RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2020 – 2021

CIVIL ENGINEERING

V & VI SEMESTER B.E

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 13 UG programs and 15 PG programs. All these programs are approved by AICTE. All the UG programs & 09 PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with 'A' grade by NAAC in 2014. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs till the year 2029. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 60% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility to all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology & Schneider Centre of Excellence. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 65 & world ranking 578 for the year 2020.**

The Centre for Advanced Training and Continuing Education (CATCE), and Entrepreneurship Development Cell (EDC) have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology secured All India Rank 8th for the year 2020 for Atal Ranking of Institutions on Innovation Achievements (ARIIA), an initiative of Ministry of Human Resource Development (MHRD), Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. It has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework, MHRD, Government of India, M S Ramaiah Institute of Technology has achieved 59th rank among 1071 top Engineering institutions of India for the year 2020 and 1st rank amongst Engineering colleges (VTU) in Karnataka.

About the Department:

The Department of Civil Engineering was started as the third department in the institute with an intake of 60 students in the year 1971. Structural Engineering was first Post Graduate program started in the year 1984 of the institute with an intake of 10 students. The UG and PG programs have been accredited by NBA for three years 2017-2020 and 2019-2022 respectively. After obtaining the autonomous status in the year 2007, the department focused towards providing state of the art curriculum development, offering electives of the present day need and techno innovative projects. These initiatives resulted in enhanced performance of the students in terms of increase in placement, increase in the number of students writing competitive examinations and pursuing higher education in the foreign universities.

Further Department of Civil Engineering was recognized as a research centre in the year 1994 leading to PhD/MSc in Civil Engineering under Bangalore University till 1994 and later it was brought under State Technological University VTU. The research centre has attracted 30 PhD research scholars to pursue their degree from this research centre and 17 research scholars have completed PhD degree. The areas of research include Structural Engineering, Transportation Engineering, Geo-Technical Engineering, Water resources Engineering and Environmental Engineering.

The Department has close interaction with number of industries and Government agencies through R&D, and consultancy works. It also has MOU's with industries and other institutes for improved interactions and coordination with outside world.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations
- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at M. S. Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To become a premier Department to impart state-of-the-art technical knowledge and professional skills through effective learning process with research ambience to produce global quality Civil Engineers to develop sustainable society.

MISSION OF THE DEPARTMENT

To transform the young minds into employable professionals by providing contemporary technical knowledge and appropriate professional skills through suitable teaching learning process.

To provide rigorous training and acquaint the students with necessary skills and leadership qualities along with ethical values to addressthe complexand multi- faceted Civil Engineering Problems.

To provide opportunity to develop their potential by fostering intellectual curiosity to promote them for pursuing higher studies and research through exposure to the modern engineering tools and techno innovative projects.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

Bachelor of engineering graduates of Civil Engineering program of M S Ramaiah Institute of Technology shall attain the following PEO's within three to four years of graduation.

PEO1	To perform well in Engineering profession as competent professionals using contemporary technical knowledge and professional skills. **(THEME: Perform well in Engineering profession as competent professionals)**
PEO2	To pursue higher education and show intellectual curiosity for lifelong learning. **(THEME: Higher education and lifelong learning)**
PEO3	To communicate effectively to work in multi-disciplinary environments embedded with ethical values and social responsibilities. **(THEME: Effective communication, leadership and ethical values)**

PROGRAM OUTCOMES (POs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineeringsciences.

PO3: Design/development of solutions: Design solutions for complexengineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmentalconsiderations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, beingable to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Apply the knowledge of basic sciences, geology and environmental science along with the conceptual knowledge of engineering sciences to illustrate the process involved in planning, analysis and design of sustainable civil engineering systems.

PSO2: Conduct laboratory experiments/field investigations, and analyze/interpret the experimental results for appropriate conclusions and recommendations to a real-world civil engineering problem with a significant perspective of economy, society and environment.

PSO3: Demonstrate professional ethics and implement the principles of project management, business and public policy to lead the project execution as per the design requirement, with the state-of-the-art technology and contemporary skills.

Curriculum Course Credits Distribution

Batch 2018-22

Semester	Humanities & Social Sciences (HSS)	Basic Sciences / Lab (BS)	Engineering Sciences/ Lab (ES)	Professional Courses- Core (Hard core, soft core, Lab) (PC-C)	Professional Courses - Electives (PC-E)	Other Electives (OE)	Project Work (PW)	Internship /other activities (IS/ECA)	Total semester load
First		9	11						20
Second	2	8	10						20
Third		4	3	18					25
Fourth		7		18					25
Fifth	3			15	3	3			24
Sixth				11	6	3	4		24
Seventh	3			10	6			1	20
Eighth							14	3	17
Total	8	28	24	72	15	6	18	4	**175**

SCHEME OF TEACHING

V SEMESTER

SI. No	Subject Code	Subject	Teaching Department	Credits			
				L	T	P	Total
1.	CV51	Design of RC Elements	Civil	3	1	0	4
2.	CV52	Water Resources Engineering	Civil	4	0	0	4
3.	CV53	Geotechnical Engineering - I	Civil	3	1	0	4
4.	CV54	Intellectual Property Rights	Civil	3	0	0	3
5.	CVE55X	Professional Elective-1	Civil	3	0	0	3
6.	CVOE01	Open Elective - 1		3	0	0	3
7.	CVL56	Concrete Lab	Civil	0	0	1	1
8.	CVL57	Environmental Engg Lab	Civil	0	0	1	1
9.	CVL58	Civil Engg Drafting Lab	Civil	0	0	1	1
			Total	**19**	**2**	**3**	**24**

Professional Elective – I

Sl. No	Sub Code	Subject
1	CVE 551	Advanced Structural Analysis
2	CVE 552	Structural Masonry
3	CVE 553	Solid Waste Management
4	CVE 554	Traffic Engineering
5	CVE 555	GIS & Remote Sensing

SCHEME OF TEACHING
VI SEMESTER

Sl. No	Subject Code	Subject	Teaching Department	Credits			
				L	T	P	Total
1.	CV61	Design of Structural Steel Elements	Civil	3	1	0	4
2.	CV62	Geotechnical Engineering - II	Civil	3	1	0	4
3.	CVE63X	Professional Elective-2	Civil	3	0	0	3
4.	CVE64X	Professional Elective-3	Civil	3	0	0	3
5.	CVOE02	Open Elective - 2		3	0	0	3
6.	CV65	Extensive Survey Camp	Civil	0	0	4	4
7.	CVL66	Highway Material Testing Lab	Civil	0	0	1	1
8.	CVL67	Detailing of Structural elements Lab	Civil	0	0	1	1
9.	CVL68	Building Graphics Lab	Civil	0	0	1	1
			Total	**15**	**2**	**7**	**24**

Professional Elective – II

Sl. No	Sub Code	Subject
1	CVE 631	Design of PSC Structures
2	CVE 632	Rehabilitation of Structures
3	CVE 633	Pavement Materials & Construction
4	CVE 634	Advanced Design of Concrete Structures
5	CVE 635	Design of Hydraulic Structures

Professional Elective – III

Sl. No	Sub Code	Subject
1	CVE 641	Principles of Bridge Engineering
2	CVE 642	Computational Structural Mechanics
3	CVE 643	Pavement Evaluation and Management
4	CVE 644	Applied Hydraulics
5	CVE 645	Environmental Impact Assessment

DESIGN OF RC ELEMENTS

Course Code: CV 51 **Credits: 3:1:0**

Contact Hours: 56

Course Content

Unit I

Introduction to limit state design: Philosophy and principle of limit state design along with the assumptions, Partial safety factors, Characteristic Load and Strength. Introduction to stress block parameters, Concept of balanced, under and over reinforced sections. Limit state of collapse in flexure of rectangular and flanged sections with examples. Limitstateof collapsein shear andtorsional strengthof sections with examples.

Unit II

Limit state design of beams: Design of singly Reinforced Beams, Doubly Reinforced Beams and Flanged Beams. Types of shear failures –Design for shear strength, Types and design of shear reinforcement. Analysis of Torsional moment– Torsional shear stress, Reinforcement for Torsion.

Unit III

Limit state design of slabs and stairs: Introduction to oneway and twoway slabs, Design of oneway cantilever slab, simply supported slab, continuous slab. Design of twoway slabs. Introduction to staircases and design of doglegged stair and openwell staircases, Importance of bond, anchorage, lap length etc.

Unit IV

Service ability limit states: Introduction to working stress method, Elastic behavior of rectangular section, Under, Balanced and over reinforced sections. Simple Problems on Flexural strength, Deflection and cracking in beams using IS Code provisions. Deflection and cracking – codal provisions, Deflection control in design and problems, Problems on calculations of crack width.

Unit V

Limit state design of columns and footings: Design of short axially loaded RC columns with problems, RC Columns with uniaxial moment including Problems, RC Columns with biaxial moments and problems, Design concepts of footing (Limit state), isolated footings with axial load–square and rectangular types. Rectangular Isolated footings with axial load and moment.

Note: Students have to be taken to construction sites to give the demonstrative examples of structural elements such as columns, beams, slab, staircase, etc.

