Structural Analysis II

[Vth Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Civil Engineering	3-1-0, (4)	Program Core	CV105101CV

[Pre-requisites: Mechanics of Solids, Structural Analysis-I]

Course Objectives

1. To understand the concept of analysis of beams and frames by various methods
2. To understand fundamental principles of Influence line diagrams for indeterminate beams.
3. To understand and apply the concepts of plastic analysis

Course Content

Unit-1: Concepts of Structural Analysis

Concepts of indeterminacies: Static and kinematic Indeterminacies, Degree of static and Kinematic indeterminacy and their significance in the structural Analysis. Computation of Indeterminacies of two dimensional and three dimensional skeletal structural systems, Concepts of Force Methods and Displacement methods of structural analysis.

Unit 2: Force methods of Structural Analysis

Use of Mohr's Area - moment theorems for structural analysis of propped cantilever and fixed beams. Method of Consistent deformation, Clapeyron's theorem of three moments for analysis of Continuous beams, Strain Energy method.

Unit 3: Displacement Methods of Structural Analysis

Slope deflection methods for analysis of beams and frames, Displacement based iterative methods (Moment Distribution Methods and Kani's Method) for analysis of beams and frames.

Unit 4: Influence Line of Indeterminate beams

Concepts and use of Influence line diagrams, Qualitative and Quantitative Influence line diagrams of indeterminate beams by Muller-Breslau Principle. Use of Muller-Breslau Principle for qualitative analysis of multistoried building frames under various loadings.

Unit 5: Plastic Analysis of Structure

Introduction, Maximum strength of tensile structural system, Assumptions in bending beyond yield point, plastic moment of a section, moment curvature relationship, shape factor, plastic hinge, collapse load, basic theorems for determination of collapse loads under bending, Static and Kinematic methods. Collapse mechanisms for beams and frames.

Course Materials

Required Text: Text books

1. Intermediate of Structural analysis – Wang. C.K. (McGraw Hill Book Company, 1983)
2. Structural Analysis – Punmia B.C. (Laxmi Publications)
3. Structural Analysis (Vol.-II) – S.S. BhaviKatti S. (Vikas Publishers)

Optional Materials: Reference Books

1. Structural Analysis : A unified Approach-D S Prakash Rao, Sangam Books Limited, London E1 6EP
2. Fundamentals of Structural Analysis – Lect and Vari (Tata McGraw Hill)
3. Structural Analysis – Pandit and Gupta (Tata McGraw Hill)

Highway and Railway Engineering

[Vth Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Civil Engineering	3-1-0, (4)	Program Core	CV105102CV

[Pre-requisites: None]

Course Objectives

1. To create ability in understanding the significance of development and various characteristics of road and rail transport infrastructure for the benefit of society.
2. To understand the fundamental concepts related to the planning, design, analysis, and maintenance of road and rail Transport infrastructure.
3. To create ability in implementing the scientific, technical and analytical knowledge for developing sustainable road and rail transportation system

Course Content

Unit 1: Highway Planning Principles, Alignment and Geometric Design

Highway Planning Principles: Introduction to transportation, different modes of transportation, classification of roads, network patterns, planning surveys.
Highway Alignment: Requirements and factors controlling and Engineering surveys
Geometric Design: Cross section Elements, Sight distances, Horizontal alignment and Vertical alignment.
Concepts of Highway project preparation

Unit 2: Traffic Engineering Principles and Traffic Operations

Traffic studies on flow, Speed and travel time, Highway capacity and level of service of rural highways and urban roads. Types of intersections, and channelization;
Traffic operations: traffic signs, road markings, signals and warrants.

Unit 3: Pavement Materials, Design & Construction

Experimental characterization of pavement materials; Types of pavement structures, Concepts on Analysis and Design of pavement systems; functions of pavement components, design factors.. Design of flexible and rigid pavement as per IRC methods.
Highway Construction: Types of Pavement layers, Construction of Granular, Bituminous and Cement Concrete layers.

