SURVEYING PRACTICE-I (0:0:3)

Sub Code: CV0107 ***CIE: 50% Marks***

Hours/week: 0+0+3 **SET: 50% Marks**

Total (CIE + SET): 100

1. Study of topographic maps and preparation of a chart of conventional symbols.
2. Measurement of distances using tape, direct/indirect ranging, setting out perpendiculars
3. Measurement of bearings/directions using prismatic compass.
4. Determination of distance between two inaccessible points using compass and accessories
5. To conduct a closed compass traverse and adjusting of traverse. To find the area of traverse by coordinates method.
6. Determination of reduced levels of points using dumpy level/auto level (simple leveling)
7. Determination of reduced levels of points using dumpy level/auto level (differential leveling)
8. To conduct profile leveling and cross sectioning, plotting
9. To conduct block leveling, preparation of contour plan.
10. Study of parts of a Vernier theodolite and practice of taking readings
11. Measurement of horizontal angle by repetition and reiteration methods
12. Measurement of vertical angles using theodolite.

TEXT BOOK:

1. K.R. Arora, ***"Surveying (Vol. 1***)" Standard Book House, New Delhi. – 2010

REFERENCE BOOKS:

1. Alak De, ***"Plane Surveying***", S. Chand and Co. ltd. New Delhi. - 2009
2. S.K. Roy, "***Fundamentals of Surveying",*** Prentice Hall of India New Delhi. - 2009
3. James M. Anderson, Edward M. Mikhail, ***"Introduction to Surveying***" Mc Graw Hill Book Company, NY. – 2009
4. B.C. Punmia, ***"Surveying Vol.1***", Laxmi Publications pvt. Ltd., New Delhi. – 2009
5. S.K. Duggal, ***"Surveying Vo. 1***", Tata McGraw Hill Publishing Co. Ltd. New Delhi. - 2009

CONCRETE TECHNOLOGY (4:0:0)

Sub Code : CV0424	***CIE : 50% Marks***
Hrs/week : 4+0+0	**SEE : 50% Marks**
SEE Hrs : 3 Hrs	**Max. Marks : 100**

COURSE OUTCOME

On Completion of this course the students will be able to:

1. Analyze & determine by experiments, the characteristics of Cement and Aggregates;
2. Design concrete mixes for construction purpose;
3. Test and characterizing of hardened concrete.

Unit - I:

Cement

Chemical composition, hydration of cement, Types of cement, manufacture of OPC by wet and dry process (flow charts only), Testing of cement – Field testing, Fineness by sieve test and Blaine's air permeability test, Normal consistency, setting time, soundness, Compressive strength of cement and grades of cement, Quality of mixing water. **8 hrs**

Self Learning Exercise: Blended Cement

Aggregates

Fine aggregate – grading, sieve analysis, Specific gravity, bulking, moisture content, deleterious materials, use of manufactures samd. Coarse aggregate – Importance of size, shape and texture. Grading of aggregates – Sieve analysis, specific gravity, Flakiness and elongation index, crushing, impact and abrasion tests.

Self Learning Exercise: Alkali- aggregate reaction.

9 Hrs

Unit - III:

Fresh Concrete Workability- factors affecting workability, Measurement of workability – slump, flow tests, Compaction factor and vee-bee consistometer tests, Segregation and bleeding, Process of manufactures of concrete; Batching, Mixing, Transporting, Placing, Compaction, Curing, Chemical admixtures – plasticizers, accelerators, retarders and air entraining agents,

Self Learning Exercise: Mineral admixtures – Fly ash, Silica fumes and rice husk ash & GGBS.

9 Hrs

Unit - IV:

Concrete Mix Design

Concept of Mix design, ***variables in proportioning***, exposure conditions, Procedure of mix design as per IS 10262-2009, Numerical examples of Mix Design.

Self Learning Exercise: Mix design by ACI code

9 Hrs

Unit - V:

Hardened Concrete

Factors affecting strength, w/c ratio, gel/space ratio, maturity concept, Effect of aggregate properties, relation between compressive strength, and tensile strength, bond strength, modulus of rupture, Accelerated curing, aggregate – cement bond strength, Elasticity – Relation between modulus of elasticity and Strength, factors affecting modulus of elasticity, Poisson's , ratio, Shrinkage
– plastic shrinkage and drying shrinkage, factors affecting shrinkage,

Self Learning Exercise: Creep – Measurement of creep, factors affecting creep, effect of creep, testing.

8 Hrs

Unit - VI:

Durability

Definition, significance, permeability, Chloride attack, carbonation, freezing and thawing, Factors contributing to cracks in concrete***.*** ***8 hrs***

Self Learning Exercise: Sulphate attack, Coded provisions for durability of concrete.

TEXT BOOK:

1. M.S. Shetty, **"*Concrete Technology*"** - Theory and Practice, S.Chand and Company, New Delhi, 2002.

REFERENCE BOOKS:

1. Neville, A.M. , **"*Properties of Concrete*"** , ELBS, London
2. Shetty, M.S*., **"Concrete Technology"*** - S.Chand & Co., New Delhi.
3. Gambhir , ***"Concrete Manual"*** - Dhanpat Rai & Sons, New Delhi.
4. N.Krishna Raju, ***"Concrete Mix Design"*** - Sehgal – publishers.
5. ***"Recommended guidelines for concrete mix design"*** - *IS: 10262-2009*, BIS publication.

SURVEYING PRACTICE-II (0:0:3)

Sub Code : CV0109 ***CIE : 50% Marks***

Hours/week: 0+0+3 **SET: 50% Marks**

Total (CIE + SET): 100

1. To determine the elevation of the top of a tower/building using single plane method.
2. To determine the elevation of the top of a tower/building using double plane method
3. To conduct a closed theodolite traverse and adjusting of traverse. To find the area of traverse by coordinates method.
4. Introduction to total station, components, temporary adjustments.
5. Horizontal and sloping distance measurement using total station.
6. Measurement of horizontal and vertical angles using total station.
7. Determination of heights of buildings/towers/power line (remote elevation measurement), determination of distance between two points(missing line measurement)
8. Orientation of total station using compass and measurement of magnetic bearings.
9. Measurement of coordinates (N, E, Z) of various points from one instrument position.
10. Traversing using total station (orientation at the first station by compass and at subsequent stations by back sighting) and area measurement.
11. Detailed survey of an area including creation of job file, selecting appropriate point codes, measurement of coordinates, downloading of data and preparation of contour map.
12. Use of hand held GPS for coordinate measurement.

REFERENCE BOOKS:

1. Satheesh Gopi, "***Global Positioning System-Principles and Applications***", Tata McGraw Hill Publishing Co. Ltd. New Delhi. - 2005
2. S.K. Roy, ***"Fundamentals of Surveying***", Prentice Hall of India New Delhi. - 2009
3. S.K. Duggal, ***"Surveying Vol. 1***", Tata McGraw Hill Publishing Co. Ltd. New Delhi. - 2009
4. B.C. Punmia, Ashok K. Jain, Arun K. Jain, "***Higher Surveying***", Laxmi Publications pvt. Ltd. New Delhi. - 2008
5. K.R. Arora, "***Surveying (Vol. 1, 2, 3)"*** Standard Book House, New Delhi. - 2010
6. Manoj K Arora and R.C. Badjatia, "***Geomatics Engineering***" Nem Chand and Bros. Roorkee – 2011.

HYDRAULICS LABORATORY (0:0:3)

Sub Code: CV0110 ***CIE : 50% Marks***

Hours/week: 0+0+3 **SET: 50% Marks**

Total (CIE + SET): 100

1. Experimental on orifices
2. ***Experiment on Mouthpieces:***
   a. External Mouth piece,
   b. Internal mouth piece.
3. ***Experiments on Venturimeter***
4. **Experiments on orifice meter**
5. **Experiment on Venturiflume**
6. **Experiment on Broad Crested Weir**
7. **Experiment on pipes :**
   a. Major losses in pipes
   b. Minor losses in pipes
8. ***Discharge over notches:***
   a. V-Notch
   b. Rectangular Notch
9. ***Impact of jet on stationary vanes:***
   a. Flat Vane
   b. Semi Circular Vane
   c. Conical Vane
10. ***Experiment on turbines:***
    a. Pelton wheel turbine
    b. Francis turbine
    c. Kaplan turbine

11. Experiments on pumps:

a. Single stage centrifugal pimp

b. Multistage centrifugal pump

REFERENCE BOOKS:

1. Dr. P.N.Chandara Mouli " ***Hydraulic Laboratory Manual***"
2. C.S.P. Ojha, R. Berndtsson, and P.N. Chandramouli, ***"Fluid Mechanics and Machinery"***, Oxford University Publication - 2010.
3. K.R. Arora, ***"Fluid mechanics, Hydraulics and Hydraulic machines***", 5th edition, standard publisher distributors, - 2005.

BUILDING PLANNING & DRAWING (1:0:2)

Sub Code	**: CV0206**	**CIE: 50% Marks**
Hrs/week	**: 1+0+2**	**SEE: 50% Marks**
SEE Hrs	**: 3 Hrs**	**Max. Marks: 100**

COURSE OUTCOME

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

1. Plan simple, cost effective, functional buildings with good elevation, satisfying local specifications;
2. Conceptualize and develop plans for residential Commercial, Educational and Government buildings;
3. Prepare the relevant drawings.

PLANNING OF BUILDINGS

Unit – I:

Orientation and positioning of various components of buildings, Traditional concepts in building planning, Building standards, Building Bye- Laws, set back and functions of local authority.

Self Learning Exercise: Basic concepts in Mass housing and affordable housing, Energy efficient housing.

6 Hrs

Unit – II

Functional design of buildings using interconnectivity diagrams (Bubble diagrams), Development of line plans for simple residential and public buildings.

Self Learning Exercise: To develop line plans for Mass housing and affordable housing, Energy efficient housing.

6 Hrs

Unit – III

Plan, Section and Elevation for Residential buildings (i.e. for various plot sizes), Commercial buildings (i.e. commercial centre/complex, hotel & bank.), Educational buildings (i.e. primary

school, high school and college), Government buildings (i.e. municipal/corporation office, post office, primary health centre Zilla Panchayath), for given requirements.

Self Learning Exercise: To develop a detailed Plan, Section and Elevation for a economically weaker family considering climatic conditions, availability of local materials and construction costs

30 Hrs

TEXT BOOK:

1. Gurucharan Singh and Jagadish Singh, ***"Building Planning Designing and Scheduling",*** Standard publishers distributors,5th edition, 2002

REFERENCE BOOKS:

1. B.P. Verma, ***"Civil Engineering Drawing and House planning***"- Khanna Publishers, 11th edition, 1992.
2. M. Chakraborti, "***Civil Engineering Drawing"*** - Published by author, 6th edition, 2004
3. Shah M.H. and Kale CM, "***Building Drawing***"- Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. BIS, National Building Code, New Delhi, 2005.

SPECIAL CONCRETES (3:0:0)

Sub Code : CV0311 **CIE : 50% Marks**

Hrs/week : 3 +0+0 **SEE : 50% Marks**

SEE Hrs : 3 Hrs **Max. Marks : 100 COURSE**

OUTCOME

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

1. Have an understanding the material characteristics of various construction chemicals and their specific suitability;
2. Have an understanding the properties of various types of concrete and their applications.

Unit- I:

Introduction to Construction Chemicals

Types, general properties.

Self Learning Exercise: Uses of construction chemeicals

2 Hrs

Unit- II:

Admixtures

Chemical admixtures, mechanism of chemical admixtures, plasticizers and super plasticizers and their effect on concrete property in fresh and harden state. Marsh cone test for optimum dosage of super plasticizers, retarder, accelerator, air entraining admixtures, new generation plasticizers. Mineral admixtures; fly ash, silica fume, Chemical composition and suitability criteria.

Self Learning Exercise: GGBS.

10 Hrs

Unit- III :

Different Types of Concrete

(i) High strength and high performance concrete**.**
(ii) Self compacting concrete – properties and applications
(iii) Polymers concrete types.

Self Learning Exercise: Geopolymer concrete applications

10 Hrs

Unit – IV:

(i) Light weight concrete – classification, properties of light weight concrete, strength and durability.

(ii) Reactive powder Concrete, No fines Concrete.

Self Learning Exercise: (i) Applications (ii) High Volume fly ash concrete

7 Hrs

Unit – V:

(i) High Density concrete-materials, placements method, properties in wet and hardened state, use of high-density concrete and applications.

(ii) Fiber Reinforced concrete – Fiber materials, mix proportion, fiber content, distribution orientation and interfacial bond.

Self Learning Exercise: (i) Radiation shields (ii) fiber properties in fresh state.

7 Hrs

Unit –VI:

(i) Roller compacted concrete. Methodology, properties**,**

Self Learning Exercise: Types

6 Hrs

TEXT BOOK:

1. Shetty M.S, **"*Concrete Technology*"**, Theory & Practice. S. Chand and Company, New Delhi - 2002.

REFERENCE BOOKS:

1. N.Krishnaraju, ***"Concrete mix Design",*** Sehgal – Publishers 2009.
2. Nevillie A.M., ***"Properties of concrete"***, Pearson Education Asis, - 2000.

