SDM College of Engineering & Technology, Dharwad

Date:18-7-2019

It is certified that the scheme and syllabus for V & VI semester of UG program in Civil Engineering is recommended by Board of Studies of Civil Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2019-20 till further revision.

Principal Chairman BoS & HoD

Program Educational Objectives (PEOs)

I. **Technical adeptness**: The Civil Engineering Graduates will be technically adept to specific fields and other disciplines. And Management towards Planning, Design, and Costing. Their technical skills and knowledge will enable them to perform their work with a commitment and quality, timeliness with continuous improvement.

II. **Interpersonal Skills**: Civil Engineering Graduates will exhibit effective interpersonal skills in teams and at work place.

III. **Awareness of Social impact:** Graduates will be made aware of causes of impacts due to the development and also to identify remedial measures if necessary.

IV. **Professionalism:** Understanding of professionalism, ethics, quality performance, sustainability and allow them to be professional leaders and contributors to society through their problem solving capabilities and executing the work.

V. **Continuous Learning:** Civil Engineering Graduates will exhibit interest in lifelong learning including studies leading to professional licensure or higher studies in engineering that provides for continued development of their technical ability and management skills

PROGRAMOUTCOMES (Pos)

Engineering Graduates will be able to:

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

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

PO3. **Design/development of solutions**: Design solutions for complex engineering 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 environmental considerations.

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. **Moderntoolusage**: 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 principle sand 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 multi-disciplinary settings.

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

PO11.**Projectmanagement and finance**: Demonstrate knowledge and understandingof the engineering and management principles and apply the set one's own work, as a member and leader in a teamto manage projects and in multi-disciplinary environments.

PO12.**Lifelong learning**: Recognize the need for, and have the preparation and ability to engage in independent and lifelonglearning in the broadest context to technological change.

PROGRAM SPECIFIC OUT COMES (PSOs)

PSO13. **Project inception and design**: Conceptualize projects related to different
fields of Civil Engineering, collect relevant data by direct and indirect methods,
analyze the project requirement and design economically viable and sustainable project.

PSO14.**Draft specification**: **Draft specification**: Select material, prepare estimates/costing, schedule work plans.

PSO15.**Experimentation**: **Experimentation and Quality Control**: Apply knowledge of different fields of Civil Engineering, conduct experiments, analyze, interpret data, and design the Civil Engineering systems

V Semester

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/ Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration In hours
15UCVC500	Structural Analysis-II	4-0-0	04	50	100	3		
15UCVC501	Design of RC Structural Elements	4-0-0	04	50	100	3		
15UCVC502	Geotechnical Engineering – I	4-0-0	04	50	100	3		
15UCVC503	Highway Engineering	4-0-0	04	50	100	3		
15UCVC504	Irrigation Engineering	3-0-0	03	50	100	3		
15UCVC505	Environmental Engineering – I	4-0-0	04	50	100	3		
15UCVL506	Fluid Mechanics Laboratory	0-0-2	01	50			50	3
15UCVL507	Computer Aided Design Laboratory	0-0-2	01	50			50	3
Total		**23-2-4**	**25**	**400**	**600**		**100**	

VI Semester B. E.

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/ Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration In hours
15UCVC600	Management, Entrepreneurship & Protection of Intellectual Property	4-0-0	04	50	100	3		
15UCVC601	Geotechnical Engineering–II	4-0-0	04	50	100	3		
15UCVC602	Environmental Engineering–II	3-0-0	03	50	100	3		
15UCVC603	Quantity Surveying and Estimation	3-0-0	03	50	100	3		
15UCVL604	Geo-technical Engineering Lab.	0-0-2	01	50			50	3
15UCVL605	Concrete & Highway Lab	0-0-2	01	50			50	3
15UCVL606	Extensive Survey	0-0-4	02	50			50	3
15UCVE6XX	Elective – 1	4-0-0	04	50	100			
15UCVE6XX	Elective – 2	4-0-0	04	50	100			
Total		**22-0-8**	**26**	**450**	**600**		**150**	

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

Elective Courses

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/ Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
15UCVE607	Design of Masonry Structures	4-0-0	04	50	100	3		
15UCVE608	Matrix Method of Structural Analysis	4-0-0	04	50	100	3		
15UCVE609	Advanced Design of Special RC Structures	4-0-0	04	50	100	3		
15UCVE610	Numerical methods in Civil Engineering	4-0-0	04	50	100	3		
15UCVE611	Advanced Structural Analysis	4-0-0	04	50	100	3		
15UCVE612	Photogrammetry and Remote Sensing	4-0-0	04	50	100	3		
15UCVE613	Earth & Earth Retaining Structures	4-0-0	04	50	100	3		
15UCVE614	Ground Water Hydrology	4-0-0	04	50	100	3		
15UCVE615	Watershed Management	4-0-0	04	50	100	3		
15UCVE616	Harbour, Dock & Tunnel Engineering	4-0-0	04	50	100	3		
15UCVE617	Railway and Airport Engineering	4-0-0	04	50	100	3		

Total number of credits offered for the Third year: 51

V Semester B. E

15UCVC500	Structural Analysis-II	(4-0-0) 4

Contact Hours: 52

Course Learning Objective (CLOs): In this course, topics on redundant trusses, Moment Distribution Method, Slope Deflection Method, Analysis of multi-storey frames, Matrix Methods are dealt.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Analysis of statically indeterminate structures by strain energy method	1,2	13	
CO-2	Analysis of redundant trusses with lack of fit and temperature stresses.	1,2	13	
CO-3	Analysis of statically indeterminate beams, rigid plane frames by slope deflection method and moment distribution method.	1,2	13	
CO-4	Analysis of Multi Storey Frames by substitute method, portal method, cantilever method and factor method	1,2	13	
CO-5	Analysis of statically indeterminate beams, rigid plane frames and pin-jointed plane frames by matrix method	1,2	13	

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	3	3											2		

Prerequisites:

1) Engineering Mechanics
2) Strength of Materials and
3) Structural Analysis- I

Course content:

1) **Redundant Trusses:** Introduction, analysis of statically indeterminate structures using strain energy method, analysis of trusses (Redundant up to second degree), lackof fit in member of indeterminate trusses, temperature stress in redundant trusses. **10 Hrs.**
2) **Moment Distribution Method:** Non-sway and sway analysis for continuous beams and frames. **10 Hrs.**
3) **Slope Deflection Method:** Introduction, sign convention, deflection equations, analysis of continuous beams and Frames **11 Hrs.**
4) **Analysis of Multi-Storey Frames:** By substitute method, portal method, cantilever method, factor method, non- sway analysis only. **09Hrs.**
5) **Matrix Methods:** Analysis of structures by Stiffness & flexibility method. **12 Hrs.**

Books/References

1) Reddy C. S., "Basic. Structural Analysis", Tata McGraw Hill Publication Company Ltd.
2) Gupta S. P.,Pandit G. S. and Gupta R. "Theory of Structures Vol. 2", Tata McGraw Hill Publication Company Ltd.
3) PrakashRao D. S., "Structural Analysis", A unified approach, University Press India Ltd., Hyderabad, 2010.
4) Wang Chu-Kia, "Statically Indeterminate Structures", Tata McGrawHill Publishers, Delhi.
5) Bhavikatti S.S., "Structural Analysis II", Vikas Publication, New Delhi.

15UCVC501	Design of RC Structural Elements	(4-0-0) 4

Contact Hours: 52

Course Learning Objective (CLOs): In this course, introduction to Working Stress Method and design of slabs, beams, columns. Footings, staircases by adopting Limit State Method of design are dealt. The delivery of topics will be made through lecture classes and site visits.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Can summarize W.S.M. and L.S.M.		1	
CO-2	Analyze and design the different types of beams for different end conditions.	1	2	8
CO-3	Analyze and design different types of slabs.	1	2	8
CO-4	Design short columns subjected to axial load an uniaxial moment.	1	2	8
CO-5	Design different types of staircases.	1	2	8
CO-6	Design different types of isolated footing and rectangular footing and rectangular combined footing.	1	2	8

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	**2.83**	**2**						**1**							

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Building Engineering Science
2) Strength of Materials
3) Structural Analysis

Course content:

1) **General features of Reinforced Concrete:** Introduction, design loads, materials for reinforced concrete, code requirements of reinforcements, elastic heory of RC sections, moment of resistance of section, balanced, under reinforced and over reinforced sections. **04 Hrs.**