Textbooks:

1. Unnikrishnan Pillai and Devadas Mennon, "Design of Reinforced Concrete Structures"–Tata Mc Graw Hill Publications.
2. Verghese PC, "Limit State Design Of Reinforced Concrete", Prentice Hall of India, NewDelhi

Referencebooks:

1. Sinha SN, "Reinforced Concrete Design", Tata Mc Graw Hill Publications
2. Karves R & Shah VL, "Limit State Theory And Design Of Reinforced Concrete", Vidyarthi Prakashan,Pune
3. Parkand Paulay, "Reinforced Concrete",John Wiley and Sons
4. Punmia BC, Jain A K and Jain A K, "Reinforced Concrete Design", Lakshmi Publications, NewDelhi

Course Outcomes (COs):

Students will be able to:

1. Describe and apply limit state design concepts of Reinforced Concrete elements.
2. Analyze, design and detailing of beams.
3. Analyze, design and detailing of slabs and stairs.
4. Compute and demonstrate serviceability criteria of flexural members.
5. Analyze, design and detailing columns and footings.

WATER RESOURCES ENGINEERING

Course Code: CV 52 **Credits: 4:0:0**

Contact Hours: 56

Course Content

Unit I

Runoff: Introduction, Types of runoff, classification of stream, Factors affecting runoff, Basin yield, stream gauging, measurement of discharge, stage-discharge relations. Rainfall-runoff correlation, Estimation of runoff with empirical equations - Dicken's formula, Ryve's formula and Inglis formula. Hydrograph - Definition, Factors affecting flood hydrograph, Components of a hydrograph, Base flow separation, Effective rainfall, Unit Hydrograph- Definition, Assumptions and Limitations of Unit hydrograph, Derivation of units of hydrograph, Unit hydrograph from complex storms, Unit hydrograph of different durations, S-Curve method.

Unit II

Irrigation and Water Requirement of Crops: Introduction. Irrigation - Definition, Necessity, Benefits and ill-effects of irrigation, Types of irrigation systems, Various irrigation methods. Water Requirement of Crops - Classification of soil water, Soil moisture constants, Depth of water applied and Frequency of irrigation, Crop seasons, Crop period and Base period, Duty, Delta, G.C.A., C.C.A., Intensity of irrigation, P.E.T., Irrigation Efficiencies. Irrigation requirements of crops.

Unit III

Design of Irrigation Canal System: Introduction. Classification of irrigation canals. Design of Canals - Silt theories, Kennedy's theory, Design procedure by Kennedy's theory, Lacey's theory, Regime channels, Regime conditions, Cross-Section of regime channel, Lacey's regime equations, Comparison between Kennedy's and Lacey's theory, Drawbacks in Lacey's theory. Longitudinal section of a canal, Balancing depth, Cross-section of an irrigation canal, barrow pit, spoil bank, Berms. Canal Regulation - Canal fall, Necessity and location of canal fall, Types of falls, Hydraulic design principles for Notch type canal fall. Canal Regulators - Cross Regulator, Head Regulator, Functions of Regulators. Cross-Drainage Works - Introduction. Classification of Cross-Drainage Works, Types of Aqueducts (or Syphon Aqueducts), Factors affecting suitability of Types of Aqueducts (or Syphon Aqueducts)

Unit IV

Head Works- Introduction, Types of Head works, Components of Diversion Head Works, Weir and Barrages, Storage Head works-Dams, Classification, Types of Earthen dams, Causes of failure of Earthen dams. Theories of Seepage - Design of Impervious floor using Bligh's theory, Introduction to Khosla's theory. Gravity Dam -

Forces acting on a gravity dam, Vertical stress at the base of the dam & Middle-third rule, Elementary profile of a gravity dam, Practical profile of a gravity dam, Design of dam by Gravity method, Joints, Keys, Water stops and Galleries. Spillways.

Unit V

Floods - Flood estimation, Rational method, P.M.F. Flow Duration Curves, Flood routing - reservoir routing by I.S.D. method. Reservoir Planning- Types of reservoirs, Zones of storage in a reservoir, Reservoir yield, Mass curve and Demand curve, Determination of reservoir capacity using mass curve, Determination of yield from a reservoir of given capacity, Reservoir losses, Useful life of a reservoir. Water Resources Development in India and Inter-State Water Dispute.

Text Books:

1. K. Subramanya, "Engineering Hydrology", McGraw Hill Education; Fourth edition (2017)
2. P. Jaya Rami Reddy, "Hydrology", Laxmi Publications; Third edition (2016)
3. P.N Modi, "Irrigation, Water resources and Water Power Engineering", STANDARD BOOK HOUSE; Eleventh edition (2014)

Reference Books:

1. Ray K. Linsley, et.al., "Water Recourses Engineering", McGraw-Hill Publishing Co.; 4th edition (1992)
2. Garg S K, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers (1976)
3. Punmia B C et.al., "Irrigation and Water Power Engineering",Laxmi Publications, Sixteenth edition (2019)

Course Outcomes (COs):

Students will be able to:

1. Develop stage discharge relations and analyze runoff using hydrographs.
2. State the importance of irrigation, types and methods of irrigation and evaluate water requirements of crops.
3. Apply silt theories and design irrigation canals. Also design various types of canal regulation and Cross-Drainage Works.
4. Enumerate various types of Head works and analyze various forces encountered in gravity dams, thereby the design of dams.
5. Estimate the floods and design the reservoir systems

GEOTECHNICAL ENGINEERING - I

Course Code: CV 53 **Credits: 3:1:0**

Contact Hours: 56

Course Content

Unit I

Introduction : Formation of soils, Phase Diagram, Definitions of Voids ratio, Porosity, Percentage Air voids, Air content, Degree of saturation, Moisture content, Specific gravity, Bulk density, Dry density, Saturated density, Submerged density and their inter relationships. Problems.

Index Properties of Soils and their Determination: Index Properties of soils – Water content, Specific Gravity, Particle size distribution, Relative Density, Consistency limits and indices, in-situ density. Laboratory methods of determination of index properties of soils: Moisture content, Specific Gravity, Particle size distribution by Sieve analysis and Hydrometer analysis, In-situ density by core cutter & sand replacement methods, Relative Density, Liquid Limit by Casagrande's method and Cone penetration method, Plastic limit and shrinkage limit determination. Importance of index properties in foundation design.

Unit II

Classification of Soils: Purpose of soil classification, basis for soil classification, Particle size classification - MIT classification and IS classification, Unified soil classification and IS classification – Plasticity chart and its importance, Field identification of soils.

Soil Water & Permeability: Free water, held water – adsorbed water & capillary water, Capillary phenomenon, Darcy's law- assumptions and validity, coefficient of permeability and its determination in laboratory, factors affecting permeability, permeability of stratified soils, Seepage velocity, Superficial velocity and coefficient of percolation. Importance of permeability in stability analysis of slopes & earthen dams.

Unit III

Stresses in Soils &Seepage Analysis: Effective stress concept - total pressure and effective stress, quick sand phenomenon. Laplace's equation, assumptions and limitations, characteristics and uses of flow-nets. Estimation of quantity of seepage for Dams and sheet pile walls. Determination of phreatic line in earth dams with and without horizontal filter near the toe. Importance of flow-nets & hydraulic gradient in stability analysis of slopes & earthen dams.

Compaction of Soils: Definition, Principle of compaction, Standard and Modified proctor compaction tests, factors affecting compaction, effect of compaction on soil properties, types of field compaction, Field compaction control, Proctor's needle, relative compaction, principles of dynamic compaction & vibro-flotation.

Unit IV

CONSOLIDATION OF SOILS: Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory-assumption and limitations (no derivation), Normally consolidated, under consolidated and over consolidated soils, pre-consolidation pressure and its determination by Casagrande's method. Consolidation characteristics of soil (Cc, av, mv and Cv), Laboratory one dimensional consolidation test for determination of - compression index, and coefficient of consolidation (by square root of time fitting method and logarithm of time fitting method). Types of settlements in soil, estimation of consolidation settlement.

Unit V

SHEAR STRENGTH OF SOILS: Concept of shear strength, Mohr's strength theory, Mohr-coulomb theory, conventional and modified failure envelopes, Total and effective shear strength parameters, Concept of pore pressure, Sensitivity and Thixotropy of clay. Determination of shear parameters using - Direct shear test, Unconfined compression test and Triaxial compression test; Shear strength tests under different drainage conditions, importance of pore pressure & shear strength in geotechnical applications.

Text Books:

1. V.N.S. Murthy, (2018), "Soil Mechanics and Foundation Engineering", CBS Publishers & Distributors, New Delhi
2. Ramamurthy T.N. & Sitharam T.G. (2010), "Geotechnical Engineering", S. Chand & Company, New Delhi.
3. Punmia B.C. (2005), "Soil Mechanics and Foundation Engg.", 16th Edition, Laxmi Publications Co. , New Delhi.

References:

1. Alam Singh and Chowdhary G.R. (1994), "Soil Engineering in Theory and Practice"' CBS Publishers and Distributors Ltd., New Delhi.
2. Bowles J.E. (1996), 'Foundation Analysis and Design"' 5th Edition, McGraw Hill Pub. Co. New York.

Course Outcomes (COs):

Students will be able to:

1. Describe the physical properties of soil and their significance in foundation design
2. Classify the soils, evaluate the permeability of soil and its importance in stability analysis of earthen structures
3. Analyze the seepage flow and estimate the compaction characteristics
4. Evaluate the settlement, consolidation characteristics of soil and their significance
5. Appraise the shear parameters of soils for foundations

INTELLECTUAL PROPERTY RIGHTS

Course Code: CV 54 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Introduction to Intellectual Property Rights: Concept of property, Nature and types of intellectual property, Constitutional aspects of IPR, Commercial exploitation of intellectual property, Comparison of Intellectual Property Vs. Physical Property, Intellectual property and economic development, Enforcement of rights and remedies against infringement.