Unit 4: Introduction, Permanent Way, Geometric Design

Role of Indian Railways in National Development – Railways for Urban Transportation –LRT & MRTS.
Permanent Way: Components and their Functions; Rails - Types of Rails, Rail Fastenings, Concept of Gauges, Coning of Wheels, Creeps and kinks; Sleepers & Ballast – Functions, Materials, Density;
Geometric Design of Railway Tracks: Gradients and Grade Compensation, Speed types, Cant, Negative superelevation, Widening of Gauges in Curves, Transition Curves, Horizontal/Vertical Curves.

Unit 5: Points & Crossings, Signalling & Interlocking, Stations & Yards

Design of turnouts, Classification of signals, Control systems of train movements, Points and signals interlocking, Types of Stations and Yards, Rolling Stock, Tractive Power, Track Maintenance.

Course Materials

Required Text: Text books

1. Highway Engineering - S.K Khanna, C.E.G. Justo and Veeraragavan, (Nem Chand and Bros, Roorkee, India, Tenth edition 2017).
2. Principles and Practices of Highway Engineering - L. R. Kadiyali & N. B Lal, (Khanna Publishers) New Delhi, Ninth Edition, 2017.
3. Railway Engineering - Chandra S. and M.M. Agarwal Oxford University Press, New Delhi, India, Second edition, 2013

Optional Materials: Reference Books

1. Principles of Pavement Design - Yoder, E.J. and M.W. Witczak, (John Wiley and Sons), Second Edition 2012
2. Relevant MORTH, and IRC codes and guidelines
3. Pavement Analysis and Design - Y.H. Huang, (Pearson Prentice Hall), New Jersey, USA, 2008
4. Railway Engineering- Saxena, S.C. and S.P. Arora, Dhanpat Rai and Sons, New Delhi, India, 1997.
5. Railway Track Engineering - J.S. Mundrey, Tata McGraw-Hill Education Private Limites, New Delhi, Fourth Edition, 2010.

Design of Reinforced Concrete Structures

[Vth Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Civil Engineering	3-1-0, (4)	Program Core	CV105103CV

[Pre-requisites: Mechanics of Solids, Structural Analysis-I]

Course Objectives

1. To understand the material properties and philosophy of analysis and design as per codal practices
2. To understand and carryout analysis and design of structural elements such as Beams, Slabs, Columns and column footings by Limit state method as per codal practices.
3. To understand and carryout analysis and design of structural Columns and column footings by working stress method.

Course Content

Unit-1 : General Design Considerations

Properties of concrete and reinforcing steel, characteristic strengths, stress-strain curves. Study of IS 456:2000,IS 875 Part I to III & V. Basis for design, loads and forces (Dead load, live load, and wind loads).

Unit 2: Working Stress Method

Working stress, Analysis, Design & detailing by working stress method- singly and doubly reinforce sections, rectangular and T-sections. Short and long columns, eccentrically loaded columns, and footings.

Unit 3: Introduction to Design Philosophy

Limit states of design. Limit states of Collapse: flexure, shear, compression, and Torsion. Serviceability conditions- limit states of deflection and cracking, calculation of deflections. Governing reinforcement as per IS 456:2000.

Unit 4 : Design by Limit State Method- Beams and Slabs

Analysis, Design & detailing by Limit state method: singly and doubly reinforced sections, rectangular and T-sections. One way and two-way slabs and staircases. Reinforcement detailing as per SP 34 of BIS.

Unit 5: Design by Limit State Method- Columns and Columns Footings

Analysis, Design & detailing by Limit state method-pedestal short and long columns, eccentrically loaded columns. Uniaxial and Biaxial bending, Isolated Column Footings for axial and bending cases. Reinforcement detailing as per SP 34 of BIS.