2) **Principles of Limit State Design and Ultimate Strength of RC Section:** Philosophy of limit state design, principles of limit states, factor of safety, characteristic and design loads, characteristic and design strength, general aspects of ultimate strength, stress block parameters for limit state of collapse, ultimate flexural strength of rectangular sections, ultimate flexural strength of flanged sections, ultimate flexural strength of doubly reinforced sections, ultimate shear strength of RC sections, ultimate torsion strength of RC sections, concepts of development length and anchorage, examples for rectangular sections, flanged sections, doubly reinforced sections, shear strength and development length. **10 Hrs.**
3) **Serviceability Limit States (Only Introduction):** General aspects, deflection limits in IS: 456-2000, calculation of deflection (Theoretical method), cracking in structural concrete members, calculation of deflections and crack width. **02 Hrs.**
4) **Design of Beams:** Practical requirements of an RCC beam, size of the beam, cover to the reinforcement, spacing of bars, design procedure, critical sections for moments and shear, anchorage of bars: check for development length, reinforcement requirements, slenderness limits for beams to ensure lateral stability, design examples for simply supported beams and cantilever beams (rectangular and flanged sections). **10 Hrs.**
5) **Design of Slabs:**Introduction, general consideration of design of slabs, rectangular slabs spanning in one direction, rectangular slabs spanning in two directions for various boundary conditions, design of simply supported slabs, cantilever slabs and continuous slabs. **10 Hrs.**
6) **Design of Columns:**General aspects, effective length, loads on columns slenderness limits for columns, minimum eccentricity, design of short axially loaded columns, design of column subjected to combined axial load and uniaxial moment using SP16. **06 Hrs.**
7) **Design of Footings:**Introduction, load for foundation, design basis (limit state method), design of footings for axial load, axial load and bending moment and Design of rectangular combined footing. **06 Hrs.**
8) **Design of Staircase:**General features, types of stair case, loads on stair cases, effective span as per IS code provisions, distribution of loading on stairs, design of stair cases. Straight, dog legged and open well stairs. **04 Hrs.**

Note: The students are required to prepare working drawings of all the designs made in Computer Aided Drafting Tools as assignments.

Books/References

1) Varghese P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, New Delhi.
2) Karve S R. and Shah V.L., "Limit state theory and design of reinforced concrete", VidyarthiPrakashan, Pune.
3) Jain A.K., "Limit state method of design," Nemichand and Bros, Roorkee.
4) IS Codes : IS 456-2000 & SP 16.
5) Krishnaraju N., "Reinforced concrete design", New Age Publication.

15UCVC502	Geotechnical Engineering – I	(4-0-0) 4

Contact Hours: 52

Course Learning Objective (CLOs): In which the basic knowledge of various parameters pertaining to engineering properties of soil and the principles of soil mechanics are imparted to the students. Topics covered include the index properties of soil, soil classification, flow of water through soils, compaction/ consolidation of soils and shear strength of soil along with numerical problems. The delivery of the topics is achieved through lecture classes, problem solving and demonstrations.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Define and explain the soil formation, phase diagram, Derive the inter relations of soil properties and explain the methods of identification of soils in the field.			1, 2
CO-2	Define and calculate the various index properties of soil, Explain the laboratory methods for their determination.		4	1,2
CO-3	Explain and determine soil classification			1,2

CO-4	Define, explain and calculate the permeability of soils, Explain the laboratory methods for its determination, Explain seepage / superficial velocity and the quick sand phenomenon, Explain flownets and characteristics / uses										2, 4			1		
CO-5	Define and explain the compaction of soils, Explain the laboratory methods for determining the compaction parameters, Explain the field compaction control.										2, 4			1		
CO-6	Define and explain the consolidation and consolidation characteristics of soils, Calculate the consolidation parameters of soils.										2, 4			1		
CO-7	Define and explain the shear strength of soil, Explain its determination in laboratory, Explain Mohr Coulomb strength theory, Calculate shear parameters using Mohr circles.										2, 4			1		
POs→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	
Mapping Level	**1**	**1.57**		**2**												

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Strength of Material
2) Building Engineering Science

Course content:

1) Introduction: Definition, origin and formation of soil, phase diagram, inter relations of soil properties, field identification of soils. **06 Hrs.**

2) **Index Properties of Soils and their Determination:** Index properties of soils, viz., specific gravity, water content, particle size distribution, consistency limits and indices, in situ density, and density index etc., laboratory tests for the determination of specific gravity by pycnometer/ density bottle method, particle size distribution by sieve analysis, liquid limit by Casagrande and cone penetration methods, plastic limit and shrinkage limit. **08 Hrs.**
3) **Classification of Soils:**Particle size classification, MIT classification, textural classification, unified soil classification and IS classification, plasticity chart and its importance. **05 Hrs.**
4) **Flow of Water Through Soils:**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, quick sand phenomenon,Introduction to flownets, Laplace Equation (Assumptions and derivation), Characteristics and Uses of flownets **08Hrs.**
5) **Compaction of Soils:** Definition, standard and modified Proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, field compaction methods, rollers and vibrators, field compaction control, Procter's needle. **06 Hrs.**
6) **Consolidation of Soils:** Definition, Mass-spring analogy, Terzaghi's one-dimensional consolidation theory, assumptions and limitations (No derivation), Normally consolidated, under consolidated and over consolidated soils, pre consolidation pressure and its determination by Casagrande's method, laboratory one dimensional consolidation test, consolidation characteristics of soils viz. coefficient of consolidation, coefficient of volume change, coefficient of compressibility, compression index **10 Hrs.**
7) **Shear Strength of Soil:** Concept of shear strength, Mohr's strength theory, Mohr Coulomb theory, measurement of shear parameters, direct shear test, unconfined compression test, triaxial compression test and vane shear test, conventional and modified failure envelops, Total and effective shear strength parameters, Factors affecting shear strength of soils. **09 Hrs.**

Reference books:

1) Dr.Punmia B.C., "Soil Mechanics and Foundations", Laxmi Publications (P) Ltd., New Delhi (16th Edition).
2) Ranjan Gopal and Rao A.S.R., "Basic and applied soil mechanics", New Age International Publishers, Bangalore.

3) NarasimhaRao A.V. and Venkatramaiah C., "Geotechnical Engineering", University Press (India) Ltd., Hyderabad.
4) Singh Alam and Chowdhary G.R., "Soil Engineering in Theory and Practice", CBS Publishers and Distributors Ltd., New Delhi.

15UCVC503	Highway Engineering	(4-0-0) 4

Contact Hours: 52

Course Learning Objective (CLOs): In which the basic knowledge of Highway alignment, design of pavement imparted to the students. Topics covered include the Highway Planning and alignment, geometric design, pavement design, highway economics, pavement maintenance and highway drainage along with numerical problems. The delivery of the topics is achieved through lecture classes, problem solving and demonstrations.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	The prioritization of the road link by a standard method.			1
CO-2	The calculation of sight distance required for driver for safe moment and overtaking.		2	1
CO-3	The geometric Design aspects of Highway Engineering.		3	
CO-4	The Design methods of flexible and rigid pavements using the IRC 37-2001 and IRC 58-2002 respectively		3	
CO-5	To comprehend construction of various types of roads.		5	
CO-6	To evaluate the structural and functional behavior of pavement.		2	
CO-7	To study different subsurface drainage system for road pavements.		1,2	

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	1.33	2	2		2										

Prerequisites:

Students taking this course shall have the knowledge of following:

Surveying

Course contents:

1. **Introduction**: Importance of transportation, modes, characteristics, comparison of different modes, Jayakar Committee recommendation and implementation, present scenario of road development in India. **3 Hrs.**
2. **Highway Planning and Alignment**: Road patterns, planning surveys, master plan, saturation system of road planning with problems, factors affecting alignment, ideal alignment, surveys and drawings for new and realignment projects (As per IRC). **4 Hrs**.
3. **Design Principles:**

   Highway geometric design: Importance cross sectional elements, width of carriage way, camber, shoulder width, design speed, sight distances, design of horizontal and vertical alignment, problems on above. **10 Hrs**

   Pavement Design: Types of pavements, design factors, determination of ESWL and EWL factors and problems, IRC method of flexible pavement design based on CSA method, stresses in rigid pavement and design as per IRC (IRC 37: 2001 and IRC 58: 2002) only. Design of joints, Tie bars, dowel bars, Temperature reinforcement. **10 Hrs**
4. **Pavement Construction**: Construction procedure of WBM, WMM, Bituminous and concrete roads, quality control measures. **7 Hrs**.
5. **Highway Economics and Financing**: Highway user benefits - VOC using charts only — Highway costs — Economic analysis by annual cost method and benefit cost ratio method.Highway financing -BOT and BOOT concepts **08 hrs.**
6. **Pavement Maintenance**: Functional & Structural deterioration of pavements, principles of pavement evaluation, types pavement failures, cases, maintenance measures for road drainage & system & pavements. **6 hrs.**
7. **Highway Drainage**: Subsurface drainage system for road pavements, types, functions, and basic design principles. **04 hrs.**

Reference Books:

1) Khanna S.K. and Justo C E G.,“Highway Engineering”, Nemchand and Bros, Roorkee.

2) KadiyaliL.R.,"Traffic Engineering And Transport Planning", Khanna Publishers, New Delhi.
3) SubramanyamK.P.,"Transportation Engineering–I", Scitech Publications, Chennai.