3. Short & Kinniburg ***"Light weight concrete"*** –, Asia Publishing House - 1963.

4. Rafat Siddigue, ***"Special Structural Concrete"***-, Galgotia Publications Pvt. Ltd., New Delhi – 2000.

5. P. Kumar Mehta, P.J.M. Monteiro, ***"Concrete MicroStructure, Properties and Materials "***, TMH,3rd Edition - 2006.

6. A.R. Shantha Kumar *"**Concrete Technology***" Oxford University Press – 2006.

GEOTECHNICAL ENGINEERING LABORATORY (0:0:3)

Sub Code : CV0111 **CIE : 50% Marks**

Hrs/Week : 0+0+3 Hrs **SEE : 50% Marks**

Total (CIE + SEE): 100

Course Outcomes

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

1. *Determine the index property of soils in order to classify the soil as per BIS specifications.*
2. *Evaluate the properties like shear strength, permeability, compaction and consolidation characteristics of soils.*

List of Experiments

1. Test for determination of specific gravity
2. Grain size analysis of coarse grained soil
3. In situ density by core cutter and sand replacement methods
4. Consistency limits
   (a) Liquid limit by casagrande and cone penetration methods
   (b) Plastic limit
   (c) Shrinkage limit
5. Standard proctor compaction test
6. Modified proctor compaction test
7. Determination of permeability by constant head and variable head methods
8. Strength tests

(a) Unconfined compression test

(b) Direct shear test

(c) Triaxial compression test (undrained)

9. Consolidation test

10. Demonstration tests

11. (a) Grain size analysis of fine grained soil by the Hydrometer method

(b) Free swell and swell pressure tests

(c) Laboratory vane shear test

12. Determination of Relative density of sand

Reference Books:

1. **"Laboratory testing of soils SP 36 (Part 1) 1987"**, Bureau of Indian Standards

2. Lambe T. W., **"Soil testing for Engineers"** Wiley India Pvt. Ltd.1985.

3. Bowles. J.E., **"Engineering properties of soils and their measurements"**- McGraw Hill. – 1992.

COMPUTER AIDED DRAWING (0:0:3)

Sub Code : CV0112 **CIE : 50% Marks**

Hrs/Week : 0+0+3 Hrs **SEE : 50% Marks**

Total (CIE + SEE): 100

Course Outcomes

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

1. *Use fundamentals of AUTOCAD.*
2. *Prepare plan and elevation of various Civil Engg. Entities using AUTOCAD.*
3. *Prepare structural drawings related to Civil Engineering projects.*

Introduction to AUTOCAD

AUTOCAD screen, Setting the options, Menu commands, Opening a drawing, Drawing tools, Editing tools, Creating drawings using wizards, Dimensioning, Text in AUTOCAD, Layers concept, Blocks, Hatching, Working with Multiple drawings, Drawing 2D objects using above tools.

Drawing Components of Building

Drawing following components of building using AUTOCAD tools - Masonry foundations, Doors and Windows, Staircases, Trusses

Building Drawing Using AUTOCAD

Drawing plans of buildings using drawing tools, creating openings in plans using modify tools, creating and inserting blocks of doors and windows, Inserting text and dimensions, Drawing elevation and sections, Creating sanction drawing. Preparation of working drawings of single storey and double storey residential buildings.

Structural Drawings Using AUTOCAD

Preparation of column layout and excavation drawings, footing, Lintel and Chejja, beams and slabs of framed structures.

Reference Books

1. Roberts JT , **"Introduction to AUTOCAD 2006"** - , BPB publications

2. George Omura, **"Mastering AUTOCAD 2006"**, BPB Publications

3. Ramesh Bangia, **"Learning AUTOCAD 2005"**, Khanna Book Publishing Co.

4. Sham Tickoo, **"Understanding AUTOCAD 2004 Abeginner's Guide"**, Wiley Dreamtech India Pvt Ltd.,

DESIGN AND DRAWING OF IRRIGATION STRUCTURES (1:0:2)

Sub Code :	**CV0207**	**CIE : 50% Marks**
Hrs/Week :	**1+0+2**	**SEE : 50% Marks**
SEE Hrs :	**03 Hrs**	**Max. Marks : 100**

Course Outcomes

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

1. *Visualize and sketch the components of the various irrigation structures.*
2. *Apply principles of Hydraulics and Empirical formula for design of the important components.*
3. *Prepare detailed drawings of major hydraulic structures associated with irrigation.*

List of Irrigation Structures

1. Irrigation Systems: Components and layout Major drawing – (minor) weirs, bunds, retaining walls, piers, abutments and wing walls, combination of components; cross section of canals; Stream sections. **2+4 Hrs**
2. Reservoirs and Spillways – Surveys, Energy dessipation; design of ogee spillway. **1+2 Hrs**
3. Diversion Head Works: Design of weirs; concrete floor on permeable foundations, Bligh's theory. Major Drawing – Surplus weir. **3+6 Hrs**
4. Concrete Dams: Theory of forces acting, stability and stresses etc., preliminary design. **2+2 Hrs**

5. Earthen Dams: Sections, Construction, Seepage analysis, drainages and filters, Sluice, Tank sluice (Major Drawing). **2+4 Hrs**

6. Canals - Sections, Design (Kennedy's an Lacey's theory) Major Drawing – Cross regulator. **2+4 Hrs**

7. Canal structures – introduction to design of canal drop, Minor structures. **2+4 Hrs**

8. CD works-types, design of an Aquaduct.

Note: Major drawing will be done to the given data.

Text Book

1. Arora KR **"Irrigation Water Power & Water Resources Engineering"-** - Standard Publishers Distributors – 2010.

Reference Books

1. C Satyanarayana Murthy **"Water Resources Engineering: Principles and Practice"** - New Age International Publishers - 2000.

2. B.C. Punmia and PandeLal, **"Irrigation and Water Power Engineering"** - Laxshmi Publications, New Delhi – 2009.

DESIGN OF RC STRUCTURES (3:2:0)

Sub Code :	**CV0428**	**CIE : 50% Marks**
Hrs/Week :	**3+2+0**	**SEE : 50% Marks**
SEE Hrs :	**03 Hrs**	**Max. Marks : 100**

Course Outcomes

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

1. *Design singly and doubly reinforced sections.*
2. *Design shallow foundations, water tank and retaining wall.*

Unit - I

Design of Beams

Introduction, Anchorage of bars, Reinforcement requirements, Slenderness limits, Design procedure, Design of cantilever beams, Design of simply supported beams, Design of lintels. **10 Hrs**

Self Learning Exercise: *Design of continuous beams.*

Unit- II

Design of Slabs

Introduction, Classification based on support condition, Design of Cantilever slabs, and Design of one way slab, Design of simply supported two way slab, Design of one way and two way continuous slabs. **5 Hrs**

Self Learning Exercise: *Inclined slabs, filler slabs.*

Unit- III

Design of Stairs

Introduction, Classification, Loadings, waist slab type. **5 Hrs**

Self Learning Exercise: *Tread-Raiser type stairs.*

Unit - IV

Design of Shallow Foundations

Introduction, Classification, Types, Soil design consideration, Isolated footings-wall footings, axially loaded pad and sloped footings, Combined footings- For two axially loaded columns.

Self Learning Exercise: *Eccentrically loaded footings & strap and strip footings.* **6 Hrs**

Unit - V
Design of Retaining Walls

Introduction, Types of Retaining wall, Design of Cantilever retaining walls. **8 Hrs**

Self Learning Exercise: *Design of Counter fort retaining walls*

Unit- VI
Design of Water Tanks

Introduction, Design considerations, Design of tank resting on ground-Circular tanks. **8 Hrs**

Self Learning Exercise: *Design of tank resting on ground - Rectangular tanks.*

Text Book

1. Dr. H.J.Shah, **"Reinforced Concrete, Vol-1 and Vol-2 Charotar"**, 8th Edition, 2009 and 6th edition - 2012 respectively.

Reference Books

1. S.Unnikrishna Pillai and Devdas Menon, **"Reinforced Concrete Design"**, TMH, 3rd Edition - 2009
2. **Bureau of Indian Standards** - IS 456-2000, SP16, SP34
3. Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "**Limit State Design of Reinforced Concrete"**, Lakshmi Publications, 1st Edition - 2007
4. P.C.Varghese, **"Limit State Design of Reinforced Concrete"**, PHI, 2nd Edition - 2009
5. J.N. Bandoyopadhyay, **"Design of Concrete Structures",** PHI, 1st Edition - 2008.
6. M. L. Gambhir, **"Design of Reinforced Concrete Design",** PHI,1st Edition - 2006

7. Dr.Ram Chandra and Virendra Gehlot, **"Elements of Limit State Design of Concrete Structures"**, Scientific Publishers, 1st Edition - 2004

8. N.Krishna Raju and R.N.Pranesh, **"Advanced Reinforced Concrete Design, CBS Publishers"**, 2nd Edition - 2005

9. S.N.Sinha, **"Reinforced Concrete Design"**, TMC, 2nd edition - 2002

10. Ashok. K. Jain : **"Reinforced Concrete Limit State Design"**, Nem Cahnd and Bros, 6th Edition - 2010

APPLIED GEOTECHNICAL ENGINEERING (3:2:0)

Sub Code :	**CV0429**	**CIE : 50% Marks**
Hrs/Week :	**3+2+0**	**SEE : 50% Marks**
SEE Hrs :	**03 Hrs**	**Max. Marks : 100**

Course Outcomes

Upon completing the course, the student will be able to:

1. *Decide the field and laboratory investigations to be conducted for civil engineering structures.*
2. *Estimate the lateral earth pressure and vertical stresses in the soils subjected to external loads.*
3. *Evaluate the bearing capacity and estimate the magnitude of settlement for shallow foundations.*
4. *Decide the various techniques to be adopted for ground improvement techniques.*

Unit- I

Sub Surface Exploration & Drainage and Dewatering

Sub Surface Exploration

Purpose of exploration, Planning and stages in subsurface exploration, Methods of exploration: Open excavation, Boring, sounding tests, geophysical methods – Electrical resistivity and Seismic refraction methods. Types of samples, Samplers. & reporting, features affecting the sample disturbance, Typical bore log, Soil exploration report.

Drainage and Dewatering

Introduction, Water table location in coarse grained and fined grained soils, Determination of ground water level by Hvorslev method, Dewatering –Electro osmosis method. **9 Hrs**

Self Learning Exercise: *Ditches and sumps, well point systems, shallow and deep well system, vacuum method.*

Unit- II

Vertical Stresses in Soils Due To External Loads

Introduction, Boussinesq and Westergaard's theories for concentrated, circular & rectangular loads, Comparison of

Boussinesq and Westergaard theories, Newmark's chart. **6 Hrs**

Self Learning Exercise: *Isobar & Pressure bulb, Contact pressure.*

Unit- III

Earth Pressure Theories

Introduction, Different types of earth pressure, Rankine's earth pressure theory - Assumptions and limitations, Lateral earth pressure distribution for cohesionless and cohesive soils.

Coulomb's theory of earth pressure – Assumptions and limitations, Culmann's graphical methods for active earth pressure. **6 Hrs**

Self Learning Exercise: *Rebhann's Graphical methods for active earth pressure (Cohesionless soil only).*

Unit- IV

Stability of Earth Slopes

Introduction, Slopes – Types, Causes, Types of failures, Definition of factor of safety, Stability analysis of Infinite slopes, Stability analysis of finite slopes by method of slices, friction circle method and Taylors stability number. **6 Hrs**

Self Learning Exercise: *Fellinious method*

Unit - V

Bearing Capacity

Definitions of ultimate, net and safe bearing capacities, Allowable bearing pressure. Terzaghi's and Brinch Hansen's bearing capacity equations- assumptions and limitations bearing capacity of footing subjected to eccentric loading. Effect of ground water table on bearing capacity. Standard penetration test, cone penetration test.

6 Hrs

Self Learning Exercise: *Estimation of bearing capacity by Plate load test*

Unit - VI

Foundation Settlement

Concept, immediate, consolidation and secondary settlement (no derivations), Tolerance. BIS specifications for total and differential settlement of footings ands rafts.

Reinforced Earth

Introduction, component and application of reinforced earth, Basic mechanism of reinforced earth, Choice of soil, Reinforcement – metal reinforcement , geotextiles , geogrids, geomembranes and geo composites.

Ground Improvement Techniques

Introduction, objectives of ground improvements. Commonly used methods of ground improvements – (sand piles and lime piles).

9 Hrs

Self Learning Exercise: *Stone column, micro piles, vibroflotation & preloading, compaction piles.*

Text Book

1. Dr. B. C. Punmia **"Soil mechanics & foundations"**- Laxmi Publications Co., 16th Edition, New Delhi – 2014.

Reference Books

1. VNS Murthy, **"Soil Mechanics and Foundation Engineering"** - UBS Publishers & distributors, 1st Edition, New Delhi – 2001.
2. Gopal Ranjan & ASR Rao, **"Basic and applied soil mechanics"** - New Age International (p) Ltd., New Delhi – reprint edition 2013.
3. S.K. Garg, **"Soil Mechanics and Foundation Engineering"** Khanna Publishers – 8th edition, 2012.
4. Braja M. Das, **"Principles of Geotechnical Engineering"** cengage learning 2nd Edition, India – 2014.
5. Iqbal. H. Khan, **"Text book of Geotechnical Engineering"** PHI, 3rd Edition, India- 2012.

6. Venkataramaiah .C., **"Geotechnical Engineering"** - New Age International (p) Ltd., 4th Edition, New Delhi – 2013.

7. Dr. K.R. Arora, **"Soil Mechanics and Foundation Engineering"** Standards Publishers & Distributors 7th edition – 2014.

DETAILING OF RC STRUCTURES (1:0:2)

Sub Code :	**CV0208**	**CIE : 50% Marks**
Hrs/Week :	**1+0+2**	**SEE : 50% Marks**
SEE Hrs :	**03 Hrs**	**Max. Marks : 100**

*** Drawing**

Course Outcome

1. *Create structural drawings of different components of the buildings.*

List of Drawings

1. **Beams:** Cantilever beams, simply supported beams.
2. **Slabs:** Cantilever slabs, one way slab, simply supported two way slab, one way and two way continuous slabs.
3. **Stairs:** waist slab, Tread-Raiser type stairs.
4. **Columns and Shallow Foundations:** Columns, Isolated footings-wall footings, axially loaded pad and sloped footings, Combined footings, Eccentrically loaded footings & strap and strip footings.
5. **Retaining Walls:** Retaining wall, Cantilever retaining walls, Counter fort retaining walls.
6. **Water Tanks:** Tank resting on ground-Circular tanks, resting on ground - Rectangular tanks.

HIGHWAY MATERIAL TESTING LAB (0:0:3)

Sub Code :	**CV0113**	**CIE : 50% Marks**
Hrs/Week :	**0+0+3**	**SEE : 50% Marks**
Total (CIE + SEE): 100		

Course Outcomes

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

1. *Evaluate highway materials and interpret the results for design and construction of highways.*

List of Experiments Tests on Aggregates

Specific gravity, sieve analysis, abrasion test, bulking, absorption, Impact test, crushing test, Flakiness Index, Elongation Index and

Angularity Number, proportioning of materials by Rothfutch's method

Tests on Bitumen

Ductility, Softening Point, Flash and Fire Point, Specific Gravity, Penetration Test and Viscosity, Marshall Stability Test

Tests on Bricks and Tiles

Absorption and strength tests

Tests on Soils

California Bearing Ratio Test

Text Book

1. Khanna S K, Justo C E G and Veeraragavan A, **"Highway Materials and Pavement Testing"**, published by Nem Chand & Bros., Civil Lines, Roorkee, 5th Edition 2009.