Unit II

Patents: Meaning of patent and its purpose, Object of patent law, Evolution of patent system, Application for patent, Criteria for patentability, Non – patentable inventions, Provisional and complete specification, Publication of the application, Opposition to grant of patent, Grant of patent – priority date, date of patent, date of sealing. Case study of disputes in patenting.

Unit III

Rights and Obligations of Patent Holder: Rights of patent holder - monopoly, assignment, license, Working of patent and compulsory license, Obligations of patent holder, Types of patents, Industrial design - registration, rights, infringement and remedies.

Unit IV

Trade Marks: Features and classification, Rights conferred by registration of trade mark and **trade secrets**, Marks not registrable, Application and procedure for registration of trademarks - term and renewal, Trademark series, joint and associated trademarks, service mark, collective mark. Case study of disputes in trademarks.

Unit V

Copy Right: Evolution of copy right law, Meaning, content and substance of copy right, Ownership, rights and period of copyright, Assignment of copyright and relinquishment, License and compulsory licenses. Case study of disputes in geographical indicators.

Text Books:

1. N.K. Acharya, “Intellectual Property Rights”, Asia Law House, Hyderabad.
2. Wadehra B.L, “Intellectual Property Law Handbook”, Universal Law Publishing Co. 16 Ltd., New Delhi.

References:

1. Dr.T. Ramakrishna, “Basic Principles and Acquisition of Intellectual Property Rights”, CIPRA, NLSIU, Bangalore.
2. Dr.T. Ramakrishna, “Ownership and Enforcement of Intellectual Property Rights”, CIPRA, NLSIU, Bangalore.

Course Outcomes (COs):

Students will be able to:

1. Define and describe the evolution of IPR globally
2. Describe the specifications and claims with reference to patent
3. Outline the rights and obligations on industrial designs.
4. Summarize the rights and working with reference to trademark
5. Describe the contents and significance of copyrights for new inventions

CONCRETE LABORATORY

Course Code: CVL 56 **Credits: 0:0:1**

Contact Hours: 14

Course Content

List of Experiments:

1. Teston specificgravityandwaterabsorptionoffineandcourseaggregate.
2. Test on grading analysis of fine and courseaggregate.
3. Teston Bulkdensityoffine,courseaggregateand bulkingoffineaggregate
4. Test on Specific gravity and fineness ofcement
5. Test on Normal consistency and initial and final setting timeof cement.
6. Test on Soundness ofcement and compressive strength ofmortar.
7. Mixdesignofconcrete as per IS 10262-2019- Freshconcrete:Slump,compactionfactor,Veebeetestandflowtest.
8. Tests on Self Compacting Concrete – Design, slump flow test, V-funnel test, J-Ring test, U Box test and L Box test.
9. Propertiesofhardenedconcrete- CompressivestrengthandFlexuralStrength,SplitTensile Strength, Torsion.
10. Determination of young's modulus of hardened concrete.

Text Books:

1. M.S Shetty, "Concrete Technology ", S. Chand & Co. Ltd, New Delhi.
2. Mehta P.K, "Properties of Concrete", Tata McGraw Hill Publications, New Delhi.

Reference Books:

1. Neville AM, "Properties of Concrete", ELBS Publications, London.
2. Relevant BIS codes.

Course Outcomes (COs):

Students will be able to:

1. Select appropriate aggregates based on their test results.
2. Characterize cement properties by conducting various tests on cement.
3. Design appropriate concrete mixes based on properties of material and evaluate the workability of fresh concrete.
4. Describe mechanical behavior of hardened concrete.
5. Determine the young's modulus of hardened concrete

ENVIRONMENTAL ENGINEERING LABORATORY

Course Code: CVL 57 **Credits: 0:0:1**

Contact Hours: 14

Course Content

List of Experiments:

1. Determination of pH, Alkalinity and Acidity
2. Determination of Chlorides, available chlorine in bleaching powder and residual chlorine.
3. Determination of Turbidity and Jar Test for Optimum Dose of alum.
4. Determination of Dissolved Oxygen and BOD.
5. Determination of COD
6. Determination of Iron.
7. Determination of Nitrates
8. Determination of Fluoride
9. Determination of Solids in Sewage: Total Solids, Suspended Solids, Dissolved Solids, Volatile Solids, Fixed Solids and Settleable Solids.
10. Determination of particulates in air using high volume air sampler
11. Determination of noise levels in the locality
12. Visit to sewage treatment plant.

Text Books:

1. Garg, S.K., (2011) Environmental Engineering, Vols. I and II, Khanna Publishers, New Delhi,
2. Punmia B C, (2011) Environmental Engineering Vol. I and II, Laxmi Publication (P) Ltd., New Delhi.

Reference Books:

1. Dr R B Kotaiah& N Kumara Swamy "Environmental Engineering Laboratory Manual",Charotar Publishing House, 1994.
2. E W Rice, R B Baird et.al, "Standard Methods for the examination of water and waste water, 22nd Edition" American Water Works Association [2012].
3. IS Standards 2490 – 1974, 3360 -1974, 3307 – 1974.
4. Clair N Sawyer, Perry L McCarty "Chemistry for Environmental Engineering and Science", Tata Mc Graw-Hill edition 2003.
5. Manual on sewerage and Sewage Treatment, (2010) CPHEEO, Ministry of Urban Development, New Delhi.

6. Metcalf and Eddy Inc., (2004) Wastewater Engineering – Treatment and Reuse, 4th Edition, Tata McGraw Hill, India,
7. "Standard Methods for the Examination of Water and Wastewater", 21st Edition, Published by American Public Health Association (APHA), American Water Works Association (AWWA) and Water Environment Federation (WEF), 2005

Course Outcomes (COs):

Students will be able to:

1. Analyze the quality of water and sewage sample.
2. Recommend suitability of tested sample as per the Indian standards for drinking.
3. Identify and choose the water source for water supply schemes.
4. Determine air and noise pollution levels in the surrounding environment
5. Demonstrate working of sewage treatment process

CIVIL ENGINEERING DRAFTING LABORATORY

Course Code: CVL 58 **Credits: 0:0:1**

Contact Hours: 14

Course Content

Part–A – Working with AutoCAD

1. Introduction to AutoCAD- Components, Screen Layout and Ribbons, Toolbars etc
2. Setting units, layout and drawing basic shapes (Draw and modify command) in AutoCAD with command and graphical approach.
3. Working with drawing aids such as layers, line weight and blocks, object snap etc
4. Editing sketches and dimensioning of elements. Introducing text and tables in AutoCAD
5. Hatching, Modelling of layout and Plotting of drawings.

Part – B – Drafting of Civil Engineering Elements

1. Building Construction: Bonds in Brick Masonry- English & Flemish
2. Building Components: Stepped wall footing
3. Building Components: Column, Lintel and chajja
4. Building Components: Doors
5. Building Components: Windows and Ventilators
6. Building Components: Doglegged Staircase and Open well Staircase
7. Drawing Simple building plan and elevation

Text Books:

1. Gurucharan Singh and SubashChander, "Civil engineering drawing".(2014), English Standard Publishers and Dist., Delhi
2. Sikka V B Kataria S K & Sons. "A Course in Civil Engineering Drawing"

Reference Books:

1. Shah M H and Kale C M, "Building drawing", Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi.
2. Gurucharan Singh, "Building Construction", Standard publishers and distributors, New Delhi.
3. National Building Code, BIS, New Delhi.
4. Sham Tickoo, "Understanding AUTOCAD 2004 A beginner's Guide", Wiley

Dreamtech India Pvt Ltd.
5. Jayaram M A., Rajendra Prasad D S., “A referral on CAD Laboratory”, Sapna Publications.

Course Outcome (COs):

Students will be able to:

1. Use the tools of AutoCAD and draft simple components.
2. Model the layout and plot the drawings.
3. Sketch the bonds in brick masonry construction
4. Sketch the different components of a building system
5. Draft the building plan and elevation.

ADVANCED STRUCTURAL ANALYSIS

Course Code: CVE 551 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Slope Deflection Method: Introduction, sign convention, Development of slope deflection equation, Analysis of continuous beams, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy ≤ 3.

Unit II

Moment Distribution Method: Introduction, Definition of terms, Development of method, Analysis of continuous beams, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy ≤ 3.

Unit II

Matrix Method of Analysis (Flexibility method): Introduction, Axis and Coordinates, Flexibility matrix, Analysis of continuous beam and plane trusses using system approach.

Unit IV

Matrix Method of Analysis (Stiffness method): Introduction, Stiffness matrix, Analysis of continuous beam. Analysis of simple orthogonal rigid frames using system approach.

Unit V

Plastic Methods of Analysis and Influence Line diagrams: Introduction and Basic concepts of plastic analysis, shape factors of simple sections. Equilibrium and Mechanism methods, Collapse loads for simple and continuous beams. Influence line diagram of continuous beam upto three spans.

Text Books:

1. Negi and Jehangir, “Basic Structural Analysis”, Tata McGraw Hill, Publication company Ltd.
2. Gupta SP, GS Pandit and R.Gupta, “Theory of Structures Vol 2”, Tata McGgraw Hill publication company Ltd.