15UCVC504	Irrigation Engineering	(3-0-0) 3

Contact Hours: 39

Course Learning Objective (CLOs): In this course, topics on Irrigation and irrigation system, water requirements of crops, Canals, Canal Works, Diversion Work, Gravity Dam and Earthen Dams are dealt. The delivery of topics will be made through lecture classes.

Course Outcomes (COs):

At the end of this course, students should meet the learning objectives through following observable and measurable outcomes by undergoing various tests planned by the course teacher as a part of course assessment.

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Explain Irrigation and Irrigation systems.		1	
CO-2	Calculate the water requirement of crops and to evaluate Duty, Delta and Base Period for the Crop.		1	
CO-3	Explain the canal system and canal works such as regulators, canal drops and types of cross drainage works.		1	
CO-4	Explain the Diversion head work and design of impermeable floors.	3		
CO-5	Analyze gravity Dam for safety, modes of failure.	3		

CO-6	Design Earthen Dam and draw elementary profile.							3							
POs→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	**2**		**3**												

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Hydrology and Water Resource Engineering

2) Hydraulics and Hydraulic Machines

Course content:

1) **Introduction**: Definition of irrigation, Necessity of irrigation in India, Types of irrigation-surface and lift irrigation, Irrigation in India, Potential and Developments, Advantages and Disadvantages of irrigation, Methods of applying water to crops for irrigation, Standards of irrigation water quality. **04 Hrs.**
2) **Irrigation and water requirements of crops**: Water requirements of crops, Duty, Delta and Base period of a crop, Relation between Duty, Delta and Base period. Factor affecting duty of water, Crop and crop seasons, Soil fertility, Methods of maintaining soil fertility, Crop rotation, Irrigation efficiencies. (Numerical), Depth and Frequency of irrigation. Consumptive use of crops. **06 Hrs.**
3) **Canal:** Types of canals, Unlined and lined canals, Alignment of canals, Definition of gross command area, cultural command area, intensity of irrigation, time factor, crop factor, Standard sections, Design of canals by Lacey's and Kennedy's method. **08 Hrs.**
4) **Canal works**: Classification and suitability of canal regulators, Canal drop, Canal escape, Types of cross drainage works, Hydraulic principles of cross drainage works (Aqueduct and Syphon aqueduct only). **06 Hrs.**
5) **Diversion work:** Objectives of diversion head works, Definitions, Layout of diversion head works, components and their functions, Weir and barrages, Design of impermeable floors - Bligh's and Khosla's (without design problems) theories, Silt control works - silt ejectors and silt excluder. **05 Hrs.**
6) **Reservoir:** Definitions,Classification of storage structures, Storage Zones of reservoir, determination of storage capacity and yield of reservoirs using mass curve. **02 Hrs.**

7) **Gravity dams:** Forces acting am gravity dam, Elementary and practical profiles, Low and high gravity dam, Modes of failure and stability requirement. Design Problems **04 Hrs.**
8) **Earthen dams**: Types of earthen dams, Failures of earth dams. Criteria for safe design of earth dam, Preliminary design, Seepage control measures, Drainage arrangements. **04 Hrs.**

Reference books:

1) Modi P.N., "Water Resources and Water Power Engineering"-. Standard book house, Delhi.
2) Garg S.K., "Irrigation Engineering and Hydraulic Structures" Khanna publications, New Delhi.
3) Punmia and Lal Pandey, "Irrigation and Water Power Engineering" Lakshmi Publications, New Delhi.
4) Sharma R.K., "Irrigation Engineering and Hydraulics", Oxford & IBH Publishing Co., New Delhi.

15UCVC505	Environmental Engineering - I	(4-0-0) 4

Contact Hours: 52

Course Learning Objective (CLOs): In this program, basic knowledge of drinking water, its requirement, effects on health and utility are taught. Engineering activities like source finding, its quality and quantity, transportation to the treatment plant, treating it to the required standards as per IS codes, supply of water to the consumers will be dealt in detail. The program intends to provide strong foundation on environmental related topics with respect to water to civil engineering students. The delivery of topics will be made through lecture classes, demonstrations and field visits.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Characterize the sources of drinking water with respect to quantity and quality.		3,12	

CO-2	Estimate the quantity of water required by computing water demand and population forecast for a given city.						3					4,12			
CO-3	Design a system for transporting water from the source to the treatment plant and then to the consumers.											3,4			
CO-4	List and describe the quality parameters of water and their effects on health and other materials.											3,4			
CO-5	Design a system to produce potable water through conventional and special treatment processes.						11								
CO-6	Explain the function of various pipe appurtenances, pipe layouts and analyze flow through pipe mains.											5			
Pos→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level			**2.25**	**2**	**2**						**3**	**2**			

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Engineering Chemistry

Course content:

1) **Introduction:** Human activities and environmental pollution, requirement of water for various beneficial uses, need for protected water supply. **02 Hrs.**
2) **Demand of Water:** Types of water demands, domestic demand in detail, institutional and commercial, public uses, fire demand, per capita consumption, factors affecting Per capita demand, population forecasting, different methods with merits and demerits variations in demand of water. Fire demand, Estimation by Kuichling's formula, Freeman formula and National Board of Fire under Writer's formula, peak factor, design periods and factors governing the design period. **06 Hrs.**

3) **Quality of Water:** Objectives of water quality management, concept of safe water wholesomeness and palatability and potable, water borne diseases, examination of water, objectives, physical chemical and microbiological examinations, (IS: 3025 and IS: 1622.Using analytical & Instrumental techniques, drinking water standards BIS & WHO standards, health significance of fluoride, nitrates and heavy metals like mercury and cadmium, sampling of water for examination. **06 Hrs.**
4) **Sources:** Surface and subsurface sources, suitability with regard to quality and quantity. **05 Hrs.**
5) **Collection and Conveyance of Water:** Intake structures, different types of intakes; factor of selection and location of intakes, pumps, necessity, types, power of pumps; factors for the selection of a pump, pipes, design of the economical diameter for the rising main; Nomograms, use, pipe appurtenances. **04 Hrs.**
6) **Water Treatment:** Objectives of treatment, flow chart, aeration, principles, types of aerators, sedimentation, theory, settling tanks, types, design, aided sedimentation- with coagulants, dosages, chemical feeding, flash mixing, flocculates, design of all units, filtration, mechanism, theory of filtration, types of filters, slow sand, rapid sand and pressure filters including construction, operation, cleaning and their design, back washing of filter, disinfection, theory of disinfection, methods of disinfection, chlorination, chlorine demand, residual chlorine, use of bleaching powder, minor methods of treatment. **12 Hrs.**
7) **Miscellaneous treatment**: Removal of color, odor, taste with methods like aeration, use of copper sulfate, activated carbon treatment, removal of iron and manganese, fluoridation and de-fluoridation. Treatment of swimming pool water, softening, definition, methods of removal of hardness by lime soda process and zeolite process. **08 Hrs.**
8) **Methods of Distribution Systems:** System of supply, service reservoirs and their capacity determination, methods of layout distribution, hardy cross method. **06 Hrs.**
9) **Miscellaneous:** Pipe appurtenances, various valves, type of fire hydrants, pipe fittings, layout of water supply pipes in buildings. **03 Hrs.**

Reference books:

1) Garg S.K., “Water supply Engineering”, Khanna Publishers.

2) Punmia B.C. and Ashok Jain, “Environmental Engineering”, standard book house.
3) Hammer and Hammer, “Water and Waste Water Technology”, PHI, New Delhi.
4) Howard S. Peavy, Donald R. Rowe, George Techno BanoGlous, “Environmental Engineering”, McGraw Hill.

15UCVL506	Fluid Mechanics Laboratory	(0-0-2)1

Contact Hours: 36

Course learning objectives (CLOs): In this course, use flow measuring devices as per the requirements, Estimate major and minor losses in pipe and pipe fittings, calibration of triangular and trapezoidal notches. Calibration of venturimeter, determination of frication losses in pipe, determination of minor losses, determination of hydraulic coefficients for orifices and mouthpieces, calibration of broad crested weir and ogee weir, calibration of venturiflume, hydraulic jump experiments. The delivery of topics will be made through demonstration and Laboratory work.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Estimate major and minor losses in pipe.		15	9
CO-2	Perform analysis on triangular, rectangular and trapezoidal notches.		15	9
CO-3	Examine Bernoulli”s theorem		15	9
CO-4	Analysis of broad crested weir and ogee weir		15	9
CO-5	Perform analysis on venturimeter and venturiflume.		15	9
CO-6	To find hydraulic jump		15	9

Pos→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level									1						2

Course Content:

1) Use flow measuring devices as per the requirements.
2) Estimate major and minor losses in pipe and pipe fittings.
3) Calibration of triangular, rectangular and trapezoidal notches.
4) Calibration of Venturimeter.
5) Determination of friction losses in pipe.
6) Determination of minor, losses in pipes (bend, sudden contraction, sudden expansion).
7) Determination of hydraulic coefficients for orifices and mouthpieces (external cylindrical only).
8) Calibration of broad crested weir and ogee weir.
9) Calibration of Venturiflume.
10) Hydraulic jump experiments

15UCVL507	Computer Aided Design Laboratory	(0-0-2) 1

Contact Hours: 36

Course Learning Objective (CLOs): In this course, topics on spread sheets for civil engineering problems, C- Programming for analysis and design of beams are dealt.

ourse Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Developing spread sheet for Design of horizontal and vertical alignment, Computation of Earthwork and Calibration of notches and weirs.	3	5	1
CO-2	Developing spread sheet for structural elements such as Beam, Slab, Column and Footing.	3	5	1
CO-3	Design of singly and doubly reinforced RCC beams by limit state method using 'C' program.	3	5	1

Pos→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	1		3		2										

Course content:

1) Spread sheet for (i) Design of horizontal and vertical alignment, (ii) Computation of Earthwork (iii) Calibration of notches and weirs (iv) Problems on mechanics of materials
2) Spread sheet for the design of various structural elements such as (i) Beam (ii) Slab (iii) Column and (iv) Footing.
3) Introduction to structural/industrial software.