Course Materials

Required Text: Text books

1. Reinforced Concrete Structures: Robert L. Park and Thomas Paulay, · 1975 (ISBN:9780471659174, 0471659177) Publisher:Wiley
2. Reinforced Concrete Limit State Design of - Jain A.K. (Nerm Chand& Bros. Roorkee,1993)
3. Relevant IS codes IS456:2000, IS 875 part1,2,3 and 5, SP-34.
4. Design Aids for Reinforced Concrete to I.S.-456-1978- SP16: 1980 (Bureau of Indian Standards, New Delhi)

Optional Materials: Reference Books

1. Reinforced Concrete Design, Second Revised Edition: S N Sinha (McGraw-Hill Education)
2. Advanced Reinforced Concrete Design: P. C. Varghese, (Prentice-Hall of India)
3. Fundamentals of Reinforced Concrete- Sinha N.C. & Roy S.K. (S. Chand & Co.)
4. Limit State Design of Reinforced Concrete –Punmia B C, Jain A K& Jain A K(Laxmi Publications)
5. Reinforced Concrete Structures- Dayaratam P. (Oxford and IBH Publishing Co. 1986)
6. Schaum's Outline of Reinforced Concrete Design- Noel J. Everard, McGraw Hill Professional.

Geotechnical Engineering - II

[Vth Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Civil Engineering	3-0-0, (3)	Program Elective-I	CV105201CV

[Pre-requisites: Geotechnical Engineering - I]

Course Objectives

1. To be able to understand and analyze the concept of stability of slopes and earth pressure for the field application related to Geotechnical Engineering.
2. To involve the application of scientific and technical principles of planning, analysis, design of foundation
3. To give an experience in the implementation of Engineering concepts which are applied in field of Geotechnical Engineering

Course Content

Unit 1 : Stability of Slopes

Embankment slopes, examples of embankment, road and earth dams, stability analysis for finite and infinite slopes, Concept of factor of safety, friction circle method, method of slices, Bishop's simplified method, limiting values of factor of safety; critical conditions for the stability of earth dams.

Unit 2: Earth Pressure

Earth Pressure at rest, active and passive earth pressure, computations using Rankine's and Coulomb's earth pressure theories, Culmann's graphical method, and additional earth pressure due to surcharge.

Unit 3: Shallow Foundations and Settlements

Common types of foundations with examples, brief illustration of situations where each one of them is adopted, basis for design, review of major soil parameters used in proportioning of shallow foundations, types and their selection, Bearing Capacity, various method of determination of bearing capacity, computation of bearing capacity in cohesion less and cohesive soils, effect of various factors on bearing capacity, use of field test data, limits of settlement, differential and permissible settlement of footing.

Unit 4: Well and Pile Foundations

Various types of caissons situations where adopted, elements of wells, types, method of construction.

Pile Foundation, their types, criteria of selection of piles, outline of steps involved in proportioning, bearing capacity and settlement of single and group of piles, design of pile groups and settlement of pile group in clay, negative skin friction.

Unit 5: Machine Foundation, Contaminated, Expansive Soil, Ground Improvement Techniques and Introduction of Rock Mechanics:

Introduction of machine foundation, types of machines and their foundations, Design criteria, Field methods of determining design Parameters, block vibration test.

I.S. code recommendations and foundation on expansive soil, identification of expansive soil, contaminated soil, and problems associated with contaminated and expansive soil, design consideration of foundation on expansive soil, CNS soils. Various ground improvement techniques- grouting, stone piling, reinforced earth, Rock tests and RQD.