COMPUTER APPLICATION LABORATORY (0:0:3)

Sub Code : CV0114 **CIE : 50% Marks**

Hrs/Week : 0+0+3 Hrs **SEE : 50% Marks**

Total (CIE + SEE): 100

Course Outcome

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

1. *Use commercially available software for analysis & design of structures;*
2. *Develop Excel sheet to analyze and design of RCC elements and estimation of buildings.*

List of Exercises

1. **Use of Structural Analysis software**

   To use STAAD.Pro software for:

   i) Analysis of beams, 2D Frames and 2D trusses

   ii) Analysis and design of 3D RCC frames (up to 4 x 4 grids and 4 storeys) subjected to deadload, live load, wind load and earthquake load. **14 Hrs**

2. **Application of Spread sheet to Civil Engineering Problems**

   Development of Excel sheet for the following civil Engineering problems

   i) Structural Engineering: Analysis of beams, design of RCC elements

   ii) Quantity Surveying: Preparation of Estimation using the given data **14 Hrs**

Reference Books

1. Bentley, **"STAAD.Pro Manual"**
2. Munir Hamad, **"Using STAAD.Pro 2006"**, Shroff publishers and Distributors

3. M.A.Jayaram, D.S.Rajendra Prasad, **"A referral on CAD Laboratory"**, Sapna Publications

4 Ramesh Bangia, Learning Excel 2002, Khanna Book Publishing Co (P) Ltd.,

5. Mathieson SA, **"Microsoft Excel"**, Starfire publishers.

MINOR PROJECT

Sub Code : CV0115 **CIE : 50% Marks**

Hrs/Week : 0+0+6 Hrs **SET : 50% Marks**

RESEARCH PROJECT

Course Outcome

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

1. Develop research methodologies and pursue research.

COURSE DESRCRIPTION

The research project is intended to be offered to the interested students in order to inculcate research attitude and develop skills. Each student will have a faculty member as a guide. The students will work on a live problem, preferably research oriented in VI semester and the report shall be submitted before the closure of the term. The project will be evaluated at the end of VI semester.

QUANTITY SURVEYING AND ESTIMATION (4:0:0)

Sub Code :	**CV0413**	**CIE : 50% Marks**
Hrs/Week :	**4+0+0**	**SEE : 50% Marks**
SEE Hrs :	**03 Hrs**	**Max. Marks : 100**

Course Outcomes

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

1. *Compute bill of quantities for Civil Engg. Structures by different methods.*
2. *Calculate financial estimate of Civil Engg. Structures.*
3. *Prepare rate analysis of Civil Engg. Components.*
4. *Prepare detail specifications for different Civil Engineering work.*

Unit – I Introduction

Different type of estimates, various types of drawings required for preparation of estimates, units of measurement. **4 Hrs**

Self Learning Exercise: *Important terms used in estimates.*

Unit – II Specifications

Definition of specifications, objective of writing specifications, General specifications. **6 Hrs**

Self Learning Exercise: *Detail specifications of general items of works in buildings.*

Unit – III
Rate Analysis

Definition, purpose, working out data procedure for quantities and rates of cement concrete of different mixes, Brick and size stone masonry, Flooring, plastering, painting, form work for different RCC items. **10 Hrs**

Self Learning Exercise: *Doors, windows & ventilators, various types of claddings.*

Unit – IV

Quantity Surveying

Methods of estimating the quantities of earthwork excavation, masonry structures, plastering work, concrete works. **6 Hrs**

Self Learning Exercise: *Form work.*

Unit – V

Estimation of Buildings & Civil Engineering Structures

Methods of taking out quantities – centre line method, long wall - short wall method and crossing method, preparation of detailed and abstract estimates for Residential buildings, (Two bed room and three bed room house, GF and FF). **20 Hrs**

Self Learning Exercise: *Framed structure with flat & sloped roof.*

Unit – VI

Estimation of Civil Engineering Structures

Septic tank & manhole. **6 Hrs**

Self Learning Exercise: Masonry structures.

Text Book

1. B.N. Dutta, **"Estimating and Costing in Civil Engineering Theory and Practice"**– 2010.

Reference Books

1. M. Chakroborti, **"Estimating, Costing & Specifications in Civil Engineering"**– 24th edition, 2010
2. S.C.Rangawala, **"Valuation of Real Properties"**, Charotar Publishing House – 9th edition, 2013.
3. K.K. Chitkara, **"Construction project management"**, Tata Mc Graw –Hill – 2014.

DESIGN OF STEEL STRUCTURES (4:0:2)

Sub Code :	**CV0504**	**CIE : 50% Marks**
Hrs/Week :	**4+0+2* Hrs**	**SEE : 50% Marks**
SEE Hrs :	**03 Hrs**	**Max. Marks : 100**

***Drawing**

Course Outcomes

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

1. *Relate the principles of the limit state method of design & design different types of Connections.*
2. *Design tension members, compression members, different types of column bases and Beams.*
3. *Interpret the drawing related to steel structures & prepare the detailing.*

Unit-I Introduction

Advantages and Disadvantages of Steel structures, Loads and Load combinations, Design considerations, Limit State Method (LSM) of design, Failure criteria for steel. **4 Hrs**

Self Learning Exercise: *Codes and Specifications, Section classification.*

Unit-II
Bolted Connections

Introduction, Behaviour of Bolted joints, Design strength of ordinary Black Bolts, Design strength of High Strength Friction Grip bolts (HSFG), Pin Connections, Simple Connections, Moment resistant connections, Beam to Beam connections. **10 Hrs**

Self Learning Exercise: *Beam and Column splices, Semi rigid connections.*

Unit-III

Welded Connections

Introduction, Welding process, Welding electrodes, Advantages of Welding, Types and Properties of Welds, Types of joints, Weld symbols, Weld specifications, Effective areas of welds, Design of welds, Simple joints, Moment resistant connections, Continuous Beam to Column connections, Continuous Beam to Beam connections. **8 Hrs**

Self Learning Exercise: *Beam Column splices, Tubular connections.*

Unit-IV

Design of Tension Members

Introduction, Types of tension members, Design of strands, Slenderness ratio, Behaviour of tension members, Modes of failure, Factors affecting the strength of tension members, Angles under tension, other sections, Design of tension member, Lug angles.

Design of Compression Members

Introduction, Possible failure modes, Slenderness Ratio, Behaviour of compression members, Elastic buckling of slender compression members, Sections used for compression members, Effective length of compression members, Design of compression members. **13 Hrs**

Self Learning Exercise: *(i) Splices, Gussets (ii) Built up compression members.*

Unit-V

Design of Column Base

Introduction, Types of column bases, Slab base, Gusset base, Design of moment resisting base plate. **8 Hrs**

Self Learning Exercise: *Foundation bolts.*

Unit-VI

Design of Beams

Introduction, Beam types, Lateral stability of beams, Behaviour of beams in bending, Design of laterally supported and laterally unsupported beams, Maximum deflection. **9 Hrs**

Self Learning Exercise: *Design of purlins, Introduction to concept of pre – engineered structures.*

Detailing of Steel Structures (Drawing Component)

Students are required to draw detailing using the design data of Bolted connections, Welded connections, Columns and Column base, roof trusses

Text Book

1. S.K.Duggal, **Limit state Design of steel Structures**, Tata McGraw Hill, 2010.

Reference Books

1. N. Subramanian, **Design of Steel Structures**, Oxford Publications, 2008

2. Dr.Ramachandra & Virendra Gehlot, "**Limit State Design of Steel structures**", – Scientific Publishers, 2012

3. M.R.Shiyekar, **Limit State Design in Structural Steel**, PHI, 2010

4. Dr.V.L.Shah & Prof Veena Gore, **Limit State Design of Steel Structures**, Structure Publications, 2009

5. S.S.Bhavikatti, **Design of Steel Structures**, I.K. International publishing house, 2009

6. D.S.Rajendra Prasad, **Design of Steel Structures**, Sapna Book House, 2010

7. Abraham J.Rokach, **Theory and Problems of Structural steel Design**, Mc Graw Hill, 1991

8. Bureau of Indian Standards, **IS 800-2007, IS875-1987** SP- 6 (1) or "**Steel Tables**"

PAVEMENT EVALUATION AND MANAGEMENT (3:0:0)

Sub Code : CV0316	**CIE : 50% Marks**
Hrs/week : 3+0+0	**SEE : 50% Marks**
SEE Hrs : 3 Hrs	**Max. Marks : 100**

Course Outcomes

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

1. *Describe various pavement distresses and to evaluate the surface condition;*
2. *Describe pavement structure and to evaluate the structural condition;*
3. *Design and detail the pavement overlays and to apply the expert systems for pavement management.*

Unit -I

Introduction

Structural and functional requirements of flexible and rigid pavements; pavement distress; different types of failures, causes and remedial measures. **3 Hrs**

Pavement Surface Condition

Various aspects of surface and their importance; factors affecting deterioration and measures to reduce: (i) Pavement slipperiness (ii) Unevenness (iii) Ruts, pot holes and cracks. **4 Hrs**

Self Learning Exercise: *Maintenance measures to reduce pavement distresses*

Unit -II

Evaluation of Surface Condition

Methods of measurement of skid resistance using portable and dynamic methods, unevenness, ruts and cracks. Pavement surface condition evaluation by physical measurements by Profilograph, 5th wheel Bump Integrator, ROMDAS and other methods and their applications; Micro paver and applications. **7 Hrs**

Self Learning Exercise: *Standards for surface condition*

Unit -III

Pavement Structure

Factors affecting structural condition of flexible and rigid pavements; effects of subgrade soil, moisture, pavement layers, temperature, environment and

traffic on structural stability, Pavement deterioration.
7 Hrs
Self Learning Exercise: *Basic Structural Response Models*

Unit -IV
Evaluation of Pavement Structural Condition
Evaluation by non-destructive tests such as FWD, Benkelman Beam rebound deflection, Plate load test, wave propagation and other methods. Evaluation by destructive test methods, and specimen testing.
7 Hrs
Self Learning Exercise: *Structural Capacity Index Concepts*

Unit -V
Overlay Design
Design of Flexible overlay over flexible pavement by Benkelman beam deflection and other methods, flexible overlays and rigid overlays over rigid pavement. Use of geosynthetics in pavement overlays, fiber reinforced concrete overlays **7 Hrs**
Self Learning Exercise: *Rigid overlays on deteriorated flexible pavements*

Unit -VI
Pavement Management
Components of pavement management systems, pavement maintenance measures, planning investment, research management, Pavement Preservation Programmes, Techniques and Tools. **3 Hrs**
Expert Systems and Pavement Management
Role of computers in pavement management, applications of expert systems for managing pavements, expert system for pavement evaluation and rehabilitation, knowledge-based expert systems, case studies. **4 Hrs**
Self Learning Exercise: *Application of HDM and other pavement software*

Text Book

1. Ralph Haas and Ronald W. Hudson, **"Pavement Management System"**, McGraw Hill Book Co, 1978.

Reference Books

1. Yoder E.J. and Witczak, **"Principles of Pavement Design"**, II Edition, John Wiley and Sons, 1975.
2. Babkov, **"Road Conditions and Traffic Safety"**, Mir Publications, 2002.

3. David Croney, **"The Design and Performance of Road Pavements"**, HMSO Publications, 1977.
4. HRB/TRB/IRC/International Conference on "**Structural Design of Asphalt Pavements"**.
5. Ralph Haas, Ronald Hudson and Zanieswki, **"Modern Pavement Management**", Kreiger Publications, 1994.
6. Khanna and Justo, **"Highway Engineering"**, Nemchand and Bros., Civil Lines, Roorkee, India, 2001.
7. Khanna, Justo and Veeraragavan, "**Highway Materials and Pavement Testing"**, Nemchand and Bros., Civil Lines, Roorkee, India, 2000.

CONCRETE AND NDT LABORATORY (0:0:3)

Sub Code : CV0121	**CIE : 50% marks**
Hrs/Week: 0+0+3	**SEE: 50% marks**
SEE Hrs : 03 Hrs	**Max. Marks: 100**

Course Outcomes

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

1. *Conduct tests on cement, aggregates, wet and dry concrete.*
2. *Use NDT equipments for assessing strength of existing structures.*

Lab Experiments

1. Test on Cement
   Normal Consistency, Setting Time, Compressive strength, Specific Gravity, Fineness of Cement (By dry sieveing),
2. Test on Aggregates (c/a & f/a)
   Sieve analysis, specific gravity, water absorbtion, bulk density for river and M-sand
3. Mix Design and Workability Tests

Slump test, compaction factor, Vee-Bee apparatus test.

4. Tests on Hardened Concrete
   Compressive strength, split tensile test.
5. Rebound Hammer Test
6. Ultrasonic Pulse Velocity Test
7. Determination of Extent of Corrosion in RC Elements
8. Rebar Locator
9. Modulus of Rupture on Plain Cement Beam and Measurement of Strain

References

1. IS 10262-1981 (RA 1989) : Recommendation guidelines of concrete mix design
2. SP 23 (S&T)-1982 Hand book on concrete mixes
3. IS 456 – 2000 : code of practice for plain & reinforced concrete
4. IS 516-1959 (RA 1991) : Method of test for strength of concrete
5. IS 13311 (part – 1) 1992 : Ultrasonic Pulse Velocity
6. IS 13311 (Part 2) 1992 : Rebound Hammer Test
7. N. Krishna Raju, **" Design of Concrete Mixes"**, CBS Publishers & distributors, Delhi 2010
8. Neville A. M., **" Properties of Concrete"**, Pitman Publishers-2009.