VI Semester B.E

15UCVC600	Management, Entrepreneurship & Protection of Intellectual Property	(4-0-0) 4

Contact Hours: 52

Course Learning Objective (CLOs): In this course, topics on Planning, Organizing, Staffing, Directing and Controlling, SSI, Government Institutional support and Project Formulation, Copyright, Patent, Trade mark and Industrial Design and their protection through the intellectual property laws are dealt. The delivery of the topics is made through lecture classes.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Define and explain the management and its functional areas viz. planning, organizing, staffing, directing and controlling.		11	
CO-2	Define and explain the concepts of entrepreneurship, functions/types of entrepreneurs, role of entrepreneurs in the economic development and the barriers of entrepreneurship.		9,11	
CO-3	Define an SSI and explain their characteristics and advantages. Explain the steps for starting SSI and identify the various Government agencies supporting SSI.		6,8,11	
CO-4	Formulate a project report by identifying the business opportunities and carrying out the feasibility studies.		11	

CO-5	Define and explain the different forms of intellectual properties viz. copy right, patent, trade mark and industrial design									6,8					
POs→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level						**2**		**2**	**2**		**2**				

Course content:

I) Management:

1) Engineering and Management: Historical Development of Engineering, Management, Engineering & Management a synthesis. **03 Hrs.**
2) Planning, Forecasting and Decision Making: Nature of Planning, the foundation of planning concepts, forecasting, and nature of decision making, tools for decision-making. **04 Hrs.**
3) Organizing and staffing: Nature of organizing, traditional organizational theory, technical and Modern organization structures, staffing technical organization, authority and power; delegation, meeting & committees. **04 Hrs.**
4) Motivating: Motivation, leadership, motivating and leading technical professionals. **03 Hrs.**
5) Controlling: process of control, financial controls, non-financial controls. **03 Hrs.**

II) Entrepreneurship:

1) Foundations of Entrepreneurship: Meaning of entrepreneur, functions of entrepreneur, types of entrepreneur, concept of entrepreneurship, role of entrepreneurs in economic development, barriers of entrepreneurship. **04 Hrs.**
2) Small Scale Industry: Definition, characteristics, objects, role of SSI in economic development, advantages of SSI, steps to start a SSI, impact of liberalization, privatization, and globalization on SSI, definition of ancillary and tiny industry. **04 Hrs.**
3) Government and Institutional Support: Nature of support of government, objectives and functions of MSME Development Institute, SIDBI, DIC, single window agency, KIADB, KSSIDC, KSFC. **04 Hrs.**
4) Preparation of Project: Meaning of project, Importance of project report, contents and formulation, identification of business opportunities, feasibility studies, types and purpose. **05 Hrs.**

III) Protection of Intellectual Property:

1) Introduction: Meaning and forms of intellectual property right, competing rationale for protection, international conventions, world court. **03 Hrs.**
2) Copyright: Meaning of copyright, content of copy right, ownership and rights, period of copyright, assignment and relinquishment of copyright, license, infringement of copy right, fair use, offenses and penalties. **03 Hrs.**
3) Patents: Concept of patent, patentable inventions, procedure for obtaining patent, rights and obligations of patent holders, infringements and remedies, offenses and penalties. **05 Hrs.**
4) Industrial Designs: Definition of design, procedure for registration, rights conferred by registration, infringements. **04 Hrs.**
5) Trademarks – concept, significance **03 Hrs.**

Books/References

1) Naidu N.V.R. and T. Krishna Rao, "Management and Entrepreneurship", I.K. International Publishing House, Bangalore.
2) Babcock Daniel L., "Managing Engineering and Technology", PHI.
3) Drucker Peter, "The Practice of Management", Harper Business.
4) Acharya N.K., "Text book on Intellectual Property Rights", Asia Law House.

15UCVC601	Geotechnical Engineering–II	(4-0-0) 4

Contact Hours: 52

Course Learning Objective (CLOs): In this course, topics on principles of soil mechanics in different soil engineering problems, subsurface exploration, dewatering, flow nets, stresses in soil, lateral earth pressure, stability analysis of earth slopes, bearing capacity of soils and foundation settlements along with the typical field problems and their solutions are dealt. The delivery of the topics is achieved through lecture classes and demonstrations.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Explain various methods of sub-surface exploration and determine the type of method to be employed.			1

CO-2	Explain the different methods of dewatering and lowering of ground water table.													1	
CO-3	Calculate the stress components at a point below the loaded soil mass and explain the pressure distribution diagrams										1,2				
CO-4	Calculate the lateral earth pressure on retaining walls for different backfills and loading conditions.										1,2				
CO-5	Explain the causes / types of slope failures and examine safety of a given slope.										1,2				
CO-6	Derive the general bearing capacity equation and calculate the safe bearing capacity of a given soil under different conditions of loading and water table.										1,2				
CO-7	Explain types of Plies, Calculate bearing capacity of piles and pile group										1,2				
CO-8	Explain the types of settlements and their ill effects on the buildings													1	
POs→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	**1.625**	**2**													

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Geotechnical Engineering – I

Course content:

1) **Subsurface Exploration:** Importance, exploration program, methods of exploration, boring, sounding tests, geophysical methods, electrical resistivity and seismic refraction methods, types of samples, undisturbed, disturbed and representative samples, samplers, sample disturbance, area ratio, recovery ratio, clearance, stabilization of bore holes, typical boring log, determination of ground water level by Hvorslev method (Rising water level method). **07 Hrs.**
2) **Drainage and Dewatering**: Sumps and ditches, well point systems, shallow well and deep well. Vacuum method, electro osmosis method. **06 Hrs.**
3) **Stresses in soils:** Boussinesq's and Westergard's theories for concentrated and circular loads. Comparison of Boussinesq's and Westergard's analysis. Pressure distribution diagrams, contact pressure, Newmark's chart. **08 Hrs.**
4) **Lateral Earth Pressure:**Active and Passive Earth pressures, earth pressure at rest, Earth pressure coefficients, Earth pressure theories –Rankine's and Coulomb's –assumptions and limitations, graphical solutions for active earth pressure (cohesion less soils only), Culmann's and Rebhan's methods. **08 Hrs.**
5) **Stability of Earth Slopes:**Types of slopes, causes and types of failure of slopes, definition of factor of safety, stability of finite slopes, method of slices, Fellineous method, Taylor's stability number. **06 Hrs.**
6) **Bearing Capacity:**Definitions of ultimate, net and safe bearing capacity, allowable bearing pressure, Terzaghi's bearing capacity equation & derivation, assumptions and limitations, bearing capacity of footings subjected to eccentric loading, effect of ground water table on bearing capacity, plate load test. **08 Hrs**
7) **Pile Foundations:** Introduction, Types of piles, Load carrying capacity of piles, Group action in piles, laterally loaded piles, under reamed piles. **05Hrs**
8) **Foundation Settlement:**Concept and Ill effects of settlement of soil on buildings, immediate, consolidation and secondary settlements. **04 Hrs.**

Reference books:

1) Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., New Delhi.
2) Narasimha Rao A. V., and Venkatramaiah C., "Geotechnical Engineering", University Press (India) Ltd., Hyderabad.

3) Ranjan Gopal and Rao A.S.R., "Basic and Applied Soil Mechanics", New Age Publishers, Bangalore.
4) Singh Alam and Chowdhary G.R., "Soil Engineering in Theory and Practice", CBS Publishers and Distributors Ltd., New Delhi.