Course Materials

Required Text: Text books

Basic and applied Soil Mechanics (Revised Edition) – Gopal Rajan and Rao A.S.R. (New Age, New Delhi. 1998)

Optional Materials: Reference Books

1. Geotechnical Engineering: Gulhati S.K., Datta, M. (Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005).
2. Soil Engineering in Theory and Practice (Vol-II) – Alam Singh (Asia Publishing House, New Delhi)
3. Foundation Engineering (2nd Edition) – Peck, R.B., Hanson (W.E. and Thornburn. W.H. Johan Wiley, New York 1976)
4. Foundation design and Construction (5th Edition) – Tomlinson, M.J. (ELBS, Singpore. 1988)
5. Foundation Analysis and Designing – J.E. Bowles (McGraw Hill, New Delhi)
6. Soil Engineering in Theory and Practice (Vol. - II) – Alam Singh (Asia Publishing House, New Delhi, 1981)

Modern Surveying Techniques

[Vth Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Civil Engineering	3-0-0, (3)	Program Elective-I	CV105202CV

[Pre-requisites: Surveying]

Course Objectives

1. Understanding modern surveying equipment and surveys
2. Using various modern equipment/technology related to EDM, Total Station, GPS, Photogrammetry, Laser Scanners etc.
3. Application of the modern surveying techniques in solving engineering problems.

Course Content

Unit 1: Modern Surveying Equipment and Surveys

Electromagnetic wave theory - electromagnetic distance measuring system - principle of working and EDM instruments, Total Station and GPS: Basic principles, classifications, applications, comparison with conventional surveying.

Unit 2: Global Positioning System

Global Positioning System – working principle and methods, reference systems, satellite orbits, GPS observations, Different Approaches to use GPS and their accuracies, Advantages of GPS in Navigation, Survey, Planning and Mapping. Overview of GNSS.

Unit 3: Photogrammetry

Aerial and terrestrial, applications of photogrammetry, types and geometry of aerial photograph, flying height and scale, relief(elevation) displacement.

Unit 4: Applications of Lasers

Point cloud, Lasers in distance, angular and volumetric measurements, Laser Scanning for mapping, Multi-sensor surveying.

Unit 5: Case Studies

Structural/3D modelling, Topographic mapping and Road profiling using modern techniques, methods, and software.

Course Materials

Required Text: Text books

1. Punmia B. C, Ashok K. Jain, Arun K. Jain, Higher Surveying, Laxmi Publications, 2005.
2. Lilles and, T.L., and Kiefer, R.W., “Remote Sensing and Image Interpretation, 4th Edition, John Wiley & Sons, 2005

Optional Materials: Reference Books

1. Agarwal, C.S. and Garg, P.K., “Remote Sensing in Natural Resources Monitoring and Management”, Wheeler Publishing House.2000
2. Bossler, J.D., “Manual of Geospatial Science and Technology”, Taylor and Francis.2002
3. Burrough, P.A. and McDonnell, R.A., “Principles of Geographic Information System”, Oxford University Press.2000
4. Borden D. Dent, Jeffrey Troguson, Thomas W. Hodler, Cartography: Thematic Map Design, McGraw-Hill Higher Education, 2008.
5. Hoffman.B, H.Lichtenegga and J.Collins, Global Positioning System - Theory and Practice, Springer -Verlag Publishers, 2001

Project Planning and Management

[Vth Semester, Third Year]

Course Description			
Offered by Department	Credits	Status	Code
Civil Engineering	3-0-0, (3)	Open Elective-I	CV105301CV

Course Objectives

1. To understand project management fundamentals for managing small and large scale projects.
2. To understand and apply planning, scheduling and controlling of various activities in a project.
3. To learn and apply various project management tools and techniques in various projects.

Course Content

Unit 1: Introduction

Concept of project, planning and management and its features, Types & characteristics of construction projects, organization of construction project, project categories, project planning & organization systems, Stakeholders in a Project, heavy construction projects, construction industry in India

Unit 2: Project Planning and Scheduling

Work scope planning, project work breakdown structures, bar charts, network analysis fundamentals, network elements, network development, CPM network development and analysis, PERT, CPM vs. pert, precedence network analysis fundamentals, line of balance, network updating, resource allocation and scheduling fundamentals, leveling & smoothing, time–cost analysis

Unit 3: Project Contracts and Safety

Project contracts and its types, tendering procedure; Construction hazards & safety measures, Safety management systems, Safety training, Safety audit, project management techniques for safety management.