CONSTRUCTION AND PROJECT MANAGEMENT (4:0:0)

Sub Code :	**CV0415**	**CIE : 50% Marks**
Hrs/Week :	**4+0+0 Hrs**	**SEE : 50% Marks**
SEE Hrs :	**03 Hrs**	**Max. Marks : 100**

Course Outcomes

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

1. *Develop various construction schedules and work break down structure;*
2. *Assess & evaluate construction equipment schedules at sites;*
3. *Prepare project scheduling and cost controlling techniques.*
4. *Adopt available tools of total quality management for various Civil Engineering projects.*

Unit – I Introduction

Need, objectives and functions of construction management, organizational chart for a construction company, Duties and responsibilities of project manager, public relation, leadership,
team work. **2 Hrs**

Self Learning Exercise: *Delegation of authority and accountability.*

Unit – II
Construction planning

Necessity of planning and scheduling, various stages in planning, various construction schedule like material schedule, labour

schedule, money schedule and machinery schedule,– Bar chart, CPM, PERT, Formulation and time computation. **16 Hrs**

Self Learning Exercise: *Project monitoring and evaluation*

Unit – III Cost Control

Different types of project cost, total project cost and optimum duration, contracting the network for cost optimization.

Financial management

Introduction, Role, Goals, objectives, functions of financial management, Types of capital, Capital investment decision management of assets. **13 Hrs**

Self Learning Exercise: *Financial analysis.*

Unit – IV

Construction equipments

Introduction, factors to be considered for selection, rent and lease of equipments, various earth moving equipments, cost of owning and operating construction equipments. **8 Hrs**

Self Learning Exercise: *Compaction equipments*

Unit – V

Introduction to departmental procedures

Types of contract, control agreement tender, earnest money deposit, security deposit, tender forms, comparative statements, administrative approval, technical sanction, nominal master roll, measurement book, method of recording bills, check measurements, preparation of bills. Types of contract. **6 Hrs**

Self Learning Exercise: *Swiss mode of contract, BOT, BOOT, PPP.*

Unit – VI

Introduction to total quality management

Introduction, Definitions, Tools for quality control, Elements of quality management, requirements, Aims and ways of TQM.

Quality circle, Quality system standards. **7 Hrs**

Self Learning Exercise: *BIS certification of quality system, quality system requirements.*

Text Book

1. K.K. Chitkara, **"Construction project management"**, 2014, Tata McGraw-Hill.

Reference Books

1. Jack R.Merdith & Samul J.Mantel, **"Project Management-a managerial approach"**, 8th Edition, Wiley India, 2014.
2. J.O.Brien, **"Construction Management"**, 7th edition, McGraw Hill, 2009.
3. J.M.Antill & R.W.Woodhead, **"Critical Path Methods in Construction"**, 4th edition, Wiley – 1990.
4. B.C. Punmia & K. K. Khandelwal, **"Project Planning and control with PERT and CPM PWD",** 4th edition, Laxmi publication, 2015.
5. Sathyanarayana B.J and Subash C. Saxena**, "Construction Planning & Equipment",** Standards Publishers & Distributors New Delhi. – 2009.
6. **"Construction planning Perrifoy equipment & methods"**, Tata McGraw-Hill, 7th edition, 2010.

PRESTRESSED CONCRETE STRUCTURES (4:0:0)

Sub Code : CV0436	**CIE : 50% Marks**
Hrs/Week : 4+0+0	**SEE : 50% Marks**
SEE Hrs : 04 Hrs	**Max. Marks : 100**

Course Outcomes

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

1. *Characterize the materials to be used and identify the basic principles of Pre-stressed Concrete and Analyze the PSC sections for flexure.*
2. *Calculate loss of prestress and estimate the deflections of PSC Members.*
3. *Design PSC beams using concept of limit state.*

Unit-I

Introduction

Basic concepts of Prestressing, Historical Development, Need for High Strength steel and Concrete, Terminology.

Material for Prestressed Concrete

High-Strength Concrete, High Tensile Steel. **10 Hrs**

Self-Learning Exercise: *Advantages of Prestressed Concrete, Applications of Prestressed Concrete.*

Unit-II

Prestressing systems

Introduction, Tensioning Devices, Pretensioning Systems, Post-Tensioning Systems.

Analysis of Prestress and Bending Stresses

Basic Assumptions, Analysis of prestress, Resultant Stresses at a section, Pressure line or thrust line and internal resisting couple, concept of load balancing, stressin tendons, cracking moment.

10 Hrs

Self-Learning Exercise: *Thermo-Electric Prestressing, Chemical Prestressing.*

Unit-III

Losses of Prestress

Nature of losses of prestress, loss due to elastic deformation of concrete, loss due to shrinkage of concrete, loss due to creep of concrete, loss due to relaxation of stress in steel, loss of stress due to friction, loss due to anchorage slip **8 Hrs**

Self-Learning Exercise: *Total losses allowed for in design.*

Unit-IV

Deflections of Prestressed concrete Members

Importance of control of Deflections, Factors Influencing deflections, Short-term deflections of uncracked members, Prediction of long time deflections, deflections of cracked members, Requirements of various codes of practice. **8 Hrs**

Self-Learning Exercise: *Load verses deflection curve, methods of reducing deflection.*

Unit-V

Limit State Design Criteria for Prestressed concrete Members

Introduction, Inadequacies of the Elastic and ultimate Load methods, Philosophy of Limit-State design**,** Criteria for Limit States, Design loads and strengths, Strength and serviceability limit states, Design loads and strengths, strength and serviceability limit states, crack widths in prestressed members. **8 Hrs**

Self-Learning Exercise: *Principles of dimensioning prestressed concrete members*

Unit-VI

Design of prestressed concrete sections

Design of sections for flexure, design of sections for axial tension, design of sections for compression and bending, design of prestressed sections for shear and torsion.

Self-Learning Exercise: *Design of prestressed members for bond, design of prestressed members for bearing* **8 Hrs**

Text Book

1.N. Krishna Raju, **"Pre-stressed Concrete"**, Tata mc. Graw Hill Publishers.-4th edition.- 2015

Reference Books

1. T.Y. Lin and Ned H. Burns, **"Design of pre-stressed concrete structures"**, John Wiley & Sons, NewYork.–3rd edition, 1981.
2. N.C. Sinha and S.K. Roy, **"Fundamental of pre-stressed concrete"**, S.Chand, 1994.
3. **IS -1343:2012**, Prestressed Concrete – code of practice.
4. N. Rajgopalan, **"Pre-stressed Concrete"**, Narosa Publishing House, 2008.
5. P. Dayarathnam, **"Pre-stressed Concrete"**, Oxford and IBH Publishing Co. 1996.

ADVANCED R.C.C. STRUCTURES (3:0:0)

Sub Code :	**CV0314**	**CIE : 50% Marks**
Hrs/Week :	**3+0+0**	**SEE : 50% Marks**
SEE Hrs :	**03 Hrs**	**Max. Marks : 100**

Course Outcomes

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

1. *Identify the failure mechanism of slabs under various conditions and analyze the same.*
2. *Design the various types of slabs.*
3. *Design shear wall.*
4. *Analyze the behavior of multistoried buildings under gravity and lateral loads.*

Unit – I

Yield line Analysis of Slabs by Virtual Work Method

Introduction, assumption, locations of yield lines method of analysis. Analysis of one-way slab, work done by yield line moments, Analysis of two-way slab. **5 Hrs**

Self Learning Exercise: *Non rectangular slabs*

Unit – II

Yield line Analysis of Slabs by Equilibrium Method.

Method of analysis. Analysis of one-way slab, work done by yield line moments, Analysis of two-way slab. **5 Hrs**

Self Learning Exercise: *Non rectangular slabs*

Unit – III

Design of Grid Floors, Ribbed and Waffled Slab

General features, proportioning of components, Analysis of grid floors, Design of grid floors. **10 Hrs**

Self Learning Exercise: *Design of ribbed and waffled slab.*

Unit – IV

Design of Flat Slabs (With & Without Drops) by Direct Design Method

Introduction, Advantages and disadvantages, Column and middle strips, Proportioning of flat slab elements, Limitations of direct design method, Distribution of moments, Design for shear and moments, Design of interior panel. **10 Hrs**

Self Learning Exercise: *Design of exterior panel.*

Unit – V

Design of Shear Walls

Introduction, classification of Shear walls, Loads in Shear Walls, Design considerations, Design of rectangular walls. **8 Hrs**

Self Learning Exercise: *Flanged Shear Walls.*

Unit –VI

Multi-storey Buildings

Introduction to structural systems, tall buildings. **4 Hrs**

Self Learning Exercise: *Gravity loads, lateral loads.*

Text Book

1. Dr. H.J.Shah, **Reinforced Concrete, Vol-1 and Vol-2 Charotar**, 8th Edition, 2009 and 6th Edition, 2012 respectively

Reference Books

1. S.Unnikrishna Pillai and Devdas Menon, **"Reinforced Concrete Design"**, TMH, 3rd Edition, 2009.
2. **IS 456, SP16, SP34**.
3. Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, **"Limit State Design of Reinforced Concrete"**, Lakshmi Publications, 1st edition, 2007.
3. P.C.Varghese, **"Limit State Design of Reinforced Concrete"**, PHI, 2nd Edition, 2009.

CONSTRUCTION SURVEYING (1:2:0)

Sub Code : CV0211 **CIE : 50% Marks**

Hours/week : 1+2+0 **SEE : 50% Marks**

SEE Hrs : 2 Hrs **Max. Marks: 50**

Course Outcomes

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

1. *Understand and follow the procedures required for setting out works*
2. *Apply horizontal and vertical control techniques for setting out operations*

Unit - I

Introduction

Construction surveying, role of surveying in civil engineering practice, typical responsibilities of a construction surveyor, skills required, Reading maps and drawings, Equipments for construction surveying; Levels, theodolite, total station, GPS, Laser levels

Horizontal control and vertical control, reference grids, base line, offsets, marking control stations, reference pillars, marking corners and lines.

4 Hrs

Self Learning Exercise: *Use of laser level in construction*

Unit-II

Setting out works

Setting out buildings and structures, conventional and coordinate methods, measurement and setting out slopes and grades, pipe lines, controlling and checking verticality in tall structures. **6 Hrs**

Self Learning Exercise: *Care and adjustment/calibration of survey equipments, safety aspects*

Unit -III

Route and Tunnel surveys

Route surveys, alignments, procuring GTS bench marks/establishing DGPS control points. traversing and other surveys.

Tunnels, Surface and underground alignments, transferring surface alignment through vertical shafts, transferring levels, use of laser instruments and laser/total station guided tunnel boring machines. **4 Hrs**

Self Learning Exercise: *Documentation; project documents/drawings, certificates, survey records, photographs*

Text Book

1. A.M. Chandra. **"Higher Surveying"** New Age International Publishers, 2007.

Reference Books

1. James M Anderson, Edward M Mikhail. **" Introduction to Surveying"**, McGraw Hill Publications, 1984.
2. S.K. Roy, ***"Fundamentals of Surveying***", Prentice Hall of India New Delhi, 2009.

DESIGN AND DRAWING OF BRIDGES (1:0:2)

Sub Code : CV0210 **CIE : 50% Marks**

Hrs/Week : 1+0+2 **SEE : 50% Marks**

SEE Hrs : 03 Hrs **Max. Marks: 100**

Course Outcomes

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

1. *Design basic types of bridges and prepare their drawings*

Unit – I

a) Introduction to Bridges

b) Standard Specifications for Road Bridges

General – Indian Road Congress Bridges Code – Width of Carriage way clearances – Loads to be considered – Dead loads – IRC Standard live loads –Application of live loads on deck slab – wind load

c) Design Principles of Bridge Sub-Structures

General – features, piers and abutments – materials, types, forces, design of piers. **5 Hrs**

Self-Learning Exercise: *Concept of moment envelopes for design of bridges*

Unit – II

Design of Bridges

a) Reinforced cement concrete slab culvert
b) Reinforced cement concrete T-beam & slab bridge
c) Pipe culvert
d) Box culvert **36 Hrs**

Self-Learning Exercise: *Principle of design of PSC bridges*

Drawing Component

Preparation of drawing using the data given for

a) RCC Slab Culvert
b) RCC T – Beam and slab bridge
c) Pipe culvert
d) Box culvert

Text Book

1. N.Krishna Raju, **"Design of Bridges"** Oxford & IBH Publishing Ltd. 4th Edition - 2009.

Reference Book

1. Ponnuswamy **"Bridges Engineering"** Tata McGrawHill–2nd Edition, - 2007.

Note: Design classes have to be conducted during 2 hr drawing classes

- Hence 6-8 drawing classes will be utilized for Design purpose only
- Other 6-8 classes are for drawing

Drawings have to be evaluated after every submission –CIE for 25 marks
MSE of Drawing 25 marks
SEE of Drawing for 100 marks scaled down to 50 marks

PROJECT MAJOR (0:0:12)

Sub Code : CV0601 **CIE : 50% Marks**

Hrs/Week : 0+0+12 **SEE : 100% Marks**

Course Outcomes

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

1. *Plan and work out an action plan in a team for completion of a civil engineering problem.*
2. *Prepare documents in team and make individual presentations.*

COURSE DETAILS

The project is offered to the students in order to inculcate research attitude and develop corresponding skills. A group of maximum four students work as a team for major project. Major project could be in the form of experimental investigation, computational work, data collection and its analysis etc. At the end of the major project, a report will be made wherein the details of the work undertaken, methodology adopted, conclusions drawn are provided. Evaluation of the major project is done as per the rubrics.

OPEN CHANNEL HYDRAULICS (4:2:0)

Sub Code: MHY0503 **CIE: 50% Marks**
Hrs/week: 4+2+0 **SEE: 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks: 100**

Course Outcomes

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

1. *Cite the principles of mechanics of open surface flow of fluids , and be able to express these in terms of mathematics.*
2. *Analyze problems associated with flow of water in streams and canals.*
3. *Design canals and associated structures, and*
4. *Adapt research in the field.*

Unit –I

Definition, comparison with pressure flow; discussion on pressure and velocity distributions – Pressure and velocity distribution coefficients. **8 Hrs**

Self Learning Exercise: *Flow Classification.*

Unit -II

Energy principles for prismatic and non-prismatic channels – Specific energy; Critical flow Computations and applications; controls, Transitions. **8 Hrs**

Self Learning Exercise: *Depth variation in different transitions.*

Unit -III

Uniform flow – computation of Uniform flow, applications; best hydraulic sections. **10 Hrs**

Self Learning Exercise: *Design of irrigation canals.*

Unit -IV

Gradually varied flow – theory, the basic equation, various forms; profiles, combination of slopes and sections; computation of gradually varied flow- Direct step method and direct integration methods. **10hrs**

Self Learning Exercise: *software's for gradually varied flow computations.*

Unit -V

Introduction to Rapidly varied flows- Momentum principle; Hydraulic Jump in prismatic channels; uses of hydraulic jump. **8 Hrs**

Self Learning Exercise: *Energy dissipation and stilling basins. Basic Introduction to spatially varied flows and unsteady flows.*

Unit VI

Flow measurement in open channels – Flumes and Weirs; **8 Hrs**

Self Learning Exercise: *Proportional weirs and End - depth measurements.*

Text Books

1. Subramanya, K., **"Flow in open channels"** – TMGH, 2013.
2. Chow, V.T., **"Open channel Hydraulics"** –McGraw Hill, Kogakusha, 2009.