15UCVC602	Environmental Engineering–II	(3-0-0) 3

Contact Hours: 39

Course Learning Objective (CLOs): In this program, knowledge of waste water, its generation and disposal, quantification and characterization of sewage, design of sewers and treatment of sewage to the required standards are dealt. The delivery of topics will be made through lecture classes, demonstrations and field visits.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Explain the necessity of sanitation and methods of sewerage systems and their suitability		2,6	12
CO-2	Quantify the domestic and storm water and design suitable sewer system for their disposal for various conditions	3	2,12	
CO-3	Describe various Sewer Appurtenances, their shapes and layout for operation and maintenance of sewerage system		2,6	
CO-4	Characterize and analyze the sewage for various pollution parameters		2,4	
CO-5	Design various treatment and disposal units for aerobic and anaerobic systems	3,7,11	13,15	

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level		2	3			2	3					1.5	2		2

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Environmental Engineering – I

Course content:

1) **Introduction** -Waste water disposal, necessity for sanitation, methods of sewage disposal, types of sewerage systems and their suitability. **02 Hrs.**
2) **Quantity of Sewage:** Dry weather flow, factors effecting dry weather flow, flow variations and their effects on design of sewerage system, computation of design flow, estimation of storm flow, time of concentration, rational method and empirical formulae of design of storm water drain. **04 Hrs.**
3) **Design of Sewers:** Hydraulic formulae for velocity, effects offlow variations on velocity, self-cleansing and non-scouring velocities, design of hydraulic elements for circular sewers flowing full and for partially full**.** **02 Hrs.**
4) **Materials of Sewers and Sewer Appurtenances:** Sewer materials, shapes of sewers, laying of sewers, jointing and testing of sewers, ventilation and cleaning of sewers.Catch basins, manholes, flushing tanks, oil and grease traps, drainage traps, basic principles of house drainage, typical layout plan showing house drainage connections, maintenance of house drainage. **06 Hrs.**
5) **Sewage Pumping:** Need, types of pumps and pumping stations. **02 Hrs.**
6) **Analysis of Sewage:** Physical, chemical and biologicalcharacteristics, concepts of aerobic and anaerobic activity, CNS cycles, more emphasis on BOD and COD. Sampling, significance, techniques and frequency. **05 Hrs.**
7) **Disposal of Effluents:** By dilution, self-purification, phenomenon, oxygen sag curve, zones of purification, sewage farming, sewage sickness, disposal standards on land and water, chlorination of sewage. **04 Hrs.**
8) **Treatment of Sewage:** Flow diagram of municipalsewage treatment plant**,** primary treatment, screening, grit chambers, skimming tanks, primary sedimentation tanks, designs, secondary treatment: trickling filter, theory and operation, types and designs, activated sludge process, principle and flow diagram, methods of aeration, modifications, F/M ratio, designs of ASP, methods of sludge disposal, sludge drying beds, sludge digestion and filter beds. **10 Hrs.**
9) **Miscellaneous Treatment Methods:** Septic tanks and oxidation pond, design, introduction to RBC, UASB, anaerobic filters. **04 Hrs.**

Reference books:

1) Garg S.K., "Waste Water Treatment", Khanna Publishers, New Delhi,
2) CPHEEO-Manual on Waste Water Treatment, Ministry of Urban .Development, New Delhi.
3) E.W. Steel and Terence J. McGee, 'Water Supply and Sewage'. Tata McGraw Hill Publications, New Delhi.
4) Ethlers Victor M, Schroeder Edward D and Steel E.W "Water and Waste water treatment", McGraw Hill, New Delhi.
5) Garg S.K, "Sewage disposal and Air Pollution", Khanna Publishers, New Delhi.

15UCVC603	Quantity Surveying and Estimation	(3-0-0) 3

Contact Hours: 39

Course Learning Objective (CLOs): In this program, estimate and types, method of taking out quantities of various items of works for buildings, steel trusses, RCC slab culverts, manhole and septic tank, brief and detailed specifications and rate analysis for items of works, measurement of earthwork for roads different methods, contracts, terms related to contracts, acceptance and award of contract, termination of contract, recording and checking of measurements, payment of bills are dealt. The delivery of topics will be made through lecture classes, demonstrations and field visits.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Explain different type of estimates, units of measurement, abstract, approximate methods of estimating buildings cost from materials and labor equations recommended by CBRI	1		
CO-2	Calculate the quantities of various items of works by center line and or long wall and short wall method of buildings, trusses, RCC slab culverts, manhole and septic tanks.	2	3	

CO-3	Understand and draft brief and detailed specifications for various items of works for building, aluminum and wooden partitions, false ceiling, aluminum and fiber doors and windows and various types of claddings.						14								
CO-4	Workout rates for the standard items of works for buildings.						2								
CO-5	Compute quantities of earthwork for roadwork by different methods.						2								
CO-6	Understand approval of works, types of contracts, essentials of contract agreement, terms related to contract, acceptance of bids, award of contract, quality control, recording and checking measurements, preparation of bills, completion of contracts, refund of deposit, termination of contracts, nominal muster roll.													12	
POs→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	**3**	**3**	**2**									**1**		**3**	

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Building Engineering Science
2) Building Planning and Drawing

Course contents:

1) **Estimate:** Types of estimates, various drawing attached with estimates, units of measurement, **02 Hrs.**

2) **Estimation:** Methods of taking out quantities bycenter line method and long and short wall method or crossing method. Preparation of detailed estimates and abstract for Buildings - Masonry structures and framed structures with flat, sloped RCC roofs, RCC slab culverts, manhole and septic tanks, **14 Hrs.**

3) **Specifications:** Definition of specification, objective of writing specifications, essentials in specifications, general and detail specifications of item of works

in buildings, specifications for aluminum and wooden partitions, false ceiling, aluminum' and fiber doors and windows, various types of claddings. **06Hrs**

4) **Rate Analysis:** Definition and purpose. Working out rates for the standard items of works. **06 Hrs.**

5) **Measurement of earthwork for roads:** Methods for computation of earthwork by midsection,mean sectional area, trapezoidal, prismoidal methods for different terrains. **04 Hrs.**

6) **Contracts:** Sanction/ approval of works, administrative approval - technical sanction, types of contract — essentials of contract agreement.Duties and liabilities of contractor/ department.Definition of the terms - Tender, earnest money deposit, security deposit**,** acceptance of contract documents, comparative statements and issue of work orders.Execution of works, quality control, procedure for recording and checking measurements - preparation of bills**,**completion certificate, refund of deposits.Termination of contract and reasons.Execution of works by department - Nominal muster roll. **07 Hrs.**

8. Introduction to CPM & PERT analysis: Determination of critical path method for given project. **02hrs**

Reference books:

1) DuttaB.N., 'Estimating & Specification', UBS publishers and distributors, New Delhi.
2) Chakraborti N., 'Estimating, Costing, Specification and Valuation in Civil Engineering', Published by author, Calcutta.
3) Rangwala S.C., 'Estimating & Specification', Charotar Publishing House, Anand.
4) Schedule of Rates of PWD and Irrigation Department.

15UCVL604	Geo-technical Engineering Lab.	(0-0-2) 1

Contact Hours: 36

Course Learning Objective (CLOs): In this course, topics on specific gravity of soil, moisture content of soil, grain size analysis and consistency of soil, compaction parameters, shear strength, relative density and various index of soil are dealt. The delivery of topics will be made through instruction classes, demonstration and Laboratory work.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Measurement and interpretation the engineering properties of soils.			9,4,15
CO-2	Categorize soils based on experimental results.			9,4,15
CO-3	Choose the suitability of soils for particular works based on values of index and engineering property parameters.		1,4	9,15
CO-4	Calculate the safe bearing capacity of soils.		1,4	9,15

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2			1.5					1						1

Course Content:

Tests for the determination of:

1) Specific gravity by density bottle, by pycnometer
2) Moisture content by oven drying method and pycnometer
3) Grain size analysis of soil (Sieve analysis).
4) In situ density by core cutter and sand replacement methods.
5) Consistency limits, liquid limit (Casagrande and cone penetration methods), plastic limit and shrinkage limit.
6) Compaction parameters by Standard Proctor compaction test and modified Proctor compaction test.
7) Coefficient of permeability by constant head and variable head methods.
8) Shear strength by a) Unconfined compression test b) Direct shear test c) Triaxial test (undrained). d) Vane shear test
9) Relative density
10) Compression index and coefficient of consolidation- Demonstration of consolidation.

Reference books:

1) Lambe T.W., "Soil testing for engineers", Wiley Eastern Ltd., New Delhi.
2) Head K.H., "Manual of soil laboratory testing", Vol . I, II and III, Pentech Press, London.
3) Bowles J.E., "Engineering properties of soils and their measurements", McGraw Hill Book Co. New York.
4) Relevant IS Codes.