Reference Books:

1. J. Sterling Kinney, “Indeterminate structural analysis”, Oxford of IBH Publishing Company.
2. Norris Wilbur JK, “Elementary structural analysis”, Mcgraw Hill International Book edition.
3. Ashok K jain, “Advanced structural analysis”, Nemchand of Bros, Roorkee, India.

Course Outcomes (COs):

Students will be able to:

1. Analyze the rotation and displacement of continuous beams and frames using slope deflection method.
2. Analyze the continuous beams by Moment Distribution method.
3. Analyze beams and trusses using flexibility method.
4. Analyze frames using flexibility method.
5. Determine collapse loads on beams using plastic analysis.

STRUCTURAL MASONRY

Course Code: CVE 552 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Masonry Units, Materials, types and masonry construction: Bricks, Stone and Block masonry units, strength, modulus of elasticity and water absorption of masonry materials – classification and properties of mortars. Defects and Errors in masonry construction – cracks in masonry, types, reason for cracking, methods of avoiding cracks.

Strength and Stability: Strength and stability of axially loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship. Compressive strength formulae based on elastic theory and empirical formulae.

Unit II

Permissible stresses: Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress and shear stresses.

Design Considerations: Effective height of walls and columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls, cavity walls, wall with pillars

Unit III

Load considerations and design of Masonry subjected to axial loads: Design criteria, design examples of walls under UDL, solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers.

Unit IV

Design of walls subjected to concentrated axial loads: Solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers, design of wall with openings.

Design of walls subjected to eccentric loads: Design criteria – stress distribution under eccentric loads – problems on eccentrically loaded solid walls, cavity walls, walls with piers.

Unit V

Design of Laterally and transversely loaded walls: Design criteria, design of solid wall under wind loading, design of shear wall – design of compound walls. Behavior of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS codal provisions, Introduction to reinforced brick masonry, lintels and slabs.

In-filled frames: Types – modes of failures – design criteria of masonry retaining walls.

Text Books:

1. Henry, A.W., "Structural Masonry", Macmillan Education Ltd., 1990.
2. Dayaratnam P, "Brick and Reinforced Brick Structures", Oxford & IBH, 1987.
3. M. L.Gambhir, " Building and Construction Materials", Mc Graw Hill education Pvt. Ltd.

Reference Books:

1. IS 1905–1987 "Code of practice for structural use o f un-reinforced masonry-(3rd revision) BIS, New Delhi.
2. SP 20 (S&T) – 1991, "Hand book on masonry design an d construction (1st revision) BIS, New Delhi.

Course Outcomes (COs):

Students will be able to

1. Understand properties of masonry units, strength and factors affecting strength of masonry.
2. Understand the different types of walls, permissible stresses and design consideration of masonry structure.
3. Understand the different loads acting and design of masonry structure subjected to axial load.
4. Design a masonry wall subjected to various loading and boundary conditions as per codal provisions
5. Identify and solve masonry structural system subjected to gravity, wind and seismicloadings

SOLID WASTE MANAGEMENT

Course Code: CVE 553 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Introduction to Solid Wastes: Definition of solid wastes, classification and characteristics of solid wastes, Municipal Solid Waste (Management and Handling) Rules, Biomedical Waste Handling Rules and Recycled Plastic usage Rules.

Unit II

Collection of Solid Waste: Systems of collection of solid wastes, transfer stations, collection equipments, route optimization techniques and numerical problems on route optimization, processing techniques of solid wastes (principle of operation and function only).

Unit III

Composting: Composting, factors affecting composting process, aerobic and anaerobic composting, Indore and Bangalore method of composting, mechanical composting process, vermicomposting.

Unit IV

Landfills: Sanitary landfilling, trench method, area method, ramp method and pit method, factors considered for a landfill site selection, cell design, leachate collection systems, control of gas movement and gas recovery systems.

Unit V

Incineration: Incineration process, factors affecting incineration process, air pollution prevention in incinerators, pyrolysis process, plastic waste, biomedical waste and its Impact on health, industrial solid waste recycling and recovery-electronic industry, sugar industry and thermal power plants.

Text Books:

1. George Tchobanoglous et.al., “Integrated Solid Waste Management”, Mc-Graw-Hill, Inc. New York, 1993.
2. Howard S.Peavy et.al., “Environmental Engineering”, Mc-Graw-Hill Book Company, New York, 1985.

Reference Books:

1. A.D. Bhide and B.B.Sudareshan, “Solid Waste management in Developing Countries”, NEERI, Nagpur 1983.
2. S.K Garg “Environmental Engineering (Vol II)” Khanna Publishres, New Delhi 2009.
3. Robert A. Corbit, “Standard Handbook of Environmental Engineering”, Mcgraw Hill Inc, New Delhi, 1990.
4. P. AarneVesilind, William Worrel and Reinhart, “Solid Waste Engineering”, Thomson Brooks, Cole.
5. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Govt. of India, 2000.
6. Management and Handling Rules for Municipal Solid Waste and Biomedical Waste and Plastic Waste, MOEF publications.

Course Outcome (COs):

Student will be able to:

1. Describe the components of solid waste management and the laws governing it.
2. Prioritize the solid waste processing methods and analyze collection systems to propose optimized routes for waste collection.
3. Implement and control the composting process for treatment of organic fraction of solid waste.
4. Design of sanitary landfills and control their conditions of operation and maintenance.
5. Evaluate the conditions of operation and maintenance of incinerators. Identify the waste recovery systems and impacts of plastic waste onenvironment

TRAFFIC ENGINEERING

Course Code: CVE 554 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Scope of Traffic Engineering, Road-user Characteristics: – physical, mental, psychological and environmental. Reaction time of drivers, PIEV theory, Driver testing equipment. Vehicular characteristics – static, dynamic. Power performance of vehicles. Numerical examples.

Unit II

Traffic Studies and Analysis: - volume studies, speed studies, origin and destination studies, parking studies & accident studies. Analysis of individual traffic accidents. Causes of accidents and measures to prevent accidents. Capacity of roads, PCU and PCU factors. Numerical examples.

Unit III

Traffic Regulation and Control: driver controls, vehicle controls, road controls. Traffic control devices - road markings, traffic signs & traffic signals. Webster's method and IRC method of signal design and signal coordination. Intelligent transport system. Numerical examples.

Unit IV

Road-side Furniture: delineators, guard rails & safety barriers.

Traffic flow theories – definitions, Lighthill and Whithams Theory, fundamental diagram, relationship between speed, concentration and flow. Numerical examples.

Unit V

Sampling Theory: types of samples. Normal distribution and its application to traffic engineering, Poisson's distribution and its application to traffic engineering, Significance tests and application to Traffic Eengineering. Traffic simulation. Numerical examples

Text Books:

1. Khanna S K and Justo C E G., "Highway Engineering". Nem Chand and Bros., Roorkee.
2. Kadiyali L R., "Traffic Engineering and Transport Planning", Khanna Publishers., New Delhi.

Reference Books:

1. Matson T M, Smith W S and Hurd F W., “Traffic Engineering”, McGraw Hill Book Co., New York.
2. Drew D R., “Traffic Flow Theory and Control”, McGraw Hill Book Co., New York.

Course Outcomes (COs):

Students will be able to

1. Describe the road user and vehicular characteristics affecting traffic behavior.
2. Carry out traffic studies. Analyze the traffic data and interpret the flow behavior.
3. Evaluate different traffic regulatory and control devices.
4. Analyze the various traffic flow theories and find solutions to traffic problems.
5. Apply suitable statistical tools to evaluate traffic situations.

GIS & REMOTE SENSING

Course Code: CVE 555 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Principles of Remote sensing- Interactions between matter and electro-magnetic radiation, Energy interaction in the atmosphere, Energy interactions with the earth's surface- spectral reflectance curves, Aerial Photography, Elements of photogrammetry and Visual interpretation

Unit II

Satellites and Data Products

Types of sensors- passive sensors and active sensors, Spectrometer, Sensor resolution- spectral, Spatial, radiometric and temporal, Photograph v/s image. Types of platforms- airborne remote sensing. Space borne remote sensing, Multispectral, Thermal and Hyperspectral remote sensing, Microwave remote sensing- SAR and SLR, Laser Altimetry. Image Classification: Supervised, unsupervised. Analysis of hyperspectral data, change detection studies

Unit - III

Introduction to Geographic Information System

Introduction to GIS principles, Raster and Vector-based GIS and data structures, Spatial data sources, Generation of thematic maps, Geo referencing, Digitization, Data Editing, Edge Matching and Mosaicing. Linking Spatial and Non Spatial Data

Unit - IV

Data formats: Geo-databases, Database concepts and Database management in GIS, Data manipulations: attribute operations, area/distance calculations and overlay analyses. Map Projections, Surface mapping, Interpolation (including TIN), digital elevation model (DEM), Terrain classification- slope aspect, angle of incidence etc, Varigram and Kriging, Regression and correlation analysis

Unit - V

Applications of Remote Sensing and GIS in Civil Engineering

Applications in Water Resources, Transportation, Environmental Engineering, Urban Landscapes, Vegetation, Soil, Minerals and Geomorphology, GPS – Distance measurement, Area Measurement, Ground truth Radiometer and Hands on experience on Commercial GIS software (Arc GIS and ERDAS)

Text Books:

1. Lillesand T.M., Kiefer. R.W., and Chipman. J.W., "Remote Sensing and Image Interpretation", Wiley Publications
2. Kang-tsung-Chang "Introduction to Geographic Information Systems", TMH Publishers

References Books:

1. George Joseph , "Fundamentals of Remote Sensing"
2. J.B. Campbell, "Introduction to Remote Sensing".
3. CP Lo Albert K W Yeung, "Concepts and Techniques of Geographic Information Systems", 2005 Prantice Hall of India
4. "Geographical Information Systems – Principles and Applications", Volume I edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991

Course Outcomes (COs):

Students shall be able to

1. Describe principles of remote sensing over conventional methods
2. Classify the various sensors and platforms used in remote sensing process
3. Demonstrate the concept of GIS and its applications
4. Describe data structures and data analysis
5. Illustrate how remote sensing and GIS can be used in various civil engineering applications

DESIGN OF STRUCTURAL STEEL ELEMENTS

Course Code: CV 61 **Credits: 3:1:0**

Contact Hours: 56

Course Content

Unit I

Bolted Connection: Introduction, Design Philosophies, Limit State Method, Concepts in design of connections, codal provisions and usage of HSFG bolts. Transfer of forces in bolted connections. Failure of bolted connections, simple and eccentric bolted connections, Prying forces, Beam to beam and beam to column connections.

