characteristics of soil

LIST OF EXPERIMENTS

1. Determination of Specific Gravity of Coarse Grained and Fine-Grained Soils
2. Determination of Atterberg Limits of Clay
3. Determination of Field Density by Core Cutter and Sand Replacement Methods
4. Determination of Grain Size Distribution of Coarse Grained Soil by Sieve Analysis
5. Determination of Grain Size Distribution of Fines Fraction of Soil by Hydrometer/pipette Analysis.
6. Determination of Coefficient Permeability of Coarse Grained Soil by Constant Head Permeability Test
7. Determination of Coefficient Permeability of Fine Grained Soil by Variable (Falling) Head Permeability Test
8. Determination of Compaction Characteristics of Soil by IS Light / Heavy Compaction Test.
9. Demonstration Experiments:
   1. Rapid Moisture Meter Test for Quick Determination of Water Content
   2. Determination of Water Content of Compacted Soil in Field by Proctor's Plasticity Needle

Reference Books
1. Relevant IS Codes of Practice

CV 3107   ENVIRONMENTAL ENGINEERING LAB

Course Objectives:
- To impart knowledge about the physical, chemical, and biological characteristics of water
- To enable the student to optimize the coagulation dose.
- To provide knowledge about the breakpoint chlorination, available chlorination, and residual chlorine.
- To assess the quality of water by physical, chemical biological characteristics relative to standard drinking water standards.
- To evaluate the quality of wastewater without being hazardous as effluent from industries.

Course Outcomes:
Students will be able to
- Perform common environmental experiments relating to water and wastewater to assess the quality.
- Statistically analyse and interpret laboratory results.

- Apply the laboratory results to identify the problem and give real-time technical solutions.
- Understand the procedures for water and wastewater sampling and sample preservations.
- Understand the effect of water and wastewater treatment on people and the environment.

LIST OF EXPERIMENTS

1. Determination of pH and Conductivity of a given water and wastewater sample
2. Measurement of Turbidity using Nephelometric Turbid meter and Determination of optimum coagulant dosage (Jar Test). Estimation of Total Solids: Settleable Solids: Suspended solids, dissolved solids
3. Determination of Hardness in a given water sample
4. Estimation of Acidity of a water sample
5. Estimation of Alkalinity of a waste and wastewater sample
6. Determination of Available Chlorine, estimation of Fluorides and iron in a given water sample.
7. Measurement of D.O. by volumetric analysis
8. Estimate the B. O. D. of a wastewater sample.
9. Estimate the C. O. D. of a wastewater sample.

Text Books
1. Environmental Engineering Laboratory Manual by Kotaiah, B. and Kumara Swamy, N. Charotar Pub. House.
2. Chemical Analysis of Water and Soil: A laboratory Manual by Muralikrishan K.V.S.G.., Envir. Prot. Society.

CV 3108   COMPUTER APPLICATIONS IN CIVIL ENGINEERING LAB

Course Objectives:
- Explore features of 'C/ Fortran 77' language and its use in Civil Engineering computations.
- Develop 'C/ Fortran 77' Programmes for various Civil Engineering problems.
- Design columns, footings, singly and doubly reinforced beams by executing C/ Fortran 77 program.
- Evaluate minor losses in pipes and runoff for a catchment by applying C/ Fortran 77 language.
- Determine the physical characteristics of water and bearing capacity of soils by compiling a program using C/ Fortran 77.

Course Outcomes:

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

- Evaluate shear force, bending moment and deflection for various types of beams subjected to different loads by executing 'C/ Fortran 77' program.
- Analyze and design columns, footings, singly and doubly reinforced beams by using C/Fortran 77 language.
- Determine runoff of a catchment, friction factor and minor losses in pipes by writing C/Fortran 77 programs and executing them.
- Compile C/Fortran 77 programs for conversion of angles from WCB to RB and classification of soils.
- Evaluate bearing capacity of soils and physical characteristics of water by executing C/Fortran 77 programs.

LIST OF COMPUTER PROGRAMS USING C/ FORTRAN 77 LANGUAGE:

1. Determination of shear force, bending moment, deflection for different loading conditions for a simply supported beam and cantilever beam.
2. Determination of fixed end moments for different loading conditions of a fixed beam.
3. Analysis and design of singly and doubly reinforced beams.
4. Analysis and design of columns and footings.
5. Estimation of runoff for a catchment.
6. Estimation of friction factor for laminar and turbulent flows, minor losses in pipe flow.
7. Conversion of angles from WCB to RB.
8. Classification of soils, determination of coefficient of permeability, degree of consolidation and shear strength of soil.
9. Estimation of bearing capacity of soil in various soils
10. Estimation of physical characteristics of water as per codal provisions.