Unit 4: Construction Equipments and Plants

Classification of construction equipment, types & characteristics of construction equipment, equipment capacities & costs, machine power, dozers, scrapers, excavators, trucks & hauling equipment, draglines & clamshells, pile driving equipment, selection of equipment, acquisition of equipment, time value of money for heavy construction equipment. Batching Plants: Cement Concrete, Bituminous Concrete and Aggregate mixes.

Unit 5: Construction Economics

Need & types of project appraisals, concepts of financial appraisal, finance source for heavy construction projects, methods of financing the heavy construction projects, major financing bodies, economic evaluation of project, Indian practice of investment appraisal, time value of money, analysis of risk, discounted and non-discounted cash flow methods.

Course Materials

Required Text: Text books

1. Construction Project Management Planning, Scheduling and Control – Chitkara, K.K. (Tata McGraw Hill Publishing Co., New Delhi,)
2. R E Levitt and N M Samelson, Construction Safety Management, John Wiley and Sons, New York, 1993
3. R L Peurifoy, Construction Planning, Equipment, and Methods, Tata McGraw-Hill, New Delhi, 2002

Optional Materials: Reference Books

1. F Harris and R McCaffer, Modern Construction Management, Seventh Edition, Blackwell Publishers, Oxford, 2013.
2. K N Jha, Construction Project Management: Theory and Practice, Pearson Education, New Delhi, 2015.
3. P Chandra, Projects: Planning, Analysis, Selection, Financing, Implementation, and Review, Tata McGraw-Hill, New Delhi, 2009

Mechanics of composite materials

[Vth Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Civil Engineering	3-0-0, (3)	Open Elective-I	CV105302CV

Course Objectives

1. To understand the mechanical behavior of anisotropic materials and how they differ from isotropic materials.
2. Familiarization with the basic expressions and methods used in the mechanics of composite structures.
3. To use failure theories to determine the composite lamina failure.

Course Content

Unit 1: Introduction to Composite Materials

Composites Definition, Fibers and Matrix materials, Types of composites, Classification: Metal matrix, Ceramic matrix and Carbon-Carbon composites; Polymer matrix composites, Advantages, Applications and Fabrication Methods of Composites.

Unit 2: Macromechanical Behavior of a Lamina

Generalized Hooke's law, Material symmetry: Anisotropic, Monoclinic, Orthotropic and transversely isotropic and isotropic materials, Plane stress constitutive equations, Transformation of stress and strain, Stiffness and Compliances Matrices of a Lamina. Hygro-thermal effects in Lamina.

Unit 3: Micromechanical Behavior of a Lamina

Develop concepts of volume and mass fractions of fiber and matrix, density and void fraction in composites.

Determine the effective mechanical and hygrothermal properties of composite using strength of material approach: Axial Modulus, Transverse Modulus, Poison's Ratio, Shear Modulus, Coefficients of Thermal Expansion, and Coefficients of Thermal Expansion.

Unit 4: Macromechanical Analysis of a Laminate

Introduction to Classical Plate Theory, Laminate stacking sequence, Laminate Constitutive relationship, Types of Laminates, Special cases of laminates, Hygro-thermal effects in Laminate.

Unit 5: Failure, Analysis and Design of Laminates

Damage Mechanisms in Unidirectional Composites: micro-level, matrix-level, coupled mechanisms.

Fundamental Failure Theories, Lamina Failure Theories: Maximum Stress Theory, Maximum Strain Theory, Tsai-Hill Theory, Hoffman Theory, Tensor Polynomial Failure Criterion (Tsai-Wu) .