Reference Books

1. Henderson, K.M. , **"Open Channel Flow"**- Mecmillan, 1966
2. Ranga Raju, K.G., **"Flow through open channels"** –TMH 1993.

REMOTE SENSING AND GIS APPLICATIONS IN WATER RESOURCE ENGINEERING (4:0:2)

Sub Code: MHY0507 **CIE: 50% Marks**
Hrs/week: 4+0+2 **SEE: 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks:100**

Course Outcomes

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

1. *Describe and discuss concepts of spatial data and remote sensing.*
2. *Describe and discuss concepts of GIS and GIS functions, and*
3. *Articulate the use of remote sensing and GIS for various application.*

Unit -I

Concepts and foundations of remote sensing

Concept of spatial data, need for spatial data, Data acquisition methods, ground based and image based methods of data acquisition, Definition of remote sensing, remote sensing process, ideal remote sensing system. Principles of electromagnetic remote sensing, electromagnetic energy, electromagnetic spectrum, black body radiation, laws governing electromagnetic radiation, atmospheric effects, scattering and absorption, atmospheric windows, Interaction with earth surface materials, spectral reflectance curves. **10 Hrs**

Self Learning Exercise: *Spectral Library.*

Unit -II

Remote sensing platforms and sensors

Remote sensing platforms, satellites and orbits, geostationary and sun synchronous satellites, earth resource satellites- IRS, LANDSAT,

SPOT, ENVISAT, CARTOSAT, RESOURCESAT, IKONOS etc. Sensors- active and passive sensors, sensor resolutions (spectral, spatial, radiometric and temporal) Creation of remote sensing data, Digital and photographic data. panchromatic, multispectral and hyper spectral data.

8 Hrs

Self Learning Exercise: *Characteristics of Indian and other major earth resource satellites.*

Unit -III

Visual image interpretation and digital image processing

Introduction, Elements of visual image interpretation, equipment

Basics of digital image processing (Brief introduction only): image display and band combinations, true and false color composites. Image pre processing , image histogram, radiometric and geometric corrections, image enhancements, image transforms based on arithmetic operations, image filtering, low pass and high pass filters, edge detection, multi image manipulation, spectral rationing, image fusion

Image classification (Brief introduction only): methods, supervised and unsupervised, accuracy assessment of image classification

10 Hrs

Self Learning Exercise: *Classification of mixed pixels, fuzzy classification.*

Unit -IV

Fundamentals of geographic information system

Introduction, basics of GIS- definition of GIS, components of GIS, GIS work flow, representing spatial data, raster and vector data. Coordinate systems and map projections, datums Spatial data input, Non spatial data.

8 Hrs

Self Learning Exercise: *database models and management (brief introduction only)*

Unit -V

Spatial data analysis

Brief introduction to measurements in GIS, reclassification, georeferencing, map overlays, neighbourhood functions, spatial interpolation, network analysis, DEMs, surface analysis, data retrieval and queries, GIS data modelling, spatial data output.

8 Hrs

Self Learning Exercise: *Common image processing and GIS software.*

Unit -VI

Applications of remote sensing and gis

Introduction, Land use/cover mapping, Urban and regional planning applications, Applications in water resources and management, Environmental applications, Disaster management applications

8 Hrs

Self Learning Exercise: *Agricultural and forestry applications*

Text Books

1. Lillesand T.M., and R.W. Kiefer, "**Remote sensing and Image interpretation"**, 4th edition, John Wiley & Sons – 2012.
2. Manoj K. Arora, R.C. Badjatia, **" Geomatics Engineering"**, Nemichand & Bros. Roorkee – 2011.

Reference Books

1. Mather P.M., **"Computer processing of remotely sensed images: an introduction"**, Wiley. – 1988.
2. Jensen J.R., **"Introductory digital image processing: A remote sensing perspective"**, 2nd Edition, Prentice Hall – 1996.

3. Richards J A., X. Jia, **"Remote sensing digital image analysis: an introduction"**, 3rd Edition, Springer - 1999.
4. Peter A. Burrough & Rachel A. McDonnel **"Principles of geographic information systems"**- (1998), Oxford University press, Great Britain.
5. Chang, **"Geographical Information Systems"** , McGraw Hill Book Co., 2007.

GROUND WATER HYDROLOGY (4:2:0)

Sub Code: MHY0511 **CIE: 50% Marks**
Hrs/week: 4+2+0 **SEE: 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks: 100**

Course Outcomes

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

1. *Identify and describe the hydro-geological characteristics of the groundwater system such as types of aquifers, formation properties etc.*
2. *Calculate and evaluate movement of groundwater with regard to local and regional systems*
3. *Solve for groundwater balances, and*
4. *Describe governing equations and apply mathematical models to the Groundwater Systems for budget calculations and scenario generation.*

Unit-I

Aquifer Properties

Porosity.Specific yield.Storage coefficient. Hydraulic conductivity and its determination (Laboratory Methods, Tracer Tests, Auger hole tests,

Pumping Tests of Wells). Specific retention.Transmissivity.Compressibility of rocks and land subsidence due to ground water withdrawals. Homogeneity and Anisotropy.

8 Hrs

***Self Learning Exercise**: Mechanical energy and Hydraulic head;*

Unit –II

Aquifer systems

Distribution of subsurface water- Zone of aeration and saturation.Types of aquifers- Aquiclude, aquitard, aquifuge, unconfined confined aquifer and leaky aquifer.Partially penetrated aquifers. Recharge and discharge areas. Regional flow system.Base flow.Fluctuation of water table and piezometric surface. **8 Hrs**

***Self Learning Exercise**: Groundwater balance.*

Unit –III

Groundwater movement

Groundwater potential, head and head distribution. Measuring Hydraulic Head with Wells and Piezometers.Darcy's law.Validity of Darcy's law. Water table contours. Flow lines and equipotential lines. Flow net analysis.

8 Hrs

***Self Learning Exercise**: Flow in Fractured Rock.*

Unit –IV

Governing equations

Derivation of general differential equations for groundwater flow-steady state without recharge and with uniform recharge; Governing equations for Transient flow; Derivation of Regional Groundwater Flow equations in unconfined and confined aquifers without recharge-and with uniform recharge in steady state and transient state; Boundary

conditions; Analytical solutions to simple cases: one dimensional steady state flow in a confined aquifer of constant thickness, one dimensional steady state flow in an unconfined aquifer with and without recharge.

10 Hrs

Self Learning Exercise*: Analytical solutions to simple cases: one dimensional steady state flow in a confined aquifer of constant thickness, one dimensional steady state flow in an unconfined aquifer with and without recharge.*

Unit -V

Well hydraulics and determination of parameters

Steady state well hydraulics- analysis of steady radial flow towards a well in confined aquifer, Analysis of unsteady radial flow in wells-unconfined and confined aquifers; pumping tests.

8 Hrs

Self Learning Exercise*: Dupuit Forcheimmer theory and steady radial flow towards a well in an unconfined aquifer.*

Unit –VI

Salt water intrusion

Ghyben-Herzberg theory.Locating the actual interface for a confined aquifer. Prevention and control of sea water intrusion.

Modeling groundwater flow

Introductory ideas about Numerical models, calibration and validation; Sofware for groundwater modeling.

10 Hrs

Self Learning Exercise*: PMWIN; Interactive Groundwater*

Text Books

1. **"Ground Water"**, H.M. Raghunath, Wiley Eastern Limited, New Delhi, 2007.
2. **"Numerical Ground Water Hydrology"**- A.K. Rastogi, - Penram, International Publishing (India), Pvt. Ltd., Mumbai.
3. **"Applied Hydrogeology"**, C.W.Fetter, Prentice Hall, 2013.
4. **"Hydrogeology and Groundwater Modeling"**, Neven Kresic, CRC Press, 2006.

Reference Books

1. R.J.M. De Wiest, **"Geohydrology"**- John Wiley, 1967
2. A. Vermjit, **" Theory of Groundwater Flow"** - MacMillan, 1970
3. M.E.Harr, **" Groundwater and Seepage"** - McGraw Hill, 1962.
4. Raghunath, K.M. **"Ground Water"**- Wiley Eastern, 2007.
5. H. Boluwer, **" Ground water Hydrology"** - McGraw Hill, Kogakusha, 1979
6. **"Ground Water Assessment Development and Management"**, K.R. Karanth, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1987.
7. **"Ground Water Hydrology"**, David Keith Todd, Wiley India Pvt. Ltd., 2005.

HYDROLOGICAL MODELLING (4:0:2)

Sub Code: MHY0518 **CIE: 50%**
MarksHrs/week: 4+0+2 **SEE: 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks: 100**

Course Outcomes

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

1. *Access hydrological data from various sources and organize it for use in planning and research.*
2. *Apply principles of Statistics, Regression and Probability in particular, for analyzing data and extracting information.*
3. *Design simple models to suit the kind of data available and extract knowledge from model results.*
4. *Use commonly available computing tools for analysis of data presentation and information, and*
5. *Apply Statistical principles in Hydrological design, necessary in water resources development.*

Unit -I

Watershed and Data

The catchment, water availability, data collection – rainfall, stream-flow, evaporation, water table; catchment characteristics;

Runoff Relationships

Runoff components; correlation coefficient - significance of; linear regression- Least squares method, Coefficient of determination; curvilinear relations; API & multi-linear regression models, hypothesis testing t-and F-tests; **10 Hrs**

Self Learning Exercise: *Land use and soil data, Confidence limits*

Unit -II

Watershed Modeling

Runoff processes and theories; Concepts of modeling,; modifications to the Curve Number Method – continuously varying CN; Conceptual Models – parametric models with one example; Tests of performance – graphical tests, analytical tests – Coefficient of Efficiency, tests of random errors, parameter optimization – trial and error procedure; example for a quasi-physically based model; inferring from a model, catchment response. **10 Hrs**

Self Learning Exercise: *Recent trends in modeling- introduction to ANN & Low flows.*

Unit – III

The Unit Hydrograph Model

Unit hydrograph theory; Derivation, S-curve and applications, travel time; Catchment response, factors influencing; Synthetic UHG;

10 Hrs

Self Learning Exercise: *Instantaneous UHG;*

Unit -IV

Design Flood

Definition; Methods of calculation and probability studies, extreme value distributions and confidence limits; tests of goodness of fit; rational formula, unit hydrographs, correlation models; reliability studies, regional analysis**;** rainfall frequencies.

10 Hrs

Self Learning Exercise: *PMP, PMF, flood formulae, flood forecasting.*

Unit -V

Stochastic Modeling

Time series, stochastic analysis- components, trend analysis, periodicity and its modeling; stochastic generation – random number generation, Autoregressive models, periodic models, Calibration, validation and applications. **5Hrs**

Self Learning Exercise: *Reservoir capacity.*

Unit -VI

Flood Routing

Definition, methods of reservoir and Channel routing. Geomorphology – channel network, order, length and relief aspects. **8 Hrs**

Self Learning Exercise: *Watershed routing, Horton's Laws.*

Text Books

1. Weissman, (J) W. and others, **"Introduction to Hydrology"**- Harper and Row, 2003.
2. Hann, C.T., **"Statistical methods in Hydrology"**- A.E.W. Press, 1977.
3. Jayarami Reddy, **"Stochastic Hydrology"**- Lakshmi Publications, 2005.
4. Mutreja, K.M., **"Applied Hydrology"**- Tata McGraw Hill Publications, 1987.

Reference Books

1. Putty, M.R.Y., **"Principles of Hydrology"** IK International Pub., New Delhi, 2014.
2. Chow, V.T. and others. **"Applied Hydrology"**- McGraw Hill, 2014.
3. Chow, V.T. **"Handbook of Hydrology"**-, McGraw Hill, 1988.
4. Rao, K.L. **"Water Wealth of India"**- Orient Blackswan, 1979.

5. Subramanya, K. **"Engineering Hydrology"**- Tata McGraw Hill, 2014.
6. Strahler, A.N. and Strahler, A.H. **"Modern Physical Geography"**. John Wiley Pub., 2008.

PIPE NETWORK ANALYSIS (4:2:0)

Sub Code:MHY0505 **CIE: 50% Marks**
Hrs/week: 4+2+0 **SEE: 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks: 100**

Course Outcomes

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

1. Describe Urban Water Distribution Systems and understand the overall processes that are necessary for analysis and planning of urban water systems.
2. Apply Hydraulic concepts and their relationships to problems in water transport in distribution networks;
3. Understand and describe the processes that are necessary for modelling, analysis and planning of water distribution systems.
4. Analyse and configure a pipe network for branched or looped networks.
5. Formulate simulation studies for a designed pipe network.

Unit-I

Urban Water Transport and Distribution Systems

System Purpose; Water Demand; Pipe Systems and Piping Materials; Water Storage; Pumps and Pumping Stations.

5 Hrs

Self Learning Exercise: *Valves and Fire Hydrants; Instrumentation and Control.*

Unit-II

Frictional Head Loss in Pipes

Introduction; Darcy-Weisbach Formula; Nikuradse's Experiments on Artificially Roughened Pipes ;Moody Diagram; Friction Coefficient Relationships; Explicit Relationships for Friction Coefficient; Empirical Formulas-Hazen –Williams Formula, Modified Hazen-Williams Formula, Manning Formula; Comparison of Head Loss Formulas; General Head Loss Formula; Simple Pipe Flow Problems – Determination of Head Loss, Determination of Discharge, Determination of Diameter; Head Loss Due to Uniformly Decreasing Discharge

Minor Head Loss in Pipe

Sudden Enlargement; Gradual Enlargement; Exit; Sudden Contraction; Gradual Contraction; Entrance; Bends and Elbows; Tees; Obstructions; Flow Meters; Valves.