CV3109   INTERNSHIP - 1

CV 3201   TRANSPORTATION ENGINEERING

Course Objectives:
- To impart knowledge about the highways and airports to improve the means of transportation.
- To impart knowledge about the different design aspects of designing a pavement, both flexible and rigid pavements.
- To familiarise the students about the construction activity associated with the highways, railways and airports
- To impart knowledge related to various geometric design elements of a highway like super-elevation, cross-section elements, designing curves, both simple curves and transition curves to add comfort and convenience to the road users.
- To impart knowledge related to geometric design elements of highways.
- To impart knowledge about the components and functions of a railway track.

Course Outcomes:
Students will be able to
- Design the geometric elements of highways.
- Design the thickness of highways with material specifications in the component layers
- Control the traffic moving on the highways effectively by facilitating the traffic control devices.
- Can understand the procedure to finalize the alignment of a highway.
- Understand the components of an aircraft and airport.
- Design the drainage facilities for a highway.

SYLLABUS

Highway Engineering I: Road development in India during twentieth century and twenty first century; Highway planning- Classification of Roads; Highway Alignment; Geometric Design of Highways-Cross-section elements, Sight distances, Horizontal and Vertical alignment, Intersection elements.

Traffic Engineering - Traffic characteristics, Traffic Studies, Traffic flow and Roadway capacity, Traffic regulation and control, Road Intersections and their types.

Highway Engineering II: Design of Highway Pavements-pavement types, Pavement components and their functions, CBR method of Flexible pavement design, CC pavements-types of stresses in Rigid pavements, Design of Rigid pavements, joints in CC pavements.

Highway Materials - Tests on Road aggregates and desirable properties, Bituminous binders and their properties;
Highway Construction - Construction of Flexible pavements, Construction of CC pavement and joints.

Highway Drainage-Surface and Sub-surface drainage systems.

Introduction to Airport Engineering: Aeroplane component parts, Aircraft characteristics, Airport site selection, Runway design, Basic Runway length.

Introduction to Railway Engineering: Railway track components and functions; Rails and Rail failures; Rail joints; Sleepers; Ballast.

Text Books
1. Highway Engineering by S.K. Khanna, C.E.G. Justo and A. Veeraragavan, Nem Chand
2. Railway Engineering by S.C. Saxena and S. Arora, Dhanpat Rai Publications Pvt. Ltd.
3. Airport planning and Design by Khanna & Arora

Reference Books
1. Principle and Practice of Highway Engineering by R.C.Sharma and S.K.Sharma, Asia Publishing House.
2. Transportation Engineering by L.R. Kadiyali, Khanna Publications.
3. Principles of Transportation Engineering by Partha Chakraborty, PHI Learning
4. Railway Engineering by Rangwala.

CV 3202 ENGINEERING ECONOMICS, ESTIMATION AND COSTING

Course Objectives:

- Quantity estimation for different civil engineering works like single storey residential building, BT road, canal etc.
- Quantity estimation and preparing schedule of bars of different items of RC works.
- Rate analysis for different items of work and finding the unit rate of different items of work.
- Cost estimation for different civil engineering works like single storey residential building, BT road, canal etc.

- To prepare a project management report for different civil engineering projects like residential building, BT road, canal etc.

Course Outcomes:

At the end of the course student will be able to

- Estimate quantities required for different civil engineering works like single storey residential buildings, bt road, canal etc.
- Cost estimation for different civil engineering works like single storey residential building, bt road, canal etc.
- Finding the unit rate for different items of work.
- Prepare schedule of reinforcement bars and scheduling a project.
- Analysing a project and finding critical activities and hence allocate resources as per the schedule of project.

SYLLABUS

Introduction: standard units, units of measurement of different items of work. Meaning of "estimating", abstract estimate of buildings, 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.

Contracts: types of contracts, contract document, contract procedure, conditions of contract, arbitration and tenders.

Specifications: meaning, purpose, types of specifications, 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. Rate analysis for building works, rate analysis for sanitary and water supply works, rate analysis for road and railway works.

Detailed estimate of building: different items of work in building; principles of taking out quantities, detailed measurement form; long walls and short walls method of building estimate, centre line method of building estimate. Estimate of RCC building, estimate of slope roof buildings; G.I. And A.C. Sheet, detailed estimate of different types of doors and windows, estimate of electricity and water supply, sanitation works etc.