Unit II

Welded Connections: Concepts in design of connections, Codal provisions, types of welds, Defects in welds, simple and eccentric welded connections, Beam to beam and Beam to column connections.

Unit III

Tension Members: Introduction, Types of sections, Grades of steel, Codal provision, shear lag and block shear, Analysis & Design of tension members with different cross sections, Lug angles.

Unit IV

Compression Members: Codal provisions, Slenderness ratio, Analysis and design of simple compression members (angles and I-Sections), built– upcross section Lacings and battens, Column splices, Column bases and Gusseted bases (Bolted and welded connections)

Unit V

Flexural Members: Codal provision, Lateral buckling, Web buckling and crippling, Analysis of later ally restrained and unrestrained beams. Design of restrained simple and built-up beams. Design of unrestrained simple beams.

TextBooks:

1. Subramanian. N, “Design of Steel Structures”, Oxford University Press, New Delhi
2. K.S. Duggal, “Design of Steel Structures”, Tata Mc Graw Hill, New Delhi

Reference Books:

1. Gaylord and Gaylord, “Design of Steel Structures”, Mc Graw Hill Publications, New York.
2. Relevant IS Codes: IS 800-2007, “SP:6(Part I) Structural Engineering Hand Book”, BIS, New Delhi.

Course Outcomes (COs):

Students will be able to:

1. Design of steel elements with different types of bolted connections.
2. Design of welded connections between different elements.
3. Design of tension members with different cross sections.
4. Design of compression members with different cross sections and column bases.
5. Design of restrained and unrestrained beams.

GEOTECHNICAL ENGINEERING - II

Course Code: CV 62 **Credits: 3:1:0**

Contact Hours: 56

Course Content

Unit I

Subsurface Exploration: Importance of exploration program, Types of samples-undisturbed, disturbed and representative samples, Samplers, sample disturbance, area ratio, Recovery ratio, clearances, Typical bore log, Number and depth of borings for various civil engineering structures; Soil exploration report.

Stresses in Soils: Boussinesq's theory – Assumptions; Vertical stress under Concentrated, Line, Strip (no derivations). Derivation for vertical stress under Circular loaded area with UDL; Pressure Bulb; Newmark's chart and its applications. Westergaard's theory; Pressure distribution diagrams, Contact pressure below foundations.

Unit II

Lateral Earth Pressure: Active and Passive earth pressures, Earth pressure at rest, Earth pressure coefficients. Earth pressure theories: Rankine's and Coulomb's theories. Lateral earth pressure in cohesive and cohesion-less soils. Graphical solutions for active earth pressure (forcohesion-less soil only) – Culmann's and Rebhann's graphical methods.

Unit III

Stability of Earth Slopes: Types of Slopes, causes of failure and type of failure of finite slopes. Definitions of factor of safety; Stability of finite slopes using Method of Slices, Friction Circle method, Fellineus method and Taylor's Stability Number.

Unit IV

Bearing Capacity of Shallow Foundations: Definitions of ultimate, net and safe bearing capacities, Allowable bearing pressure; Terzaghi's bearing capacity equations-assumptions and limitations, IS Code's bearing capacity equations, Bearing capacity of footings subjected to eccentric loading. Effect of ground water table on the bearing capacity of soil. Standard penetration test - Bearing capacity based on corrected SPT value.

Foundation Settlement: Calculation of settlement - Immediate, Consolidation and Secondary settlements (no derivations), differential settlement, tilt, permissible settlements & tilts as per B.I.S.

Unit V

Deep Foundations: Types of Deep Foundations; Load Transfer in Pile Foundations, Classification of pile foundations based on load transfer only; Ultimate bearing capacity of different types of piles in different soil conditions using IS code Method, Bearing capacity & settlement of Pile groups, negative skin friction on single pile and pile groups.

Text Books:

1. V.N.S. Murthy, (2018), "Soil Mechanics and Foundation Engineering", CBS Publishers & Distributors, New Delhi
2. Gopal Ranjan and Rao A.S.R. (2000), " Basic and Applied Soil Mechanics", New Age International (P) Ltd., New Delhi.
3. Punmia B.C. (2005), "Soil Mechanics and Foundation Engg.", 16th Edition, Laxmi Publications Co. , New Delhi.

References Books:

1. Bowles J.E. (1996), 'Foundation Analysis and Design"' 5th Edition, McGraw Hill Pub. Co. New York.
2. Alam Singh and Chowdhary G.R., "Soil Engineering in Theory and Practice", CBS Publishers and Distributors Ltd., New Delhi.

Course Outcomes (COs):

Students will be able to:

1. Prepare a detailed site investigation report based on geotechnical data.
2. Analyze the earth pressure on retaining structures.
3. Evaluate the stability of slopes based on different methods of analyses.
4. Assess the bearing capacity of soils and foundation settlements.
5. Select type of deep foundation required for the soil at a place and load carrying capacity of pile foundations.

EXTENSIVE SURVEY PROJECT

Course Code: CV 65 **Credits: 0:0:4**

Contact Hours: 42+14

Course Content

An extensive survey training involving investigation and design of the following projects is to be conducted for 2 weeks (14 days). The student shall submit a project report consisting of designs and drawings.

1) **General instructions**: Reconnaissance of the sites.

2) **New Tank Project**: The work shall consist of
   I) Alignment of center line of the proposed bund, Longitudinal and cross sections of the center line.
   II) Capacity surveys.
   III) Details at Waste weir and sluice points.
   IV) Canal alignment

3) **Restoration of an Existing Tank:** The work shall consist of:
   I) Alignment of centre line of the existing bund, Longitudinal and Cross sections along the CL.
   II) Capacity surveys, Details at sluice and waste weir
4) **Water Supply and Sanitary Project**: Examination of sources of water supply, Calculation of quantity of water required based on existing and projected population. Preparation of village map by any suitable method of surveying (like plane tabling), location of sites for ground level and overhead tanks underground drainage system surveys for laying the sewers

5) H**ighway Project**: Preliminary and detailed investigations to align a new road (min. 1 to 1.5 km stretch) between two obligatory points. The investigations shall consist of topographic surveying of strip of land for considering alternate routes and for final alignment. Report should justify the selected alignment with details of all geometric designs for traffic and design speed assumed. Drawing shall include key plan initial alignment, final alignment, longitudinal section along final alignment, typical cross sections of road. (Drawing should be preferably done using AutoCAD).

Course Outcomes (COs):

Students will be able to:

1. The components of a proposed new tank
2. Canal cross-sections, canal regulation and cross-drainage works
3. Redesign of the tank bund, surplus weir and increase in the reservoir capacity.
4. Comprehensive water supply and sewerage system for a specified community
5. Alignment and realignment of Roads.

HIGHWAY ENGINEERING LABORATORY

Course Code: CV L66 **Credits: 0:0:1**

Contact Hours: 14

Course Content

1. **Tests on Aggregates:**
   I) Aggregate Crushing Value Test
   II) Stone Polishing Value test
   III) Aggregate Impact Test
   IV) Shape tests (Flaky, Elongation, Combined Index, Angularity number)
   V) Specific gravity and water Absorption Test

2. **Tests on Bituminous Materials and Mixes:**
   I) Specific Gravity Test,
   II) Penetration Test,
   III) Ductility Test,
   IV) Softening point Test,
   V) Flash and fire point Tests,
   VI) Viscosity Test vii. Marshall Stability tests

3. **Tests on Subgrade Materials**:
   I) California Bearing Ratio test on subgrade soil
   II) Wet Sieve Analysis

4. **Traffic studies:** Volume and Speed studies.

Reference Book:

1. Relevant IS Codes and IRC Codes.
2. S.K Khanna, C.E.G. Justo, and A. Veeraragavan, "Highway Material and Pavement Testing Laboratory Manual" Revised 5th Edition 2009, Nemi Chand & Bros.

Course Outcomes (COs):

Students will be able to:

1. Characterize aggregates based on mechanical properties.
2. Evaluate bitumen properties for its suitability for various conditions.
3. Characterize and identify the source of binders.
4. Evaluate soil for gradation and strength parameters.
5. Design bituminous mix based on Marshall mix properties.