Equivalent Pipes

Introduction; Pipes in Series; Pipes in Parallel

15 Hrs

Self Learning Exercise: *Reduction of Carrying Capacity with Age, Pipes in Series-Parallel; Minor Loss Elements - Datzy-Weisbach Formula, Hazen-Williams Formula, Manning Formula, Equivalent Pipe Lengths.*

Unit-III

Reservoirs, Pumps, and Special Valve

Reservoirs-Impounding Reservoirs, Service and Balancing Reservoirs, Three-Reservoir System, Multiple-Reservoir System; Pumps - System Head-Discharge Curve, Pump Head-Discharge Curve, Head-Discharge Relationship, Characteristic Curves, Pump Combinations;

Types and Parameters

Types of Networks - Serial Network, Branching Network, Looped Network.

Parameters – Configuration, Pipe Lengths, Pipe Diameters, Pipe Roughness Coefficients, Minor Appurtenances, Demand Pattern, Source Supply Pattern, Hydraulic Gradient Levels at Demand Nodes, Hydraulic Gradient Levels at Source Nodes; Labelling Network Elements - Branching Networks, Looped Networks, Parameter Interrelationships , Pipe Head Loss Relationship, Node Flow Continuity Relationship, Loop Head Loss Relationship; Rules Proposed by Bhave

12 Hrs

Self Learning Exercise: *Special Valves - Check Valves, Pressure Reducing Valves, Rules for Solvability of Pipe Networks - Rules Proposed by Shamir and Howard, Rules Proposed by Gofinan and Rodeh, Comparison of Rules;*

Unit-IV

Formulation of Equations

Single-Source Networks with Known Pipe Resistances; Multisource Networks with Known Pipe Resistances;

5 Hrs

Self Learning Exercise: *Inclusion of Pumps; Inclusion of Check Valves; Inclusion of Pressure Reducing Valves, Networks with Unknown Pipe Resistances*

Unit-V

Hardy Cross Method

Method of Balancing Heads - Single-Source Networks with Known Pipe Resistances, Multisource Networks with Known Pipe Resistances, Networks with Pumps and Valves; Method of Balancing Flows - Networks with Known Pipe Resistances,

Newton-Raphson method

Basic Concepts - Single-Variable Function, Multiple-Variable Function; Head Equations - Networks with Known Pipe Resistances **10 Hrs**

Self Learning Exercise: *Modified Hardy Cross Method - Method of Balancing Heads, Method of Balancing Flows, Convergence Problems; Networks with Unknown Pipe Resistances, Networks with Pumps and Valves; Loop Equations - Networks with Known Pipe Resistances, Networks with Unknown Pipe Resistances, Networks with Pumps and Valves;*

Unit-VI

Extended-Period Simulation

Introduction; Iterative Method; Direct Method; Input Data for Hydraulic EPS Modeling; Extended-Period Simulation Setup;

Hydraulic Calibration

Introduction; Steady-State Calibration; EPS Calibration

5 Hrs

Self Learning Exercise: *Types of Extended-Period Simulation Analyses Extended-Period Model Calibration;*

Text Books

1. **"Analysis of Water Distribution Networks"** by Pramod Bhave, R Gupta. Publisher: Narosa Publishing House, 2009.
2. **"Design of Water Supply Pipe Networks"** by Prabhata K. Swamee, Ashok K. Sharma. Publisher: John Wiley & Sons, 2008.

Reference Books

1. **"Water Transmission and Distribution: Principles and Practices of Water Supply Operations"** by Larry Mays. Publisher: American Water Works Association, 2010.
2. **"Introduction to Urban Water Distribution"** by Nemanja Trifunovic. Publisher: Taylor and Francis, 2006.
3. **"Computer Modeling of Water Distribution Systems"**. AWWA MANUAL M32Third Edition. Publisher: American Water Works Association, 2005.
4. **"Problems in Water Distribution-Solved, Explained, and Applied"** by Y. Koby Cohen. Publisher: CRC PRESS, 2002.

DESIGN OF HYDRAULIC STRUCTURES (3:2:0)

Sub Code: MHY0401 **CIE: 50% Marks**

Hrs/week: 3+2+0 **SEE: 50% Marks**

SEE Hrs: 3 Hrs **Max. Marks: 100**

Course Outcomes

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

1. *Judge to select suitable sites for locating different hydraulic structures.*
2. *Estimate forces to be considered for design of hydraulic structures.*
3. *Understand the recommendations made in IS Code, and*
4. *Analyze & design different hydraulic structures.*

Unit I

Dams (general)

Definition, classification of dams, factors governing selection of type of dam, selection of site for dam, preliminary and final investigations of dam sites, problems. **5 Hrs**

Self Learning Exercise: *silent features of important dams of India*

Unit II

Design and Construction of Gravity Dams

Introduction, forces acting on gravity dams, load combinations design, reaction of foundation and distribution of vertical (or normal) stress at the base of dam-middle third rule, principal and shear stresses, modes of failure of dam- stability requirements, quality and strength of concrete and masonry, elementary profile of gravity dam, practical profile of gravity dams, joints, fey and water stops, openings in dams, galleries,

adits, vaults and shafts, temperature control in concrete dams, illustrative examples, problems **12 Hrs**

Self Learning Exercise: foundation treatment

Unit III

Buttress and Arch Dams

Introduction, buttress dams, types of buttress dams, forces on buttress dams, design of flat slab type buttress dams, advantages and disadvantages of buttress dams, arch dams, types of arch dams, forces on an arch dams, problems **6 Hrs**

Self Learning Exercise: design of arch dams

Unit IV

Embankment Dams

Introduction, type of earth dams, foundation of earth dams, design of earth dams, causes and failure of earth dams, safety against overtopping, determination of seepage line, characteristics of seepage line, seepage line where vertical and horizontal permeability differ, flow net, stability of side slopes of earth dam-stability analysis, stability of earth dams - against horizontal shear developed at the base of the dam, stability of foundation of an earth dam against horizontal shear, check for free passage of water through earth dams, safety against piping, protection of upstream slope of an earth dam, protection of downstream slope of an earth dams, measures to control seepage through earth dams and their foundations, typical cross sections of earth dams, design consideration in earthquake regions, illustrative examples, problems **13 Hrs**

Self Learning Exercise: rock fill dams

Unit V

Canals and Canal Structures

Theory and design principles, design of canal sections in alluvial soil and hard rock zones canal inlets and sluices, design examples of regulators and canal falls. **3 Hrs**

Self Learning Exercise: gates maintenance problems

Unit VI

Coastal Structures

Coastal forces, corrosion and related issues, Design principles – onshore and offshore structures.

3 Hrs

Self Learning Exercise: Design storage structures – BGL, GRL Elev.

Text Books

1. Varshney **"Concrete dams"**— Oxford & IBH Publications, 1978
2. S. Sathyanarayana Murthy **"Design of Minor Irrigation & Canal structures"-** New Age Publications , 1990

Reference Books

1. Creager, Justin, Hinds. **"Engineering for Dams (all volumes)"** – Wiley India Publications.

S. K Garg **"Irrigation Engineering"** – Khanna Publications , 2013

ENVIRONMENTAL MANAGEMENT OF WATER RESOURCES
(4:0:2)

Sub Code: MHY0519	**CIE: 50% Marks**
Hrs/week: 4+0+2	**SEE: 50% Marks**
SEE Hrs: 3 Hrs	**Max. Marks: 100**

Course Outcomes

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

1. *Describe quality and quantity issues of ponds, lakes and streams, identify sources of water pollution, effect of pollution and to estimate dissolved Oxygen deficit using water quality models.*
2. *Develop coastal areas with the knowledge of Coastal Zone Regulations, to administer ground water resources, and to assess impact of reservoir projects.*
3. *Devise water availability by planning and designing rain water harvesting and ground recharge structures with the knowledge of traditional water conservation techniques and the application of economic theories for water management.*

Unit-I

Introduction

Sources of water – surface and ground water sources – need for Environmental Management of water sources, environmental acts.

Ponds, Lakes and Tanks

Inflow of sediments and nutrients – process of Eutrophication – effects of Eutrophication – preventive measures – monitoring – restoration of tanks and lakes. **8 Hrs**

Self Learning Exercise: *A case study on restoration of tank*

Unit –II

Streams and Rives

Seasonal and perennial streams – causes of quality deterioration – ill effects – impact on human society – self-purification of streams and rivers – water quality models- monitoring river water quality – control measures to prevent pollution – case studies. **9 Hrs**

Self Learning Exercise: *Ganga Action Plan.*

Unit –III

Seas and Oceans

Seas and Oceans as water sources – pollution due to domestic and industrial effluent discharges – oil spills – effects – need for effective management, coastal zone regulations.

Ground Water Sources

Quality and quantity aspects – pollution of ground water sources – ground water depletion & seawater intrusion – Impact on human society – Management of ground water sources.

9 Hrs

Self Learning Exercise: *Ground water availability in arid and semi arid regions*

Unit –IV

Multi- Purpose Reservoir Projects

Impact assessment of reservoir projects – adverse effects on flora & fauna – water logging – salinity – comparison of small and big dams in terms of economy and effect on environment.

9 Hrs

Self Learning Exercise: *Impact assessment tools and techniques*

Unit –V

Water Conservation

Traditional water conservation techniques: Need for water conservation – scope for waste water recycling and reuse – Rain water Harvesting – Ground water recharge techniques – Farm ponds – Water audit, Design aspects. **9 Hrs**

Self Learning Exercise: *A case study of successful water conservation project*

Unit –VI

Environmental Economics

A brief introduction – externalities – the problem of social cost – measuring the benefits and costs of pollution control – Pigou and Coase theories. **8 Hrs**

Self Learning Exercise*: Development and Sustainability*

Text Books

1. Gilbert M Masters, **"Introduction to Environmental Engineering and Sciences"** - Prentice– Hall Publication, 2008.
2. Sincero and Sincero, **"Environmental Engineering"**- Prentice – Hall Publication, 1996.
3. Metcelf & Eddy, **"Waste water Engineering"** - Tata Mc- Graw Hill Publication, 2003.

Reference Books

1. Ulaganathan Sankar, **"Environmental Economics"** - Oxford University Press, 2001.
2. Edward J Kormondy, **"Concepts of Ecology"** - Prentice – Hall Publication, 1969.

3. S.K.Garg, **"Water Resources Engineering"** - Khanna Publishers, 2009.
4. David Keith Todd, **"Ground Water Hydrology"** – Wiley publications, 2005.

GROUP PROJECT

Sub Code: MHY0402 **CIE: 50% Marks**
Duration: 8 Weeks Credits:4 Final Evaluation: 50% Marks

Course Outcomes

1. Work in a group to procure data from experiments or from proper sources.
2. Analyse data, draw inferences, discriminate between results and findings.
3. Prepare documents in team and make individual presentations.

Course Description

The students work in groups and carry out projects in the Institution /external organizations, for two months. Students will identify, formulate, design and solve real life problems, and submit reports. The work will be evaluated by an internal panel.

INDUSTRIAL TRAINING

Sub Code: MHY0403 **CIE: 50% Marks**
Duration: 8 Weeks Credits:4 Final Evaluation: 50% Marks

Course Outcomes

1. Understand and know various facets of water resources projects
2. Work in groups and write reports.

Course Description

Students get trained for two months in an industry, where they work individually or in groups, under the guidance of experts and submit a report. The work will be evaluated by an internal panel.

SEMINAR (0:0:4)

Sub Code: MHY0201 **Credits:2**

Course Outcomes

1. Independently make a study and prepare technical reports.
2. Prepare documents and make presentations by using state of art tools.

Course Description

Accomplished individually, the student will choose and prepare, under the supervision of a CI, for a topic relevant to the Programme. The Seminar presented and the report submitted will be evaluated by an internal panel.

PROJECT WORK
Phase 1 - (MHY0801)

Sub Code: MHY0801 **Duration: 8 Weeks** **Credits: 8**

Course Outcomes

1. Work independently to procure data from experiments or from other sources.
2. Analyse data, draw inferences, discriminate between results and findings.
3. Present findings, write reports and proposals.

Course Description

The project work is accomplished by each of the students individually under the guidance of a faculty member of the Department, and a co–guide, either from the Dept. or from an external agency, if required. The project work comprises of two phases – Phase-1 spreads over the last two months in the third semester and Phase-2 covers the complete length of the fourth semester. The students will select a problem, usually of current research interest or a prospective water resource project, carryout a detailed literature survey, collect data and plan the course of work during the first phase. The project will be valued at the end of the Phase-1 by an internal panel.

MAJOR PROJECT

Sub Code: MHY2801

Course Outcome

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

1. *Plan and work out an action plan for completion of a hydraulic engineering problem.*
2. *Prepare documents in team and make individual presentations.*
3. *Develop research methodologies and pursue research.*

COURSE DESRCRIPTION

The project is offered to the students in order to inculcate research attitude and develop skills. Major project could be in the form of experimental investigation, computational work, data collection and its analysis etc. At the end of the major project, a report will be made wherein the details of the work undertaken, methodology adopted, conclusions drawn are provided. Evaluation of the major project is done as per the rubrics.

DESIGN OF CONCRETE STRUCTURES (3:2:2)

Sub Code : MSE0502 **CIE : 50% Marks**
Hrs/week : 3+2+2 **SEE : 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks : 100**

COURSE OUTCOME

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

1. *Design continuous beams applying redistribution of moments and design slabs by yield line analysis*
2. *Understand tall structural systems*
3. *Design prestressed concrete members*

Unit 1

Design of Continuous Beams with Redistribution of Moments

Introduction, Analysis parameters, Live load arrangements, Redistribution of moment Reinforcement requirements, Typical continuous beam details, Flexure design considerations, Simplified analysis for uniform loads, ***Moment and shear coefficients for continuous beams***.

Self learning Exercise: Moment and shear coefficients for continuous beams.