Estimate of earthwork: different formulae for calculations, estimate of metaled road, tar road, concrete road, railway track, estimate of culverts and bridges etc.

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

Text Books
1. Estimating and costing in civil engineering by b.n. Dutta, sangam books.
2. Textbook of estimating and costing by g.s. Birdie, dhanpat rai publishing companyprivate limited.

Reference Books
1. Estimation, costing, specifications and valuation in civil engineering by m.chakraborti.
2. Textbook on estimating, costing and accounts by d.d. Kohli and r.c. Kohli, s chand &company pvt. Ltd.

CV 3203   STRUCTURAL ANALYSIS – II

Course Objectives:
- To impart the principles of structural analysis and behaviour of indeterminate structures.
- To impart knowledge about various methods involved in the analysis of indeterminatestructures.
- To impart skills of these methods for analyzing the indeterminate structures to evaluatethe response of structures.
- To make the student familiar with analysis Arches and Suspension bridges.
- To impart knowledge about matrix methods.

Course Outcomes:
The student after undergoing this course will be able to:
- Analyse indeterminate structures and adopt an appropriate structural analysis technique.
- Determine response of structures by Force, displacement and matrix methods.
- Understand the concept of analysis of Arches and Suspension bridges.

SYLLABUS

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

Theorem – II.

Analysis of Three Span Continuous Beams using Kani's Method, 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.

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.

Suspension Bridges: Stresses in Loaded Cables with Supports at the Same and Different Levels.Length of Cable; Two and Three Hinged Stiffening Girders.

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. Theory of Structures by S.Ramamrutham, R.Narayan, Dhanpat Rai, PublishingCompany.
2. Theory of Structures by B.C.Punmia, Ashok K Jain,Arun K Jain, Laxmi Publications.
3. Mechanics of Structures Vol II by S.B.Junnarkar, H.J.Shah, Charotar Publishing House.

Reference Books
1. Statically Indeterminate Structures by C.K. Wang, Mcgraw-Hill.

CV3204   PROFESSIONAL ELECTIVE –

IICV 3205   OPEN ELECTIVE –II

CV 3206   COMPUTER AIDED ANALYSIS AND DESIGN LAB

Course Objectives:
- Know the necessity of structural analysis and design software along with its applications.
- Familiarize with the generation of models by using design software.
- Understand the usage of various commands in the software.

- Analyze beams and trusses by generating models using structural analysis and designsoftware.
- Create models for two and three dimensional frames and analyze them by using software.

Course Outcomes:
- Understand the importance of structural engineering and design software.
- Summarize the applications of different commands in structural analysis and design software.
- Create various structural models by using design software.
- Develop beams and truss models by using structural engineering software.
- Analyze two dimensional and three dimensional frames by generating models by usingthe software.

SYLLABUS

1. Introduction to structural engineering.
2. Introduction to structural analysis and design software.
3. Applications of various commands in the software.
4. Model generation using structural engineering software.
5. Analysis and design of various structural components of civil engineering and buildingframes.
     i.   Modeling and analysis of various types of beams.
     ii. Modeling and analysis of trusses.
     iii. Modeling and analysis of two dimensional frames.
     iv. Modeling and analysis of three dimensional frames.

CV 3207   FLUID MECHANICS – II LAB

Course Objectives:
- To provide practical knowledge in verification of principles of fluid flow
- To conduct a test on hydraulic jump and measurement of rugosity coefficients in openchannels.
- To understand major losses in pipe flows.
- To understand drag characteristics of cylinder in a wind tunnel e.
- To conduct experiments on impact of jets on vanes.
- To gain knowledge in performance testing of hydraulic turbine and hydraulic

pumps atconstant speed and head.
- To learn and practice writing technical reports.

Course Outcomes:
- On completion of this course, the student will be able to
- Demonstrate practical understanding in formation of hydraulic jump and measurement ofRugosity coefficients.
- Demonstrate practical understanding of friction losses in pipe flows
- Demonstrate practical understanding of boundary layer, separation and drag
- Provide the student knowledge in calculating performance analysis in turbine and pumps.
- Demonstrate the ability to write clear lab records.