15UCVL605	Concrete & Highway Lab	(0-0-2) 1

Contact Hours: 36

Course learningobjectives (CLOs): In this course, characteristics of cement, strength of aggregate, shape tests on aggregate, strength parameters of concrete, properties of bitumen are dealt. The delivery of topics will be made through demonstration and Laboratory work. The delivery of topics will be made through instruction classes, demonstration and Laboratory work.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Perform crushing test, impact test & abrasion test.		15	9
CO-2	Perform specific gravity test & shape test to know characteristics of aggregate.		15	9
CO-3	Estimate the workability of concrete by slump test, compaction factor test & Vee-bee consistometer test.		15	9
CO-4	To find normal consistency, initial & final setting time of cement.		15	9
CO-5	Design the mix proportion for given grade of concrete	3	15	9
CO-6	Perform tests on bitumen.		15	9

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level			3						1						2

Part - A

1) **Cement:** Normal Consistency, Setting time, Soundness by Autoclave method, Compression strength test and Air permeability test for fineness, Specific gravity of cement
2) **Fresh concrete:** Workability-slump, Workability for self-compacting concrete, Compaction factor and Vee-Bee test.
3) **Hardened concrete:** Compressive strength and Split tensile tests,Durability tests,NDT Methods.

Part - B

1) **Aggregates:** Crushing, abrasion, impact and Shape tests (Flakiness & Elongation, Angularity number) Specific gravity and water absorption.

2) **Bituminous materials and mixes:** Specific Gravity, Penetration, Ductility, Softening point, Flash and fire point, Viscosity. Marshall Stability tests, bitumen extraction. Sub grade Soil CBR Test.

Books/References

1) Gambhir.M.L.,"Concrete Manual", Dhanpat Rai & sons New Delhi.
2) "Highway Material Testing Laboratory Manual", New Chand & Bros.
3) Relevant IS Codes and IRC Codes

15UCVL606	Extensive Survey	(0-0-4)2

Contact Hours: 36

Course Learning Objective (CLOs): In this project work students will formulate, organize and carry out the project work related to water supply, highway, restoration of old tank and new tank projects. The project will be carried out through field surveys and office work.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Use Surveying equipment, schedule and conduct necessary field surveys.	5,11		

CO-2	Conduct different experiments to obtain required data.			4			15								
CO-3	Arrange to collect additional data by direct and indirect methods.			13											
CO-4	Plan, organize and prepare project reports.			13											
CO-5	Revise if necessary and finalize the project report.			13,15											
POs→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level				**3**	**3**						**3**		**3**		**2.5**

(Any two of the following projects in detail is to be carried out between fifth & sixth semester for a period of 2 weeks; Viva voce conducted along with sixth semester exams). An extensive survey training involving investigation and design of the following projects is to be conducted for 2 weeks. The students shall submit a project report consisting of designs & drawings. (Total station and GPS to be used). General instructions, Reconnaissance of the sites and fly leveling to be used to establish bench marks.

1) **New Tank Project**: Alignment of center line of the proposed bund, longitudinal and cross sections of center line, capacity surveys, details at waste weir and sluice points, canal alignment.
2) **Restoration of an Existing Tank**: Alignment of center line of the existing bund, longitudinal and cross sections along the center line, capacity surveys, details at sluice and waste weir.
3) **Water Supply 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 tank.
4) **Highway Project:** Preliminary and detailed investigations to align a new road 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.

15UCVE607	Design of Masonry Structures	(4-0-0)4

Contact Hours: 52

Course Learning Objective (CLOs): In this program, types of materials, masonry units, masonry construction, strength and stability of masonry construction, permissible stresses, design of masonry construction and gravity retaining walls are dealt. The delivery of topics will be made through lecture classes.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Classify different masonry materials with respect to physical and mechanical properties. Identify defects and error to avoid cracking.	1		
CO-2	Assess unit strength of materials, rate of absorption and effect of curing and mechanism of failure.	1	4	
CO-3	Calculate slenderness ratio of columns and walls, load dispersion on lintels and arches.	1,3		
CO-4	Design walls subjected to axial and eccentric loads with and without openings.	1		
CO-5	Stability analysis of flexure and compression member including shear walls.	1	4	
CO-6	Design masonry gravity retaining walls.	**1,3**		

POs→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	**3**		**3**	**2**											

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Strength of Materials
2) Structural Analysis

Course content:

1) **Masonry Units, Materials and Types:**Brick, stone and blockmasonry unit, strength, modulus of elasticity, water absorption, masonry materials, classification and properties of mortars, selection of mortars. **5hrs.**
2) **Masonry Construction:** Defects and errors in masonry construction, cracks in masonry, types, reasons for cracking methods of avoiding cracks. **5 hrs**.
3) **Strength and Stability:** Concentrically loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rateofabsorption, effect of curing, effect of ageing, workmanship, strength formulae and mechanism of failure for masonry subjected to direct compression. **8 hrs.**
4) **Permissible Stresses:** Permissible compressive stress, reduction and shape reduction factors, increase in, permissible stresses for eccentric vertical and lateral loads, permissible tensile, shear stresses. **6 hrs.**
5) **Design Considerations:**Effectiveheightof walls and columns, opening inwalls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels. **8 hrs.**
6) **Design of Structural Masonry:** Wall carrying axial load, eccentric load with different eccentricity ratios, walls with openings, free standing wall, design ofload bearing masonry for building up to 2 storeys using IS: 1905 and SP: 20 procedure. **6 hrs.**
7) **Reinforced Masonry:** Application, flexural and compression elements, shear walls. **5 hrs.**
8) **Masonry Walls in Composite Action:** Composite wall beam elements, in-filled frames. **4 hrs.**
9) **Design of masonry gravity retaining wall. 5 hrs.**

Reference books:

1) Hendy A W., - “Structural Masonry”, Macmillan Education Ltd.
2) Dayaratnam P., “Brick and Reinforced Brick Structures”, Oxford & IBH.
3) Sinha B P,Davies S R.,“Design of masonry structures” E&FN spon 1997
4) IS Codes: IS 1905-1987, “Code of practice for structural use of un-reinforced masonry, SP 20 (S&T).

15UCVE608 Matrix Method of Structural Analysis (4-0-0)4

Contact Hours: 52

Course Learning Objective (CLOs): In this program, advanced concepts of structural analysis using matrix method are provided. The delivery of topics will be made through lecture classes.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Apply fundamental knowledge of structural systems			1
CO-2	Illustrate and apply matrix flexibility method		2	
CO-3	Analysis indeterminate structures such as beams, trusses and frames (element approach) using matrix flexibility method.	2		
CO-4	Illustrate and apply matrix stiffness method		2	
CO-5	Analysis indeterminate structures such as beams, trusses and frames (element approach) using matrix stiffness method.	2		
CO-6	Formulate direct stiffness approach	1,2		
CO-7	Solve trusses and beams using direct stiffness method		2	

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2	2.5													

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Engineering Mathematics – All courses
2) Structural Analysis – I
3) Structural Analysis – II

Course content:

1) **Matrix Flexibility Method:** Introduction, element flexibility matrix, principle of contra gradience, general procedure for analysis of indeterminate structures (element approach) beams, trusses and frames. **18 Hrs.**
2) **Matrix Stiffness Method:** Introduction, member stiffness matrix, principle of contra gradience, solution procedure matrix, principle of contra gradience, solution procedure (element approach) of continuous beams, trusses and frames. **18 Hrs.**
3) **Direct Stiffness Method:** Introduction, local and global coordinate systems, direct assembly of element stiffness matrices, analysis of indeterminate structures, truss, continuous beams & Simple frames. **16 Hrs.**

Reference 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
3) Pundit and Guptha, "Theory of Structures", Vol II, TMH Publications, New Delhi
4) Amin Ghali and Adam Neville, "A unified classical and Matrix Approach", CRC Press.
5) C S Reddy, "Basic Structural Analysis", TMH Publications, New Delhi.

15UCVE609 Advanced Design of Special RC Structures (4-0-0)4

Contact Hours: 52

Course Learning Objective (CLOs): In this course design of flat slabs, grid floors, continuous beams, bunkers and silo's, shells and folded plates, yield line analysis of slabs and curved beams are dealt. The delivery of topics will be made through lecture classes and site visits.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	To study different parts of flat slabs, grid floors, bunkers and silos.	2,3		8
CO-2	Different design methods for flat slab, grid floors, bunkers and silos.	2,3	8	
CO-3	Design of slab using Yield Line Method.	1,2,3	8	
CO-4	Analysis and design of continuous beams and curved beams.	1,2,3	8	
CO-5	Design of flat slabs, grid floors bunkers and silos following relevant IS Codes.	2,3	8	
CO-6	Design detailing of flat slabs, grid floors bunkers and silos etc.	1,2,3	8	

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	3	3	3					1.83							

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Engineering Mechanics
2) Strength of Materials
3) Structural Analysis Vol.I and Vol.II

Course content:

1) **Design of Slabs:**Flat slab by direct design method (with and without drops), Waffle slabs. **12 Hrs.**
2) **Design of Grid Floors: Rankines** Method and Approximate method. **10 Hrs.**

3) **Yield Line Analysis of Slabs:** Virtual and equilibrium methods, design of slabs using yield line theory. **08 Hrs.**
4) **Design of Continuous Beams:** Bending moment envelops, moment redistribution, IS Code provisions. **08 Hrs.**
5) **Design of Bunkers and silos:** Johnson's and Airy's Theorem. **08 Hrs.**
6) **Beams curved in plan:** Introduction, Design. **6 hrs**

Reference books:

1) Krishna Raju N., Advanced Reinforced Concrete design, New Age Publication, 2013.
2) Punmia B.C., "Reinforced Concrete Structures", Laxmi Publication
3) Shaw H.J., "Reinforced Concrete Structures", Charotar-Publishers, 7th Edition, 2014.
4) Verghese P.C., "Advanced Reinforced Concrete", PHI. New Delhi.
5) Relevant IS Codes.