Unit -II:

Yield Line Analysis of Slabs

Yield lines, ultimate moment along a yield line, internal virtual work due to an ultimate moment, virtual work due to

an applied load. ***Effect of top corner steel in a square slab.***

Self learning Exercise: Effect of top corner steel in a square slab.

Unit - III:

Structural Systems for Tall Buildings

Introduction, Subsystems and Components, Floor Systems, Vertical Framing Systems, Lateral Resisting Frame Systems, Moment Resisting Frames, Braced Frames, Shear Walls, , Loadings to be considered,

6 Hrs

Self learning Exercise: Framed Tube Systems.

Unit -IV:

Design of Prestressed Concrete

Review of concepts of mechanics of PSC, flexural strength, Limit state design criteria. Simplified procedures as per codes, strain compatibility method, Basic concepts in selection of cross section for bending, stress distribution in end block, Design of anchorage zone reinforcement, ***Design of prestressed concrete tanks, Pipes***

Self learning Exercise,

Design of prestressed concrete tanks, Pipes

Students will conduct following experiments in laboratory

1. Flexural test on RC beams
2. Shear test on RC beams
3. Load test on RC slabs
4. NDT on RC members

TEXT BOOK

1. Dr. H. J. Shah, "***Reinforced Concrete***", Vol-1 and Vol-2, Charotar, 8th Edition – 2009 and 6th Edition – 2012 respectively.
2. T.Y. Lin and N.H. Burns ***"Design of Prestressed concrete Structures***" - John Wiley – 1981.

REFERENCE BOOKS

1. P.C Varghese ***"Advanced Reinforced Concrete Design***" -. Prentice Hall of India – 2004.
2. N. Krishna Raju "***Advanced Reinforced Concrete Design***" -, 2nd edition, CBS Publishers and Distributors.- 2009.
3. Krishna Raju N., "***Prestressed concrete***", Tata McGraw Hill Company, New Delhi 1998
4. Rajagopalan, N, "***Prestressed Concrete***", Alpha Science, 2002. 5. IS456, IS1343, SP16, SP34

ANALYSIS & DESIGN OF SUB STRUCTURES (4:2:0)

Sub Code: MSE0509 **CIE: 50% Marks**
Hrs/week: 4+2+0 **SEE: 50% Marks**
SEE Hrs : 3 Hrs **Max. Marks: 100**

Course Outcomes

Upon completing of this course, the student will be able to;

1. *Proportion the different types of shallow foundation.*
2. *Design the deep foundation like pile and caisson.*
3. *Decide the safety aspects and economical design of foundation on expansive soils, and*
4. *Decide the modern techniques to be adopted to improve the engineering properties of weak ground.*

Unit -I

Soil Investigation and Design Parameters

Introduction, Soil investigation - Responsibility of design engineer, Information required from soil investigation, soil test report.

Shallow Foundation

Presumptive Bearing capacity according to BIS, Factors affecting Bearing capacity and Settlement, Types of shallow foundations, Criteria to fix depth of footing, Foundation loading, Principles of design of footings, Proportioning of footings for equal settlement, Design of spread footings, Design of eccentrically loaded spread footings, Combined footings (Rectangular & Trapezoidal), Design of strap footings, Principles of design of raft foundation, Common types of raft foundation, Design methods for raft foundation, Settlement of foundations.

12 Hrs

Self Learning Exercise: *Variation of contact pressure under footings,*

Unit -II

Pile Foundation

Introduction, Load transfer in pile foundation, Load carrying capacity of pile based on static and dynamic methods, penetration tests and pile load tests, Group capacity of piles in different types of soils, Group efficiency of piles, Negative skin friction, Under reamed piles, Proportioning and design of pile foundation, Settlement of piles.

12 Hrs

Self Learning Exercise: *Laterally loaded piles, tension piles and batter piles,*

Unit -III

Foundations on Expansive Soils Introduction, Identification of expansive soils, Swell potential, swell pressure, effects of swelling on buildings, preventive measures for expansion soils, modification of expansive soils, Design **6 Hrs**

Self Learning Exercise: *Construction of under reamed pile foundation.*

Unit -IV

Foundation for Bridges

Introduction, drilled piers, construction of drilled piers, advantages and disadvantages of drilled piers, design of open caisson, construction of open caisson, Pneumatic caissons, construction of pneumatic Caisson, Floating caissons. Different shapes of wells, components of well foundation, Forces acting on well foundations, Grip length

8 Hrs

Self Learning Exercise: *sinking of wells, measures for rectification of tilts and shifts.*

Unit -V

Machine Foundation

Introduction, types of machine foundation, basic definitions, degree freedom of a block foundations, general criteria for design of machine foundation, free vibration, forced vibration, vibration analysis of machine foundation, determination of natural frequency, design criteria for foundations of reciprocating machines, reinforcement and construction details

10 Hrs

Self Learning Exercise: *vibration isolation and control.*

Unit -VI

Ground Improvement Techniques

Introduction, improvement of cohesive soils – pre-compression, sand drains, wick drains and stone columns. Improvement of cohesionless soils – vibrofloation, dynamic compaction, compaction by blasts, compaction piles.

4 Hrs

Self Learning Exercise: soils stabilization.

Text Books

1. P.C. Verghese **"Foundation Engineering"** - PHI Learning Pvt. Ltd., 2009.
2. K.C Arora "**Soil Mechanics and foundation Engineering**" - Standard Publishers Distributors, 2011.

Reference Books

1. Swami Saran, "**Analysis and Design of substructures**" – Oxford and IBH Pub. Co. Pvt. Ltd., Second edition, 2008.
2. Bowles J.E, "**Foundation Analysis and Design**" - McGraw-Hill Int. editions, 5th Ed., 1996.
3. Kasmalkar "**Foundation Engineering**" - PVGP Publications, 2012.
4. N.N.Som & S.C. Das "**Theory and Practice of Foundation Design**" - PHI Learning, - 2009.

FIRE RESISTANCE OF STRUCTURES (4:2:0)

Sub Code: MSE0514 **CIE: 50% Marks**
Hrs/week: 4+2+0 **SEE: 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks: 100**

Course Outcomes

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

1. *Interpret the intentions of code requirements for fire safety.*
2. *Understand the concepts of fire severity and fire resistance, and*
3. *Design steel, concrete or timber structures to resist fire exposure*

Unit -I

Classification of Buildings and Types of Production Processes

Types of construction and classification of buildings, Main building elements, Requirements of buildings, Combustibility and fire resistance **8 Hrs**

Self Learning Exercise*: Fire hazard category of production processes.*

Unit -II

Calculation of Required Fire Resistance Limit of Building Structures

Initial condition for calculating fire resistance of structures, Duration of fire, Temperature of fire, Main points on the method of investigating temperature regimes of fires, Results of experimental investigations on fires, Simulation of temperature regimes of fires, Determination of fire in residential and public buildings, Determination of fire duration of fire in industrial buildings and warehouses

8 Hrs

***Self Learning Exercise**: Standardization of fire resistance of structures.*

Unit -III

Methods of Testing Structures for Fire Resistance

Problems of testing for fire resistance, Set-up for testing fire resistance, Temperature regime of the tests, Test pieces of structures, Conditions of loading and supporting of structures

8 Hrs

***Self Learning Exercise**: Measurements.*

Unit -IV

Fire Resistance of Reinforced Concrete Structures

Main aspects of the calculations for fire resistance, Thermo technical part of the calculation

Boundary conditions, Calculation of temperature in plane structures (one- dimensional temperature field), Calculation of temperature in bar type structures (Two- dimensional temperature field), Calculation of depth at which a given temperature is reached, Effect of moisture in concrete on the heating of structures, Thermo physical properties of concrete at high temperatures ,Statics part of calculations, Change in the strength of reinforcement steel with increase of temperature, Change in

the strength of concrete in compression with increase in temperature, Coefficients of thermal expansion of reinforcement bars and concrete, Axially loaded columns, Statically determinate elements subjected to bending stresses

10 Hrs

***Self Learning Exercise**: Explosive failure of concrete.*

Unit -V

Fire Resistance of Steel Columns

General, Cross sections of steel columns and other design data, Methods of protecting steel columns from heat, Limiting state of steel columns on heating, Heat insulating capacity of protection and fire resistance limit``s of columns, Calculation of fire resistance of steel columns, The effect of the form of the cross-section of steel columns and filling of space between the column shafts and the protection, on the fire resistance of steel columns, Different stages of thermal deformation of column bars with different types of fire protection

10 Hrs

***Self Learning Exercise**: Effect of cross-sectional area of the column shaft on fire resistance.*

Unit -VI

Protection of Openings of Fire Walls

1. Fire doors-Door specifications in the building standards and regulations

2. Noncombustible doors, Low combustible doors, Doors made of glass-fiber reinforced plastic

Glass fittings for openings - Specifications of building standards and regulations

8 Hrs

***Self Learning Exercise**: Hollow glass blocks, reinforced glass, hardened glass*

Text Book

1. Andrew H. Buchanan, **"Structural Design for Fire Safety"** John Wiley & Sons. Ltd – 2001.

Reference Books

1. U.S Bendev Etal, "**Fire Resistance of Buildings**"- Amerind Publishing Co. Pvt. Ltd
2. Andrew H. Buchman "**Structural design for fire safety, comprehensive overview of the fire resistance of building structures"-,** John Wiley and sons., 2001.
3. John A. Purkiss **"Fire Safety Engineering Design of structures**"-, Butterworth Heinemann, 2009.

STRUCTURAL DYNAMICS
(4:2:0)

Sub Code : MSE0504 **CIE** : 50% Marks
Hrs/week : 4+2+0 **SEE** : 50% Marks
SEE Hrs : 3 Hrs **Max. Marks** : 100

COURSE OUTCOME

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

- *Comprehend the basic principles of dynamics;*
- *Analyze lumped mass systems for their dynamic behavior;*
- *Analyze continuous systems for their dynamic behavior*

Unit I: **Introduction**

Introduction to Dynamical problems in Civil Engineering, Concept of degrees of freedom, D'Alembert's principle, principle of virtual displacement and ***energy principles.***
Self Learning Exercise: Energy principles.

Unit II: Single-degree-of-freedom systems

Mathematical models of SDOF system, Free vibration response of damped and undamped systems, response to harmonic loading, support motion, evaluation of damping, vibration isolation, transmissibility, response to periodic forces. Numerical methods applied to SDOF, direct integration and Duhamel integral principle of vibration measuring instruments-seismometer and accelerometer
Self learning exercises: Seismometer and Accelerometer

Unit III **Multi Degree Freedom Systems**

Mathematical models of MDOF systems, free vibration of undamped MDOF system-Natural frequencies and mode shapes – orthogonality conditions, free vibration of damped MDOF system, modal analysis-free and forced vibration with and without damping

Self learning exercises: forced vibration without damping

UNIT IV **Approximate methods of Analysis**

Rayleigh's method, stodola's method, Rayleigh-Ritz method,

Self learning exercises: matrix iterative method

Unit V **Dynamics of Continuous Systems**

Vibrations of beams, beams with various boundary conditions, Eigen functions and orthogonality of functions, response of beams to dynamic loads

Self learning exercises: introduction to wave propagation in bars

TEXT BOOK

1. Mukyopadhyaya, "***Vibration and Structural Dynamics***"- Oxford &IBH – 1990.
2. Mario Paz, "Structural dynamics – ***Theory and Computation***"- CBS Publishers – 2010
3. William Seto, ***"Mechanical Vibrations***"- McGraw Hill Pub., (Schaum Series) – 2008

REFERENCE BOOKS

1. Biggs "***Structural Dynamics***"-, McGraw Hill – 1964.
2. R.W. Clough & J. Penzien "***Dynamics of Structures***" -, McGraw Hill -1993.
3. Anil K. Chopra, ***"Dynamics of Structures***" - Prentice Hall of India – 2007.
4. Timoshenko, S "***Vibration Problems in Engineering***" - VanNostrand Co., - 2001
5. William Thompson "***Theory of Vibration with Applications***" -, Pearson Education – 2008.

DESIGN OF STEEL STRUCTURES (4:2:0)

Sub Code: MSE0505 **CIE: 50% Marks**
Hrs/week: 4+2+0 **SEE: 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks: 100**

Course Outcomes

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

1. *Comprehend the plastic behavior of structural steel.*
2. *Design microwave towers and transmission towers, light gauge steel structures, and*
3. *Analyze and design tubular structures Industrial buildings and steel stacks.*

Unit -I

Plastic Behaviour of Structural Steel

Introduction, Plastic theory, Plastic hinge concept, Plastic collapse load, conditions of plastic analysis, Theorem of Plastic collapse, Methods of Plastic analysis **8 Hrs**

Self Learning Exercise: *Plastic design of continuous beams.*

Unit -II

Design of Towers

Introduction, Types of towers, Tower configuration, loads, Analysis, Member selection. **8 Hrs**

Self Learning Exercise: *Configuration of towers for power transmission*

Unit -III

Design in Light Gauge Steel

Introduction, types of sections, material, local buckling of thin elements stiffened compression members, multiple stiffened compression elements, compression members, laterally supported flexural members **8 Hrs**

Self Learning Exercise*: laterally unsupported flexural members*

Unit -IV

Tubular Structures

Introduction, Classification, Advantages and disadvantages, Behaviour of tubular sections, minimum thickness, combined stresses, connections, Design of truss elements including purlins, **12 Hrs**

Self Learning Exercise*: Design of Space truss*

Unit -V

Design of Industrial Buildings

Introduction, Selection of roofing and wall material, selection of bay width, structural framing, purlins, girts and eave strut, plane trusses, floor plates, end bearings, Design of Gantry girders **10 Hrs**

Self Learning Exercise*: Concepts of pre-engineered building*

Unit -VI

Design of Steel Stacks

Introduction, Proportioning of stack, Codal provisions, Loads on Stacks, Load combinations, Stresses in Self supporting stacks, Design procedure for self supporting stacks, Guyed steel stacks, Pull on guy wires **6 Hrs**

***Self Learning Exercise**: Design procedure for guyed steel stacks*

Note: Study of this course should be based on IS800-2007

Text Book

1. Duggal S.K, "**Limit State Design of Steel Structures**"- Tata Mac Graw Hill, New Delhi, 2010.

Reference Books

1. N. Subramanian "**Design of Steel Structures**"- Oxford, 2008.
2. M.L.Gambir **" Design of Steel Structures**" PHI Learning, 2012.
3. Ramachandra **" Limit State of Design of Steel Structures** " Standard Book House - 2012
4. **Bureau of Indian Standards**, IS800-2007,IS801,IS806,IS1161, IS875,SP6

FINITE ELEMENT ANALYSIS (4:0:0)

Sub Code: MSE0506 **CIE: 50% Marks**
Hrs/Week: 4+0+2 **SEE: 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks: 100**

Course Outcomes

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

1. *Analyze trusses, beams and frames using stiffness method.*
2. *Describe the basic concepts of finite element analysis, and*
3. *Analyze trusses beams and frames by finite element method.*

Unit - I

Introduction

Basic concepts of elasticity, introduction to stiffness method– Element approach for the analyses of beams, trusses and frames, direct stiffness method for the analysis of trusses.