LIST OF EXPERIMENTS

1. Study of Characteristics of a hydraulic jump – To measure and draw (E1-E2)/E1 vs F1 and Lj / y2 vs F1, and compare with theoretical results wherever possible.
2. Study of Rugosity coefficients in an open channel flow.
3. Study of major losses in pipes – Pipe friction – To compute Darcy- Weisbach friction factor.
4. Study of impact of a jet on flat and curved vanes.
5. Study of performance characteristics of a centrifugal pump – To measure the discharge, head developed, and power input at various discharges for centrifugal pump and draw theperformance characteristics.
6. Study of performance characteristics of a reciprocating pump – To measure the discharge, head developed, and power input at various discharges for reciprocating pump and calculate percentage slip and efficiency.
7. Study of performance characteristics of a Pelton turbine – To measure the discharge, head difference across the turbine, the brake load, speed of turbine for various discharges and draw the performance characteristics.
8. Study of performance characteristics of a Francis turbine – To measure the discharge, head difference across the turbine, the brake load, speed of turbine for various discharges and draw the performance characteristics.

CV 3208   HIGHWAY MATERIAL LAB

Course Objectives:

- To impart knowledge about the tests to be conducted on aggregate for its suitability inpavement construction.
- To familiarise the students about the applicability of aggregate in flexible pavement andrigid pavement respectively.
- To impart knowledge about the procedure to determine the strength of the soil subgradeto take up the pavement component layers of it.
- To make the students understand the tests to be conducted on a sample of bitumen for usein flexible pavements
- To familiarise the students about the compatibility of stone chippings and bitumen tomake a bitumen mix for use as a wearing layer in bituminous pavements.

Course Outcomes:

Students will be able to

- Perform tests on aggregate sample for use in various component layers of flexiblepavements and rigid pavements.
- Understand the test procedure and practically conduct the test and infer the applicability of the aggregate sample according the IRC recommendations.
- Assess the strength of the soil subgrade and design the pavement thickness that can be provided over the soil subgrade in the field.
- Perform various tests on the bitumen sample and infer its applicability in flexible pavement construction as a wearing coat material by comparing the test results with IRC specifications.
- Perform tests to identify the compatibility of the stone chipping and bitumen sample.

SYLLABUS

Testing of Aggregates: Sieve Analysis test ; Impact Value test ; Aggregate Crushing value test ; Shape tests – Flakiness Index test, Elongation Index test, Angularity Number ; Los Angeles Abrasion test ; Specific gravity test ; Soundness test.

Testing of Bituminous Material: Penetration Value test; Viscosity test; Softening Point test; Ductility test; Flash and Fire Point test; Specific Gravity test.

Testing on Soil Subgrade: California Bearing Ratio (C.B.R) test.

Testing on Bituminous Mixes: Aggregate Stripping value test.

Reference Book

Highway material testing by S.K. Khanna, C.E.G. Justo and A. Veeraragavan, NemChand & Brothers

CV 3209   SOFT SKILLS

Course Objectives:
- To develop skills to communicate clearly.
- To aid students in building interpersonal skills.
- To enhance team building and time management skills.
- To inculcate active listening and responding skills.

Course Outcomes:
- Make use of techniques for self-awareness and self-development.
- Apply the conceptual understanding of communication into everyday practice.
- Understand the importance of teamwork and group discussions skills.
- Develop time management and stress management.

SYLLABUS

Introduction to Soft Skills: Communication – Verbal and Non Verbal Communication - Personal grooming (Etiquette, Attitude, Body Language), Posture, Gestures, Facial Expressions, Eye Contact, Space Distancing, Presentation Skills, Public Speaking, Just a Minute (JAM) sessions, Adaptability.

Goal Setting and Time Management: Immediate, Short term, Long term, Smart Goals, Strategies to Achieve goals, Types of Time, Identifying Time Wasters, Time Management Skills,Stress Busters.

Leadership and Team Management: Qualities of a Good Leader, Team Dynamics, LeadershipStyles, Decision Making, Problem Solving, Negotiation Skills.

Group Discussions: Purpose (Intellectual ability, Creativity, Approach to a problem, Tolerance),Group Behaviour, Analyzing Performance.

Job Interviews: Identifying job openings, Covering Letter and CVs / Resumes, Interview (Opening, Body-Answer Q, and Close-Ask Q), Telephone Interviews, Types of Questions.

Reference Books:
1. Krannich, Caryl, and Krannich, Ronald L. Nail the Resume! Great Tips for CreatingDynamite Resumes. United States, Impact Publications, 2005.
2. Hasson, Gill. Brilliant Communication Skills. Great Britain: Pearson Education, 2012
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