DETAILING OF STRUCTURAL ELEMENTS LABORATORY

Course Code: CV L67 **Credits: 0:0:1**

Contact Hours: 14

Course Content

Part–A – RCC Elements

1. Beams: Simply supported, Cantilever and Continuous
2. Slabs: One-way, Two-way and One-way Continuous
3. Foundations: Isolated & Combined Footing (Beam & Slab type)
4. Staircase: Doglegged
5. Retaining wall: Cantilever Type
6. Retaining wall: Counter-fort Type
7. Water Tanks: Circular and Rectangular in Plan

Part–B – Steel Elements

8. Beam to Beam connection: Bolted and Welded
9. Beam to Column connection: Bolted and Welded
10. Column Bracket connection: Bolted and Welded
11. Built–up Columns with Lacings
12. Built–up Columns with Battens
13. Column bases and Gusseted bases with bolted &welded connections
14. Column Splices

Text Books

1. N. Krishnaraju "Structural Design & Drawing Reinforced Concrete & Steel", University Press.
2. Krishnamurthy "Structural Design and Drawing (Concrete Structures)", CBS publishers, New Delhi. Tata Mc Graw publishers.

Reference Books

1. B.C. Punmia "Reinforced Concrete Structures" Laxmi Publishing Co.
2. Subramanian .N, "Design of Steel Structures", Oxford University Press, New Delhi.
3. K.S. Duggal, "Design of Steel Structures", Tata Mc Graw Hill, New Delhi.

Course Outcomes (COs):

Students will be able to:

1. To detail the RC members as per SP 34.
2. Detail the reinforcement of different types of foundation systems.
3. Detail the reinforcement of retaining wall and water tank as per codal provisions.
4. Detail the different connection in steel members
5. Detail the built-up column with lacing and batten system, column bases & column splices.

BUILDING GRAPHICS LABORATORY

Course Code: CV L68 **Credits: 0:0:1**

Contact Hours: 14

Course Content

1. Principles of civil engineering drawing and introduction to AutoCAD, Concept of setbacks, carpet area, plinth area, floor area ratio, and floor space index, super built up area, bubble diagram and coverage. Introduction to urban and municipal bylaws as per national building codes.
2. Sectional elevation of masonry wall including footing.
3. Concept of plan, elevation, cross section, schedule of opening and site plan of a single bed residential building.
4. Development of plan, elevation and section of building from single line diagram.
5. Development of plan, elevation and section of two storied building from single line diagram.
6. Space design of a apartment building using circulation diagram satisfying the given requirement.
7. Space design of a primary health Centre.
8. Space design of a educational building.
9. Space design office building.
10. Space design of post office and bank building.
11. Development of water supply, sanitary and electrical drawing for a given residential building as a layer.
12. Development of center line drawing for a storied building- footing, column, beam locations.

Text Books:

1. Gurucharan Singh and Subash Chander, "Civil Engineering Drawing". (2014), English Standard Publishers and Dist., Delhi
2. Sikka V B Kataria S K & Sons. "A Course in Civil Engineering Drawing"

Reference Books:

1. Shah M H and Kale C M, "Building drawing", Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi.
2. Gurucharan Singh, "Building Construction", Standard publishers and distributors, New Delhi.
3. National Building Code, BIS, New Delhi.

4. Sham Tickoo, “Understanding AUTOCAD 2004 A beginner’s Guide”, Wiley Dreamtech India Pvt Ltd.
5. Jayaram M A., Rajendra Prasad D S., “A referral on CAD Laboratory”, Sapna Publications.

Course Outcomes (COs):

Students will be able to:

1. Develop the ability to draft civil engineering drawing using CAD software.
2. Demonstrate the knowledge of local bylaws and will be able to design the building in accordance with local regulations.
3. Design the different types of building in accordance with climatic conditions, with environmentally responsibility and as per the requirements of the owner.
4. Create working drawings for construction.
5. Create detailed drawing of utilities including water supply, sanitary and electrical layout as layers.

DESIGN OF PSC STRUCTURE

Course Code: CVE 631 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Materials, Basic Principles of Pre - Stressing & Analysis of Sections For Flexure: High strength concrete and steel, Stress-Strain characteristics and properties, Pre-tensioning and Post-tensioning systems with end anchorages, Comparison of behavior of reinforced concrete and prestressed concrete Stresses in concrete due to pre-stress and loads for different types of cross sections, stresses in steel due to loads, Cable profiles, Load balancing concept, Centre of Thrust.

Unit II

Losses of Pre-Stress & Deflections: Losses in Prestress, Loss of Prestress due to Elastic shortening, Friction, Anchorage slip, Creep of concrete, Shrinkage of concrete and Relaxation of steel , Total Loss.

Deflections of pre-stressed members, Short term and long term deflections, Elastic deflections under transfer loads and due to different cable profiles. Deflections limits as per IS 1343. Effect of creep on deflection, Methods of reducing deflection. Limit state of serviceability and control of deflections.

Unit III

Limit State of Collapse: Flexure and Shear - IS code recommendations, Calculation of Ultimate flexural strength of sections. Calculation of principal tensile stress, shear resistance of sections, shear reinforcement.

Unit IV

Design of End Blocks: Transmission of prestress in pretensioned members, transmission length, Anchorage stress in post-tensioned members. Bearing stress and bursting tensile force, stresses in end blocks, IS code method, provision for the design of end block reinforcement.

Unit V

Design of Beams: Design of pre-tensoned and post-tensioned sections. Permissible stress, design of pre - stressing force and eccentricity, limiting zone of pre-stressing force, cable profile.

Text Books:

1. Krishna Raju N, “Pre - stressed Concrete”, Tata Mc Graw Hill, New Delhi
2. Rajagopalan N, “Pre - stressed Concrete”, Narosa Publishing House, New Delhi

Reference Books:

1. Lin T Y and Burns N H, “Design of Pre - stressed Concrete Structures” , John Wiley and Sons, New York
2. Pundit G S and Gupta S P, “Pre - stressed Concrete”, C B S Publishers, NewDelhi

Course Outcomes (COs):

Students will be able to:

1. Understand the requirement of PSC member for present scenario and analysis of stresses of PSC elements for transfer and at working.
2. Understand the efficiency of design of PSC after studying losses and deflection of PSC elements.
3. Evaluate the ultimate flexural and shear strength for design requirements.
4. Analyze and design the end block as per I.S code
5. Design the beam sections for different requirement

REHABILITATION OF STRUCTURES

Course Code: CVE 632 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Maintenance: Definition, necessity of maintenance, classification of maintenance, environmental agencies, normal wear and tear, failure of structures, inspection of structures, inspection periods, preventive maintenance, predictive maintenance, reliability centered maintenance, reactive maintenance, organization for maintenance, computerized maintenance & management system. Condition of flooring, roof leakage, condition of service fittings, drainage from terrace roof, growth of vegetation, steps to reduce repairs and replacement, normal breakup & management tools for effective maintenance.

Unit II

Durability and deterioration: Physical causes: Durability of concrete causes of distress in concrete, shrinkage, freeze and thawing, weathering, abrasion, temperature, fire, form work movement, settlement, foundation settlement, construction errors, overloads, accidental loadings and design errors.

Chemical causes: Chemical attack on concrete, Sulphate attack, acid attack, alkali reaction, aggregate reaction, silica reaction, crystallization of salts in pores, sea water attack, biological attack & other chemical attacks. Corrosion: Principle of corrosion, mechanism, process, damage due to corrosion, codal provisions, symptoms of distress due to corrosion & corrosion protection techniques.

Unit III

Structural damage assessment: Inspection, structural appraisal, economic appraisal, components of quality assurance & conceptual basis for quality assurance schemes. Destructive testing systems - direct load tests & load test on structural elements. Semi destructive testing systems - penetration techniques, Pull out test, core sampling &permeability test. Non-destructive testing systems – NDT methods, ultrasonic pulse velocity test, pulse echo method, electromagnetic methods, acoustic emissions & radiographic methods.

Unit IV

Functional materials for repair and rehabilitation: Criteria for selecting repair materials, classification of materials, physical and chemical strength tests, adhesive strengths and test for surface quality. Patching materials-cementitious materials,

polymer mortar and concrete, quick setting compounds, bituminous materials, protective coatings, sealing materials, water stops, water proofing materials, coatings, membranes & bonding materials. Special repair materials, chemicals and mineral admixtures, SP, accelerators, fly ash, GGBS,CSF, polymeric materials and coatings, SFRC, application of SFRC to repair, FRF composites, ferro cement, carbon fibers SIFCON, SIMCON, Slurry Infiltrated Fibrous Concrete & Nano materials for rehabilitation.

Unit V

Rehabilitation and Strengthening techniques: Repair of cracks, methods of repair, stages of repair, resin injection, routing and sealing, stitching, external stressing, bonding, blanketing, overlays, flexible sealings, drilling, plugging, surface coatings, grinding, sand blasting & acid etching. Rust eliminators and polymers coating for re-bars, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Examples of repairs to structures, repairs to overcome low member strength, deflection, cracking, chemical disruption, weathering, wear, fire, leakage, marine exposure. Structure concrete strengthening, jacketing, external bonding, section enlargement, externally bonded steel plates, external reinforcement & NSM techniques.

Text Books:

1. Dr. B. Vadivelli, "Rehabilitation of Concrete Structures", Standard Publishers Distributors, Delhi.
2. M S Shetty, "Concrete Technology – Theory and practice", S.Chand and company, New Delhi.