Self Learning Exercise: *Direct stiffness method for the analysis of beam.* **10 Hrs**

Unit – II

Introduction to Finite Element Analysis

General description of finite element method, Basic steps involved in FEM, difference between FEM and finite difference method.

Discreatisation of structures – Finite elements used for one dimensional, two dimensional and three dimensional problems. Nodes, element aspect ratio, boundary conditions –numbering of nodes, mesh refinement, properties of stiffness matrix. **10 Hrs**

Self Learning Exercise: *Banded matrix lagrangian and serendipity family of elements.*

Unit – III

Shape functions

Coordinate systems natural and normalized, convergence criterion, compatibility requirements, geometric invariance shape functions – polynomial displacement functions for one, two and three dimensional elements. **8 Hrs**

Self Learning Exercise: *Lagrangian interpolation functions.*

Unit – IV

Finite element formulation using energy concepts

Energy concepts, theorem of minimum potential energy, principle of virtual work, R-R method.

8 Hrs

Self Learning Exercise: *Variation method and minimization of energy approach for element formulation.*

Unit – V

Finite Element analysis of structural elements using direct method.

Finite Element Method for the analysis of simply supported beams and trusses.

8 Hrs

Self Learning Exercise: *Finite element analysis of cantilever beams.*

Unit – VI

General topics

Concepts of ISO parametric elements, non-linear techniques, use of standard finite element packages.

8 Hrs

Self Learning Exercise: *Axi-symetric problems.*

Note: Students will analyze (linear) the following using standard Finite Element Software;

1. Masonry Prisms
2. Plain Concrete Beams
3. RCC Beams & Slabs

Text Books

1. Rajasekaran. S, **"Finite Element Analysis in Engineering Design"**- Wheeler Publishing, 1988.

2. Chandrupatla TR and Belagonda "**Finite Element Analysis**" Universities Press, 2009.

Reference Books

1. Krishnamoorthy C S, "**Finite Element Analysis**"- Tata McGraw Hill, 2005.
2. Bathe K J. "**Finite Element Procedures in Engineering Analysis**"- Prentice Hall, 1982.
3. Cook R D, Malkan D S & Plesta M.E, "**Concepts and Application of Finite Element Analysis"** - 3rd Edition, John Wiley and Sons Inc., 2007.
4. Shames I H and Dym C J, "**Energy and Finite Element Methods in Structural Mechanics"-** McGraw Hill, New York, 1985
5. Desai C and Abel J F, **"Introduction to the Finite Element Method**"- East West Press Pvt. Ltd., 1972.

ANALYSIS AND DESIGN OF SHELL STRUCTURES (4:0:0)

Sub Code: MSE0401 **CIE: 50% Marks**
Hrs/week: 4+0+0 **SEE: 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks: 100**

Course Outcomes

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

1. *Appreciate the generalization & intricacies of theory of elasticity, when the surface transforms from plane to curved.*
2. *Appreciate and apply the intricacies & nuances of differential geometry from the Euclidian geometry in analysis of shells.*
3. *Using the simplified model of membrane analysis without flexural rigidity arriving and at simple solution of problem, having Gaussian curvature positive, zero and negative.*
4. *Making the transition from membrane theory to realistic bending theory, enables the students to analysis the students to analyze real world shell structures, and*
5. *Proficient & competitive enough in professional world, so as to be successful in analyzing, designing supervising and construction of shell structures.*

Unit -I

Geometry of shell; shell of revolution and shells of translation. Principal curvature at a point and Gaussian curvature; synclastic and anticlastic shells. Ruled and unruled surfaces; developable and non-developable surfaces; typical examples, stress resultants. **4 Hrs**

Self Learning Exercise: *Determination of principal curvature for a given surface and CODDSZI equation.*

Unit -II

Equilibrium & strain displacement equations in membrane theory of shells of revolution under axially symmetric loading for cylindrical spherical and conical shells including barrel vaults. **8 Hrs**

Self Learning Exercise: *Stress resultants in ellpsoid and hyperboloid of revolution (Cooling towers)*

Unit -III

Membrane analysis of shells of translations (cylindrical) under various types of loading; Analysis of shells of double curvature using Pucher's stress function elliptical parabolic and hyperbolic parabolic. **8 Hrs**

Self Learning Exercise: *Analyze using single trigonometric series.*

Unit -IV

Axially symmetric bending of cylindrical shells, typical application of water tank problems and cylindrical shells subjected to uniform internal pressure; bending theory of cylindrical shells. Donnell's theory and approach to solve for various boundary conditions along the straight edges. Edge beam theory. **14 Hrs**

Self Learning Exercise: S*chorer's theory for long shells; use of ASCE tables for shells analysis.*

Unit -V

Folded plate behavior, Whitney and Simpsons theory; method analysis of folded plate roof. **10 Hrs**

Self Learning Exercise: *NIL*

Unit -VI

Design of shell structures; design of rings at the base of shells revolution; design of cylindrical shell roofs. Multishell and simple shell roofs. **8 Hrs**

Self Learning Exercise: *Design of edge beams; design of hyperbolic & parabolic roofs.*

Text Books

1. K Chandrashekhara, "**Analysis of thin concrete shells**", New Age International, 1995.
2. Timoshenko and Krieger, "**Theory of plates and shells**, McGraw – Hill International Edition., 1959.

Reference Books

1. P C Verghese, "**Design of reinforced concrete shells and folded plates**", PHI, 2010.
2. David P. Billington, **"Thin shell concrete structures"** McGraw Hill Book Company, 1982.
3. J.B. Gibson "The **Design of shell roofs**", E & F.N. Spon Ltd., London, 3rd Edition, 1968.
4. G S Ramaswamy "**Design and construction of concrete shell roofs**", CBS publishers and Distributers, 2005.
5. Wilhelm Flugge, **"Stress in shells"** Springer – verlag, 1973.

REPAIR REHABILITATION AND MAINTENANCE OF STRUCTURES (4:2:0)

Sub Code: MSE0507 **CIE: 50% Marks**
Hrs/week: 4+2+0 **SEE: 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks: 100**

Course Outcomes

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

1. *Asses existing conditions of buildings.*
2. *Identify repairs and remedies to be adopted for rehabilitation of buildings, and*
3. *Find causes of leakages and suggest remedial measures of water proofing.*

Unit -I

The Challenge of Renovation / Rehabilitation

Terminology, When to Renovate, Beginning a Renovation Project, Typical Structural Challenges, Role of Building codes in Renovation, Renovation Provisions of Model Building Codes

8 Hrs

Self Learning Exercise: *Renovate or Rebuild?*

Unit -II

Investigating Existing Conditions

Why Investigate?, Assessing Building Condition, Material Properties in Steel systems, Concrete Framing, Load Testing of Concrete Structures, Post-Tensioned Concrete Framing, Wood Framing, Masonry

8 Hrs

Self Learning Exercise: *Building Envelope.*

Unit -III

Repairing Deteriorated Concrete

Overview, Repairing cracks, Corrosion of Reinforcement and its Effects on concrete, Patching spalls and Deteriorated Areas, Cathodic – Protection and Electrochemical Chloride Extraction, Corrosion Inhibitors, Other types of Damage to concrete, Materials for concrete Repair, Durability of Repairs **8 Hrs**

Self Learning Exercise: *Systematic Maintenance Program.*

Unit -IV

Rehabilitation of Concrete Structures

Method of repair & restoration – patch repair, pressure grouting, guniting shotcreting, jacketing, replacement, fiber wrapping etc. materials construction chemicals **7 Hrs**

Self Learning Exercise: *Repair sequences.*

Unit -V

Renovating Steel-Framed Buildings

Steel: The Venerable Material, Past Design Methods and Allowable Stresses for iron and steel Beams, Early Iron and Steel Columns, Properties of Early Fasteners, Open- Web Joists, Strengthening Floors, Reinforced Steel Members by Welding, Reinforced Beams by Composite Action with Concrete, Strengthening Beams Connections, Composite Steel-Concrete Columns, Openings in Existing Steel Beams,

Thermal Prestressing of Steel Structures **12 Hrs**

Self Learning Exercise: *Steel Corrosion: Evaluation and Protection.*

Unit -VI

Renovating Masonry

Evolution of masonry design methods, Evaluation of Masonry structure, cracks in masonry, Masonry repair, Strengthening Masonry structural elements, Repairing Masonry Arches **9 Hrs**

Self Learning Exercise: *Other Masonry renovation tasks.*

Text Books

1. Alexander Newman "**Structural Renovation of Buildings**" –, McGraw Hill, 2009.
2. Raiker R.N, " **Learn for Failure from Deficiencies in design, Construction & service**" –R&D Center (SDCPL)

Reference Book

1. Allen RTL and Edwards, SC, "**The Repair of Concrete Structures**" Blakie and Sons, 1993.

DESIGN OF STORAGE STRUCTURES (4:2:0)

Sub Code: MSE0515 **CIE : 50% Marks**
Hrs/week: 4+2+0 **SEE : 50% Marks**
SEE Hrs: 3 Hrs **Max. Marks: 100**

Course Outcomes

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

1. *Design the bunkers and silos.*
2. *Design circular and rectangular water tanks resting on the ground.*
3. *Design underground water tanks, and*
4. *Design elevated water tanks with top dome and Intze tanks with staging.*

Unit -I

Design of Bunkers and silos

Introduction, Janssen's theory, Airy's theory. Design of rectangular bunkers & silos. ***Self Learning Exercise****: Design of Circular bunkers and silos* **12 Hrs**

Unit -II

Water tanks – General

Introduction, Design requirements according to IS 3370 **6 Hrs**

Self Learning Exercise*: Joints in water tanks.*

Unit -III

Design of water tanks resting on ground

Design of circular tanks with flexible base, Design of recangular tanks.
8 Hrs

Self Learning Exercise*:Design of circular tanks with Rigid joints at base.*

Unit -IV

Design of Underground Water Tanks

Introduction, earth pressure on tank walls, uplift pressure on the floor of the tank, design of rectangular tanks with L/B < 2
10 Hrs

Self Learning Exercise*: Design of rectangular tanks with L/B > 2.*

Unit -V

Design of overhead water tanks -1

Design of flat base slab for elevated circular tanks.
8 Hrs

Self Learning Exercise*: Design of Circular tank with domed bottom and roof.*

Unit -VI

Design of overhead water tanks -2

Design of Intze tank **8 Hrs**

Self Learning Exercise*: Design of conical shaped tank.*

Text Books

1. H.J. Shah "**Advanced Reinforced Concrete Structures**" Vol – II, Charator Publishers, 6th Edition, 2012.

2. Bhavikatti S.S. "**Advanced RCC Design"** New Age International (P) Ltd. Publishers, New Delhi, 2006.

Reference Books

1. B.C. Punmia, Ashok Kumar Jain & Arun Kumar Jain **" Comprehensive RCC Designs**" – Lakshmi Publication, 2005.
2. N. Krishna Raju "**Advanced Reinforced Concrete Design"** – CBS Publishers & Distributors, New Delhi, 2008.
3. P.C. Varghese "**Advanced Reinforced Concrete Design**" PHI Pvt. Ltd., New Delhi, 2007.
4. M.L. Gambhir" **Design of Reinforced Concrete Structures**" PHI Pvt. Ltd., New Delhi, 2008.
5. Ashok K. Jain "**Reinforced Concrete, Limit State Design**" Nem chand & Bros, Roorkee, 2009.

Industrial Training

Sub Code: MSE0402
Credits: 4

Course Outcome

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

1. Understand and know various facets of structural projects
2. Work in groups and write reports.

Course Description

Students get trained for two months in an industry, where they work individually or in groups, under the guidance of experts and submit a report. The work will be evaluated by an internal panel.

Design Studio

Sub Code: MSE0403
Credits:4

Course Outcomes

1. Work in a group to procure data from experiments or from proper sources.
2. Analyze data, draw inferences, discriminate between results and findings.
3. Prepare documents in team and make individual presentations.

Course Description

The students work in groups and carry out projects in the Institution /external organizations, for two months. Students will identify, formulate, design and solve real life problems, and submit reports. The work will be evaluated by an internal panel.

Project Work – Phase - I

Sub Code: MSE0801
Credits: 8

Course Outcomes

1. Work independently to produce data from experiments or from other sources
2. Analyse data, draw inference, and discriminate between results and findings
3. Present findings, write reports and proposals

Course Description

The project work is accomplished by each of the students individually under the guidance of a faculty member of department and co-guide, either from the department or from an external agency, if required. The project work comprises of two phases:Phase–1 spreads over the last two months in the third semester and Phase–2 covers the complete length of the fourth semester. The students will select a problem, usually of current research interest, carry out a detailed literature survey collect data and plan the course of work during the first phase. The project will be valued at the end of the Phase–1 by an internal panel.

MAJOR PROJECT

Sub Code: MSE2801

Course Outcome

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

1. *Plan and work out an action plan for completion of a structural engineering problem.*
2. *Prepare documents in team and make individual presentations.*
3. *Develop research methodologies and pursue research.*

COURSE DESRCRIPTION

The project is offered to the students in order to inculcate research attitude and develop skills. Major project could be in the form of experimental investigation, computational work, data collection and its analysis etc. At the end of the major project, a report will be made wherein the details of the work undertaken, methodology adopted, conclusions drawn are provided. Evaluation of the major project is done as per the rubrics.