15UCVE610	Numerical methods in Civil Engineering	(4-0-0)4

Contact Hours: 52

Course Learning Objective (CLOs): In this program, application of numerical techniques to civil engineering problems isprovided. The delivery of topics will be made through lecture classes.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Illustrate numerical techniques in field of civil engineering			1
CO-2	Apply numerical technique and solve system of linear equation	1	2	
CO-3	Formulate algorithm and develop MATLAB program to solve system of linear equations	5	2	
CO-4	Apply numerical technique to find the roots of the equations	1	2	

CO-5	Formulate algorithm and develop MATLAB program to find the roots of the equations.							5				2			
CO-6	Apply numerical techniques for integration							1,5				2			
CO-7	Apply numerical technique to find solutions of ordinary differential equations							1,5				2			
CO-8	Apply finite difference technique in structural mechanics							1,5				2			
POs→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	**2.67**	**2**			**3**										

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Strength of materials
2) Structural Analysis – I
3) Engineering Mathematics – All courses

Course content:

1) **Introduction:** Historical development of numerical techniques, role in investigations, research and design in the field of civil engineering. **02 Hrs**

2) **Application of solution of linear system of equations to Civil Engineering problems:**
   i) Development of simultaneous equations from problems in construction planning, slope deflection method applied to beams and frames, truss analysis.
   ii) Development of algorithm and Mat Lab program for a) Gaussian elimination method b) Gauss-Jordan matrix inversion method c) Gauss-Siedel method and d) Cholesky decomposition method. **10 Hrs.**
3) **Application of root finding the Civil Engineering problems :**i) Development of non-linear algebraic and transcendental equations from problems in hydraulics, irrigation engineering, structural engineering and environmental engineeringii) Development of algorithm & mat lab program for bisection method and Newton-Raphson method. **10 Hrs.**

4) **Application of Numerical integration for solving simple beam problems:** Computation of area of BMD drawn for statically determinate beams byTrapezoidal and Simpson's one third rule. New Marks methods for computation of slope and deflection in statically determinate beams. Development of algorithm and Mat Lab program for trapezoidal rules & Simpson's one third rule. **10 Hrs.**
5) **Application of solution of ordinary differential equation to civil engineering problems:**Application of solution ODE by Euler's method and RungeKutta 4^{th} order method in statically determinate beam problems, problems in environmental engineering, problems in hydraulics and geotechnicalengineering.
ii) Development of algorithm and Mat lab program for Euler's method & Runge Kutta 4^{th} order method. **10 Hrs.**
6) **Application of Finite difference technique in structural mechanics:** i) Introduction, expression of derivatives by finite difference backward differences, forward differences and central differences. ii) Application of finite differences method to analysis of a) Statically determinate beams, b) Statically indeterminate beams. **10 Hrs.**

Reference books:

1) Chopra S.C. and R.P. "Numerical Methods for Engineers", McGraw Higher Ed.
2) Krishna Raju N., Mathu K.U., "Numerical Methods for Engineering Problems", MacMillan India Ltd.
3) Schilling R.J.Harrica S.L., "Applide Numerical methods for Engineers using MATLAB and C, Thomson, Singapore.
4) Jain, Iyengar and Jain, "Numerical Methods for Scientific and Engineering", New Age International.

15UCVE611	Advanced Structural Analysis	(4-0-0)4

Contact Hours: 52

Course Learning Objective (CLOs): In this course, topics on formulae differentiate equation, simultaneous equation, differentiate boundary condition, probability analysis and sizer value problem for beams and columns in Civil Engineering are dealt. The subject will be taught through class room lectures, demonstration and by solving numerical.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Apply ezen rule problems for critical load of beams & columns and vibration of problems	2,3	15	4
CO-2	Study and evaluate different equation of beam, column on elastic foundation.	2,3	15	4
CO-3	Solve simultaneous linear equation for beams and frames using WSDM and kanis method.	2,3	15	4
CO-4	Apply fine difference method for beam, column and plan.	2,3	15	4
CO-5	Probability analysis to the reinforced	2,3	15	4

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level		3	3	1											2

Prerequisites:

This subject is required the knowledge of Engineering Mechanics, Strength of Materials structural analysis 1, structural analysis 2 and the knowledge of engineering mathematics.

Course content:

1) **Differential equations:** 2^{nd}, 4^{th} order, partial differential equations, Application to problem of beams, columns, plots, beams on elastic foundation and vibration problems **10 Hrs.**
2) **Numerical methods:**Thesolution of simultaneous linear equations Application - Moment - distribution as relaxation method, Kani's iteration method. **10 Hrs.**

3) **Finite difference method:** Derivatives by finite difference, errors in finite difference, boundary conditions, application to beams critical loads of columns with variable moment of inertial and plates. **10 Hrs.**
4) Probability Random variable, elementary definition of probability, density function, different types of distribution, application to reinforced concrete structures. **10 Hrs.**
5) **Eigen value problem**: Application to critical loads of columns and beams, vibration problems. **10 Hrs.**

15UCVE612	Photogrammetry and Remote Sensing	(4-0-0)4

Contact Hours: 52

Course Learning Objective (CLOs): In this course, topics on measurements like of heights, distances, angular separation from the terrestrial and aerial photos, scale, flight planning, and instruments used in photogrammetry for quantitative measurements; fundamentals of remote sensing and application of remote sensing in Civil Engineering are dealt. The subject will be taught through class room lectures, demonstration and by solving numerical.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Analyse the advantage and limitations of terrestrial, aerial photogrammetry and Remote sensing.		1	
CO-2	Make quantitative measurements and qualitative analysis from terrestrial, aerial photogrammetry and satellite data.		2	
CO-3	Decide upon the scale and influencing factors, and decide upon the trade off		3,13	

CO-4	Plan for aerial photogrammetric survey											3,13			
CO-5	use instruments for quantitative measurements from photographs and generate maps											1			
CO-6	Use principles of remote sensing technology for its application in Civil Engg.											1			
CO-7	Explore the areas of applications of remote sensing in different projects of Civil Engg and use of advanced survey tools in the concerned project.											5,13			
POs→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	**2**	**2**	**2**		**2**								**2**		

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Surveying – I
2) Surveying – II
3) Engineering Physics

Course content:

1) **Photogrammetry:**Introduction, metric and non-metric photogrammetry, metric cameras, advantages of photogrammetry, terrestrial photogrammetry, terrestrial and aerial photogrammetry, introduction of digital photogrammetry. **10Hrs.**
2) **Aerial Photogrammetry:**Advantages over ground survey methods, vertical, titled and oblique photographs, geometry of vertical photographs-scale of vertical photographs, ground coordinates, relief displacement, titled photograph, scale, ground coordinates relief displacement, flight planning. **06 Hrs.**
3) **Stereoscopy:** Stereoscope, parallax, measurement of parallax, parallax equations, elevation by parallax differences. **10 Hrs.**
4) **Terrestrial Photogrammetry:**Photo-theodolites,locating points from two photos, determinations of focal length. **08 Hrs.**

5) **Remote Sensing:** Advantages electromagnetic radiations idealized remote sensing system, types of sensors, satellites, Indian and other remote sensing satellites, black body radiation, gray body, atmospheric windows, spectral signature, multi concept in R.S. Remote sensing products, Basics of image processing. **10 Hrs.**
6) **Applications of remote sensing:** water resources, land use and land cover analysis-environmental applications, Geological applications. **08 Hrs.**

Reference books:

1) Punmia B.C., "Surveying Vol II and III "Lakshmi Publications, New Delhi.
2) DuggalS.K.,"Surveying Vol I & II", Tata McGraw Hill publishing Co.,
3) Lillisand and Kiefer, Principles of Remote Sensing and image interpretation, John Wiley and Sons.
4) Sabins F.F, Freeman W.H and company (NY) "Remote sensing-Principles & Interpretation".