Course Materials

Required Text: Text books

1. Autar K. Kaw, Mechanics of Composite Materials , CRC-LLC Press
2. R. M. Jones, Mechanics of Composite Materials, CRC Press
3. CT Herakovich, Mechanics of Fibrous Composites, John Wiley & Sons, Inc. New York

Optional Materials: Reference Books

1. M. Mukhopadhyay, Mechanics of Composite Materials, University Press
2. S. Daniel and Ori Ishai, Engineering Mechanics of Composite Material, Oxford University Press
3. B.D. Agarwal and L.J. Broutman, Analysis and Performance of Fiber Composites, John Wiley & Sons.

Transportation Engineering Lab

[Vth Semester, Third Year]

Course Description			
Offered by Department	Credits	Status	Code
Civil Engineering	0-0-2, (1)	Laboratory	CV105401CV

Course Objectives

1. To develop an ability in understanding the behavior of aggregates and Bitumen under different types of loading.
2. To understand the procedure for testing of various physical and mechanical properties of aggregate and Bitumen and its mixtures.
3. To interpret the test results of aggregates, Bitumen and its mixtures by comparing with standard specifications.

Course Content

A. Aggregate Tests

1. To determine the Abrasion value of aggregates
2. To determine the Impact value of aggregates
3. To determine the Crushing value of aggregates
4. To determine the Specific Gravity and Water Absorption of aggregates
5. To determine the combined Flakiness & Elongation index value of aggregates

B. Bitumen Tests

1. To determine the Penetration value of Bitumen sample
2. To determine the Specific Gravity value of Bitumen sample
3. To determine the Softening point value of Bitumen sample
4. To determine the Absolute and Kinematic Viscosity value of Bitumen sample
5. To determine the Flash and Fire point value of Bitumen sample
6. To determine the Ductility value of Bitumen sample
7. To determine the Binder Content of Bitumen mixtures
8. To determine the Marshall Stability value of Bitumen mixtures

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Course Materials

Required Text: Text books

1. Indian Standards IS 2386 (Part-1 to Part-8), “Methods of Test for Aggregates”
2. Indian Standards IS 1201 to 1220, “Methods for testing Tar and Bituminous Materials”.

Optional Materials: Reference Books

1. MoRTH (Fifth Revision) 2013, Specifications for Roads and Bridges
2. MoRD (First revision), 2014, “Specifications for Rural roads”.
3. Relevant ASTM standards for testing of Aggregates and Bituminous materials

Structural Analysis Lab

[Vth Semester, Third Year]

Course Description

Offered by Department	Credits	Status	Code
Civil Engineering	0-0-2, (1)	Laboratory	CV105402CV

Course Objectives

1. To develop an understanding of the effects of different types of forces and support conditions in structural members.
2. To introduce the students to the available software for the analysis of structural members.
3. To impart the importance of analysis methods in the field of civil engineering.

Course Content

1. To study the behavior of beams with respect to the support conditions and loadings.
2. To study the effects of change in material properties and cross-section areas in a beam.
3. To study the behavior of 2-dimensional trusses.
4. To study the influence line diagram for beams and trusses.
5. To study the behavior of two hinged and three hinged arches.
6. To study the portal frames under different loading and support conditions.
7. To study slabs under different loading and support conditions.
8. To study the effects of lateral loading in the structures.
9. To study unsymmetrical bending and torsion in the beams.
10. To study the behavior of 3-dimensional trusses.

Course Materials

Required Text: Text books

1. Reddy, Basic Structural Analysis, Tata McGraw Hill, Third Edition
2. Wang, Intermediate Structural Analysis, Tata McGraw Hill, Second Edition
3. Prakash Rao, Graphical Method of structural Analysis, Universities Press, First Edition

Optional Materials: Reference Books

1. Kassimali, Structural Analysis, Cengage, Fifth Edition
2. Hibbler, Structural Analysis, Pearson Publication, Ninth Edition
3. Willbur and Norris, Elementary Structural Analysis, Literary Licensing, First Edition
4. Menon, Structural Analysis, Narosa Publication, Third Edition
5. Negi, Structural Analysis, Tata McGraw Hill, Second Edition