Reference Books:

1. Dension Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical, U.K, 1991.
2. RT. Allen and S.C. Edwards, "Repair of concrete Structures", Blakie and sons, UK, 1987.
3. "Training course notes on damage assessment and Repair in low cost housing Santhakumar", S.R.RHDC-NBO Anna University, Madras, July, 1992.
4. "CPWD hand book for Rehabilitation of structures"

Course Outcomes (COs):

Students will be able to

1. Summarize the importance of maintenance and inspection of structures.
2. Identify the causes of deterioration in structures due to physical and chemical attack.
3. Inspect and assess the structures using techniques of visual inspection and NDT.
4. Evaluate structural damage and recommend suitable repair materials and strengthening methods.
5. Identify and suggest the Rehabilitation and Strengthening techniques.

PAVEMENT MATERIALS AND CONSTRUCTION

Course Code: CVE 633 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Aggregates - Origin, classification, requirements, properties and tests on road aggregates, concepts of size and gradation, design gradation, maximum aggregate size, aggregate blending to meet specifications. Bitumen and Tar - origin, preparation, properties and chemical constituents of bituminous road binders, requirements.

Unit II

Binders-Bituminous Emulsions, Cutbacks and Modified binders– preparation, characteristics, uses and tests. Bituminous Mixes – mechanical properties, design methods using Rothfutch's method and specifications for voids in mineral aggregates, voids in total mix, density, flow, stability, percentage voids filled with bitumen.

Unit III

Equipment in highway construction –Various types of equipment for excavation, grading and compaction – their working principle, advantages and limitations. Special equipment for bituminous and cement concrete pavement and stabilized soil road construction.

Unit IV

Subgrade – Functions, requirements and tests, earthwork grading and construction of embankments and cuts for roads. Preparation of subgrade, quality control tests. Base course and sub-base course layers – functions, requirements, types, specifications, construction methods, quality control tests.

Unit V

Pavement Construction: Flexible pavements – specifications of materials, construction method and field control checks for various types of flexible pavement layers. Cement concrete pavements – specifications and method of cement concrete pavement construction, quality control tests, construction of various types of joints.

Text Books:

1. Khanna SK and Justo CEG, "Highway Engineering", Nem Chand and Bros, Roorkee.

2. Sharma BC, “Construction Equipment and Its Management”, Khanna Publishers.

Reference Books:

1. Bituminous Materials in Road construction, RRL, DSIR, HMSO Publications.
2. “Soil Mechanics for Road Engineers”, HMSO Publications.
3. Relevant IRC Codes and MoRTH specifications.

Course Outcomes (COs):

Students will be able to:

1. Characterize materials for pavement construction based on MoRTH specifications.
2. Design bituminous mixes as per MoRTH specification.
3. Determine usage of equipment’s for pavement construction.
4. Adopt construction techniques, specifications and quality control for pavement layers.
5. Compare construction procedure and quality checks for pavement systems.

ADVANCED DESIGN OF CONCRETE STRUCTURES

Course Code: CVE 634 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Retaining walls: Design of Cantilever retaining wall and Counter fort retaining wall

Unit II

Footings: Design of Raft (slab base) and combined footing

Unit III

Water Tanks: Design of circular water tanks resting on ground (Rigid and Flexible base).

Unit IV

Bunkers and Silos: Design of bunkers, silos using Janssen's Theory and Airy's Theory.

Unit V

Chimneys: Design of RCC Chimneys.

Text Books:

1. Reinforced Concrete Structures, Vol-II- B C Punmia :Laxmi Publications (P) Ltd, New Delhi.
2. Limit State Design of Reinforced Concrete Vol-II- P C Varghese: Prentice Hall of India (P) Ltd, New Delhi.

Reference Books:

1. Plain and Reinforced Concrete – Vol-II- Jai Krishna and Jain,:Nem Chand Bros, Roorkee.
2. Analysis of Structures- Vol-II : Vazirani V N & M M Ratwani : Khanna Publishers, New Delhi

Course Outcomes (COs):

Students will be able to

1. Design of retaining walls.
2. Design of Raft and combined footing.
3. Design of water tanks with fixed and flexible base
4. Design of bunkers and silos
5. Design reinforced cement concrete chimneys

DESIGN OF HYDRAULIC STRUCTURES

Course Code: CVE 635 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Canal Regulation Works: Introduction, Function of a regulator, Design of cross regulator. Device for sediment control; Silt ejector and silt excluder (No design). Canal falls: types, design of notch type fall.

Unit II

Introduction, cause of failure, design principles, principal and shear stresses. Elementary profile and practical profile of a gravity dam. Design of gravity dams.

Unit III

Earth Dams: Introduction, causes of failure of earth dams, preliminary section, Determination of parametric line by Casagrande's method. Estimation of seepage.

Unit IV

Arch Dams and Buttress Dams: definition, concepts and components. Spillways: Design of spillways.

Unit V

Cross Drainage Works: Introduction, cross section and L Section of an unlined channel. Type of C.D works, Design considerations for C.D works. Transition formula design of protection works (Hydraulic design only).

Text Books:

1. Arora K.R, "Irrigation, Water Power and Water Resources Engineering". Standard publishers, Fourth edition, (2010)
2. Sharma R.K, "Text book of Irrigation Engineering and Hydraulic Structures", Oxford & IBH Publishing co, New Delhi., (2002)
3. Asawa G.L., "Irrigation and Water Resources Engineering", New age International publications, New Delhi., (2005)

Reference Books:

1. Santhosh Kumar Garg., "Irrigation engineering and Hydraulic structures", Khanna publishers, New Delhi., (1976)

2. Modi P.N, “Irrigation, water Resources and Water Power Engineering”, Standard Books House, New Delhi., Eleventh edition (2014)
3. Sharma R.K. & Sharma T.K, “Irrigation Engineering”, S. Chand & Co. New Delhi., (2007)

Course Outcomes (COs):

Student will be able to

1. Design the various structures involved in canal regulation
2. Analyze various forces acting on gravity dam and the structure
3. Analyze the causes of failure of earthen dams and design the same considering seepage
4. Conceptualize Arch and Buttress dam and design spillways
5. Design the various components involved in cross-drainage works

PRINCIPLES OF BRIDGE ENGINEERING

Course Code: CVE 641 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Introduction: Definition, classification of bridges, components of bridge, Site Selection for Bridges, Hydraulic design for linear waterway & economical span.

Unit II

RCC Box culvert: Introduction, Behavior of Box girder bridges, Design of box culvert subjected to class AA tracked vehicle and class AA wheeled vehicle.

Unit III

RCC Slab Culvert: Introduction, Behavior of slab culvert, Design and detailing of slab culvert subjected to class AA tracked vehicle, Class AA wheeled vehicle and also for Class A train.

Unit IV

T-Beam Bridge: Introduction, Behavior of T-beam bridge, Design and detailing of slab panel, cross girder, main girder using COURBON'S Method, subjected to class AA tracked vehicle.

Unit V

Substructure, Foundations, Bearings, Joints and Appurtenances: Definition of pier and abutment behaviour of pier and abutment, loads to be considered on pier and abutment, types of foundations for pier and abutment and loads to be considered on them, Importance of bridge bearings, sketches of different types of bearings

Text Books:

1. Johnson D Victor, "Essentials of Bridge Engineering", Oxford & IBH Publishing Co New Delhi
2. Krishna Raju N, "Design of Bridges", Oxford & IBH Publishing Co New Delhi

Reference Books:

1. SP Bindra, Dhanpat Rai & Sons, "Principles and Practice of Bridge Engineering", New Delhi
2. IRC 6–2000 Standard Specifications and Code of Practice for Road Bridges Section II Loadsand Stresses, The Indian Road Congress New Delhi

Course Outcomes (COs):

Students will be able to

1. Demonstrate the components of bridge and define the load flow mechanism.
2. Describe the concept of planning, loads and investigation for bridges.
3. To design slab culverts as per IRC specifications.
4. To design T-beam bridges as per IRC specifications.
5. Identify the causes of failure of bridges due to faulty design, poor quality of materials and construction methods.

COMPUTATIONAL STRUCTURAL MECHANICS

Course Code: CVE 642 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Introduction: Structural systems, Geometrical and material nonlinearities. Static and Kinematic indeterminacy. Concepts of stiffness and flexibility. Flexibility and stiffness matrices of truss and beam elements. Energy concepts- Principle of minimum potential energy and minimum complementary energy

Unit II

Element Flexibility Method: Transformation of system forces to element forces in flexibility method. Assembly of structure flexibility matrix in element flexibility method, Flexibility method applied to trusses, continuous beams and rigid frames.

Unit III

Element Stiffness Method: Transformation from system forces to element forces in stiffness method, Assembly of structure stiffness matrix in element stiffness method. Stiffness method applied to trusses, continuous beams and rigid frames. Introduction to analysis of grids.

Unit IV

Direct Stiffness method: Local and Global coordinate systems, Stiffness matrices of truss and beam elements in global coordinates, Analysis of trusses and beams by Direct Stiffness method

Unit V

Storage Techniques: Half band, skyline storage, Equation solvers, Frontal solvers, Band width consideration, Algorithms and flowcharts, Solution of equations, Uses of commercial packages

Text Books:

1. Weaver W and Gere J H,“ Matrix Analysis of Framed Structures”, CBS Publications, New Delhi
2. Rajasekaran S, “Computational Structural Mechanics“, PHI, New Delhi

References:

1. Pundit and Guptha, “Theory of Structures”, Vol II, TMH Publications, New Delhi
2. A K Jain, “Advanced Structural Analysis”, Nemchand Publications, Roorkee
3. CS Reddy, ‘Basic Structural Analysis“, TMH Publications, New Delhi

Course Outcomes (COs):

Students will be able to:

1. Describe structural systems and application of the concepts of flexibility and stiffness matrices
2. Adopt flexibility matrices to solve problems in trusses, beams and rigid frames
3. Adopt stiffness matrices to solve problems in trusses, beams, rigid frames and grids
4. Adopt direct stiffness methods to solve problems in trusses, beams and rigid frames.
5. Describe various storage schemes and standard commercial packages

PAVEMENT EVALUATION AND MANAGEMENT

Course Code: CVE 643 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Introduction Definition, Components of Pavement Management Systems, Pavement Management Levels and functions. Influence Levels- Use of Pavement Management System as a planning and technology improvement tool; PMS applications

Unit II

Data Requirements: Classes of data required: Importance of performance related data; Construction and Maintenance data - Modern Technologies for Inventory Data Collection like LIDAR, Drone - Pavement Surface Distress Surveys- Types of Distress- Causes and Treatments as per IRC:82 and IRC:SP:83; Equipment for Automatic Distress Evaluation- Development of Condition Index (PCI); field studies on distress data collection and development of PCI as per PAVER.

Unit III

Pavement Condition Evaluation Functional Condition Evaluation: Serviceability-Performance Concept - Evaluation of Surface Condition by physical measurements-Equipments for evaluating roughness like MERLIN, Bump Integrator, Hawkeye, ROMDAS and their calibration- Applications of Roughness data in PMS Structural Condition Evaluation: Pavement Structural Condition evaluation by non-destructive tests such as Benkelman beam, Falling Weight Deflectometer and other NDT tests - Structural Condition Evaluation as per IRC:81-1997 and IRC : 115-2014; deflection bowl analysis; Bench Marking of structural condition of pavements with deflection bowl parameters; Problems

Unit IV

Performance models Concepts: Modeling techniques- structural condition deterioration models-: mechanistic and empirical models; probabilistic models-comparison of different deterioration models. Functional condition deterioration models: unevenness prediction models and other models- comparison of different models. Models as per HDM-4; Case Studies. Remaining Service Life Estimation

Unit V

Ranking, Optimisation and PMS at Project and Network level. Sample size selection-establishing criteria - determining needs- rehabilitation and maintenance strategies-

priority programming of rehabilitation and maintenance- analysis of alternate pavement maintenance strategies- selection of optimal design strategy at project and network level; Life cycle cost analysis; Application of HDM-4; Case Studies.

Text Book

1. Ralph Haas and Ronald Hudson with Lynne Cowe Falls, "Pavement Asset Management", Scrivener Publishing, Wiley, 2015.
2. Haas- R. C. G.- W. Ronald Hudson- and John P. Zaniewski. "Modern Pavement Management". Malabar- Fla: Krieger Pub. Co- 1994

Reference Books:

1. Hudson- W. Ronald- R. C. G. Haas- and Waheed Uddin. "Infrastructure Management: Integrating Design- Construction- Maintenance- Rehabilitation- and Renovation". New York: McGraw-Hill1997.
2. Rajib B.Mallick- Tahar El-Korchi- "Pavement Engineering: Principles and Practice- 2nd Edition"- CRC Press- 2013
3. Prithvi Singh Khandal- "Bituminous Road Construction in India"- PHI Learning Private Limited2016. 4. Shahin- M.Y- "Pavement Management for Airports- Roads and Parking Lots"- Chapman & Hall1994 (Chapters 2 to 10)
4. Richard Robinson, Uno Danielson and Martin Snaith- "Road Maintenance Management – Concepts and Systems"- Macmillan Press- 1998 (Chapters 4 to 7)
5. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, "Highway Engineering", Revised 10th Edition, Nem Chand & Bros., 2017.

Relevant Codes

1. IRC- "Code of Practice for maintenance of Bituminous surfaces of highways"- IRC: 82-1982- Indian Road Congress- New Delhi.
2. IRC- "Guidelines for Surface Evenness of Highway Pavements"- IRC: SP: 16(First Revision)- Indian Road Congress- New Delhi.
3. IRC- "Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique"- IRC: 115-2014- Indian Road Congress- New Delhi.
4. IRC, ' Guidelines for Maintenance, Repair and Rehabilitation of Cement Concrete Pavements; IRC:SP:83-200

Course Outcomes (COs):

Students will be able to

1. Interpret and assess the components of pavement managements system.
2. Collect and analyze the data for pavement management system.
3. Assess the functional and structural conditions of pavements.
4. Analyze the performance models regarding to the pavement systems.
5. Utilize the optimization methods in road asset management

APPLIED HYDRAULICS

Course Code: CVE 644 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Boundary Layer Theory and Drag & Lift: Introduction. Laminar and Turbulent flows. Boundary Layer- Definition, Thickness of B.L, Boundary Layer along a long thin plate and its characteristics, Prandtl's Boundary layer equations, Laminar boundary layer, Turbulent boundary layer. Laminar sub-layer, Separation of boundary layer, Methods of controlling boundary layer. Flow Around Submerged Objects: Introduction. Drag and Lift - Definitions, Types of drag, Dimensional analysis of drag and lift, Drag on a sphere, cylinder, flat plate and airfoil, Lift on a circular cylinder and airfoil.

Unit II

Energy and Momentum Principles in Open Channel Flow: Introduction, Classification of flow in open channels, Types of channels, Velocity distribution in channel section, pressure distribution in open channel, Energy and Momentum principles, Description of specific energy curve, channel transitions, Metering flumes – Venturi flume, Standing wave flume.

Unit III

Gradually Varied Flow in Open Channel: Introduction. Dynamic equations of Gradually Varied Flow, Characteristics of flow profiles, Control sections, Analysis of flow profiles- Gradually Varied Flow computations, Practical applications

Unit IV

Rapidly Varied Flow in Open Channels: Introduction. Hydraulic Jump - Momentum equation for the Jump, Classification of Jumps, characteristics of jump in a rectangular channel, Hydraulic jump as an energy dissipater, Location of the jump. Rapidly Varied Flow computations, Flow over spillways and weirs.

Unit V

Unsteady Flow in Open Channel Flow: Introduction, Dynamic equation for unsteady flow, Monoclinical rising wave, Wave propagation, Surges in open channels, Flood Routing – Channel routing, Muskingum method.

Text Books:

1. P.N. Modi & S.M.Seth, "Hydraulics & Fluid Mechanics Including Hydraulics Machines", Standard Book House New Delhi, 22nd edition (2017)
2. K. Subramanya, "Flow in Open Channel Flow", McGraw-Hill; Fifth edition (2019)

Reference Books:

1. VenTe Chow, "Open Channel Hydrulics", McGraw Publishing Company Ltd. New York., (2001)
2. Chaudhry, M Hanif, "Open-Channel Flow", Springer, 2nd Edition (2008)

Course Outcomes (COs):

Student will be able to

1. Describe the boundary layer formation and estimate the drag and lift forces acting on it.
2. Apply Energy and Momentum Principles in Open Channel Flow.
3. Describe and analyze Gradually Varied Flow in Open Channel.
4. Analyze Gradually Varied Flow in Open Channel and describe flow over spillways.
5. Describe Unsteady Flow in Open Channel and Flood routing.

ENVIRONMENTAL IMPACT ASSESSMENT

Course Code: CVE 645 **Credits: 3:0:0**

Contact Hours: 42

Course Content

Unit I

Definition of EIA, Need for EIA, EIS, FONSI, Utility of EIA, Scope of EIA, Step by step procedure for conducting EIA, REIA, CEIA, Limitations of EIA, Frame work of EIA, EIA Guidelines for developmental projects.

Unit II

Developmental projects - Description of affected environment with factors and indices, Methodologies of EIA – Adhoc method, Checklist method, Matrices method, Network method and Overlay method.

Unit III

Assessment and prediction of impacts on attributes- Air environment, Water environment, Noise environment.

Unit IV

Assessment and prediction of impacts on attributes - Soil and Ground water Environment and Socio-Economic and Human Health Impacts.

Public participation in environmental decision making, objectives of public participation and public participation techniques. Practical consideration in preparing in EIA and EIS

Unit V

EIA for Water Resource Project, Highway Project, Iron ore Mining Project.

Text Books:

1. Y. Anjaneyulu and Valli Manickam, "Environment Assessment Methodologies", B.S Publications, Hyderabad, 2007.
2. R.K Jain et.al Van Nostrand, "Environmental Impact Analysis" - Reinhold Company, 1977.

Reference:

1. Larry W Canter, "Environmental Impact Assessment" –McGraw – Hill International Editions, 1996.

2. Guidelines for EIA of Developmental Projects, Minister of Environment and Forests, GOI.

Course Outcomes (COs):

Students will be able to

1. Describe the fundamental concepts of EIA
2. Identify various attributes and methods of EIA
3. Apply prediction and assessment methods to EIA of air, water and noise environment
4. Asses the impacts on soil & ground water, Socio-economic and human health impacts and explain techniques of public participation in EIA
5. Apply suitable method of EIA for developmental projects