15UCVE613	Earth & Earth Retaining Structures	(4-0-0)4

Contact Hours: 52

Course Learning Objective (CLOs): In this course, topics on earth structures, retaining wall, bulkheads, traced cuts and coffer dams in Civil Engineering are dealt to meet the specified needs with appropriate consideration for society. The subject will be taught through class room lectures, demonstration and by solving numerical.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Explain, design, analyze, ensure of failure of earth structure.	1	15	2,4
CO-2	Discuss the design properties, stability analysis and mode of failure of retaining walls.	3	15	2,4

CO-3	Describes the types of sheet piles with different types of soil design of anchors.						3					15			2,4
CO-4	Describe sheeting and bracing system and design of bracing.						3					15			2,4
POs→	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	**3**	**1**	**3**	**1**											**2**

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Geotechnical Engineering – I
2) Geotechnical Engineering – II

Course content:

1) Earth Structures: Introduction about earthen dams and embankments, different types of earthen dams with sketches and theirsuitability, hydraulic fill and rolled fill methods of construction, causes of failure of earth dam, design criteria of earth dams, stability analysis, seepage control and role of filters in earthen dam design. **06 Hrs.**

2) Retaining Walls: Introduction, types of retaining walls, Failure of retaining walls by sliding, overturning and bearing, stability analysis, principles of the design of retaining walls, gravity retaining walls, cantilever retaining walls, counterfort retaining walls (no structural design), other modes of failure of retaining walls, drainage from the backfill. **06 Hrs.**

3) Bulkheads: Introduction, types of sheet pile walls, free cantilever sheet pile, cantilever sheet pile in cohesion-less soils, cantilever sheet pile in penetrating clay, anchored sheet pile with free earth support in cohesion-less and cohesive soil, anchored bulkheads with fixed earth support method, types, locations and design of anchors. **15 Hrs.**

4) Braced Cuts: Introduction, lateral earth pressure on sheeting, different types of sheeting and bracing systems, design of various components of bracings. **10 Hrs.**

5) Coffer Dams: Introduction, types of coffer dams, design of cellular coffer dams on rock by Tennesse Valley Authority (TVA) method, safety against

sliding, slipping, overturning, vertical shear and stability against bursting, design of cellular coffer dam on soil. **15 Hrs.**

Reference Books:

1) Punmia B.C., "Soil Mechanics and Foundation Engineering", Laxmi publications Ltd., New Delhi.
2) Arora K.M., "Soil Mechanics and Foundation Engineering", Standard Publishers& Distributors, New Delhi.
3) Venkataramaish C., "Geotechnical Engineering", new age publications, Hyderabad.
4) Murthy V.N.S., "Soil Mechanics and Foundation Engineering", Sai Tech Publication, Bangalore.

15UCVE614	Ground Water Hydrology	(4-0-0)4

Contact Hours: 52

Course Learning Objective (CLOs): In this course, topics like aquifer characteristics, Ground water exploration, design of wells, well hydraulics, sustainability and ground water Development etc. are included.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Characterize aquifer conditions.		1,15	
CO-2	Evaluate Fundamentals of Ground Water Flow in aquifer		2,15	
CO-3	Analyse ground water flow through aquifers		2,15	
CO-4	Locate ground water occurrence		4,15	
CO-5	Synthesise Ground Water Development methods		3,13	
CO 6	Augment water Resources for sustainable		5,15	

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2	2	2	2											2

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Fluid Mechanics

Course content:

1) **Introduction:**Importance, vertical distribution of subsurface water, occurrence in different types of rocks and soils, definitions-aquifers, aquifuge, aquitard, aquiclude, confined and Unconfined aquifers. **10 Hrs.**
2) **Fundamentals of Ground Water Flow:**Aquifer parameters, specific yield and specific retention, porosity, storage coefficient, derivation of the expression, Darcy's law, hydraulic conductivity, coefficient of permeability and intrinsic permeability, transmissibility, permeability in isotropic, unisotropic layered soils, steady one dimensional flow: cases with recharge. **10 Hrs.**
3) **Well Hydraulics:** Steady Flow,Radial flow in confined and unconfined aquifers, pumping test Unsteady Flow,General equation, derivation; thesis method, Cooper and Jacob method, Chow's method, solution of unsteady flow equations, leaky aquifers (only introduction), interference of well, image well theory. **06 Hrs.**
4) **Ground Water Exploration:** Seismic method, electrical resistively method, principles. **10 Hrs.**
5) **Ground Water Development:** Types of wells, methods of construction, tube well design, dug wells, pumps for lifting water, working principles, power requirement, Conjunctive use, necessity, techniques and economics. **10 Hrs.**
6) **Artificial Recharge** **06 Hrs.**

Reference books:

1) Bower H., "Ground Water Hydrology", McGraw Hill.
2) Garg Satyaprakash, "Ground Water and Tube Wells", Oxford & JBH.
3) Raghunath H.M., "Ground Water", Wiley Eastern Publication.
4) Todd O.K., "Ground Water Hydrology", Wiley & Sons.

15UCVE615 Watershed Management (4-0-0)4

Contact Hours: 52

Course Learning Objective (CLOs): In this course, topics like the concept of watershed management, water demand, water conservation methods, water harvesting, sustainable watershed approach, coastal watersheds, application of Remote Sensing and GIS in watershed management etc. are included.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Relate between surface and ground water resources system, and human influences.		1,13	
CO-2	Integrate water resources system in arid and semi-arid regions and watershed aquifer for management,			2,13
CO-3	Analyse water resources related issues for Conservation			6
CO-4	Synthesize Augmentation of water Resources Methods		3,13	
CO-5	Design Sustainable integrated watershed management,.		7,15	
CO 6	Apply of Modern tools in watershed management		5	

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2	1	2		2	1	2						1.7		2

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Hydrology & Water Resource Engineering

Course contents:

1) Principles of Watershed Management: Basics concepts, hydrology and water availability, surface water, ground water, conjunctive use, human influences in the water resources system. **08 Hrs.**

2) Water demand: Integrated water resources system, river basins, watershed management practices in arid and semi-arid regions, watershed management

through wells, management of water supply, case studies, short term and long term strategic planning **07 Hrs.**

3) Conservation of Water: Perspective on recycle and reuse, waste water reclamation, social aspects of watershed management, community participation, private sector participation, institutional issues, socio-economy, integrated development, water legislation and implementations, case studies. **08 Hrs.**

4) Water Harvesting: Rainwater management, conservation, storage and effective utilization of rainwater, structures for rainwater harvesting, roof catchments system, check dams, aquifer storage. **08 Hrs.**

5) Sustainable Watershed Approach: Sustainable integrated watershed management, natural resources management, agricultural practices, integrated farming, soil erosion and conservation. **08 Hrs.**

6) Applications of Geographical Information System and Remote Sensing in Watershed management, role of decision support system in watershed management. **08 Hrs.**

7) Watershed characteristics of coastal regions, coastal aquifer tor management, uniqueness of coastal water resources. **05 Hrs.**

References Books:

1) Singh Vir, R., "Watershed Planning and Management", Yash Publishing House, Bikaner.
2) Murthy, J.V.S., "Watershed Management in India", Wiley Eastern, New Delhi, American Society of Civil Engineers.
3) "Decision Support System for Integrated Watershed Management", ColoradoStateUniversity.
4) Murthy J.V.S. & Allam, G.I.Y., "Watershed Management", New Age International, New Delhi.

15UCVE616	Harbour, Dock and Tunnel Engineering	(4-0-0)4

Contact Hours: 52

Course Learning Objective (CLOs): In this course, harbour layout, natural phenomena viz. winds, waves and tides, Harbour components viz. Breakwaters, Approach Channel, Wharves, Jetties, Quays, Warehouses, Wet and dry Docks, Navigational Aids viz. Light House, Buoys, Beacons, Sound Signals, Tunnel Surveys, Soft Soil Tunneling methods, Tunneling in Rock, Explosives for Rock

Tunneling, Tunnel Lining, Tunnel Ventilation are dealt. The delivery of topics will be made through lecture classes and demonstrations.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs(1,12)/ PSOs (13,15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Define components of Harbours, Docks and Tunnels		2	1
CO-2	Classify and describe types of Harbours, Docks and Tunnels		2	1
CO-3	Classify and Characterize Components of Harbours, Docks and Tunnels		2	1
CO-4	Describe Tunneling methods		2	1

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	1	2													

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Fluid Mechanics

Course content:

Harbours& Docks:

1) Definition of Harbour, classification of Harbours (with sketches), general design features, definition of various terminology. **03 Hrs.**

2) Natural forces on Harbours, winds, waves, tides, currents, effects of each on the Harbour structures. **04 Hrs.**

3) Harbour structures, break waters, quays jetties (with sketches). **04 Hrs.**

4) Docks, Types (with sketches), differences of Harbours and docks, construction details of dry docks and wet docks, operation of each, self-docking docks, importance and method of use. **08 Hrs.**

5) Warehouses and other storage and transport facilities at Harbours. **02 Hrs.**
6) Sketches of two important Harbours showing entire layout with important components and locations. **02 Hrs.**
7) Bouys and Bouyage systems, Light house purpose, construction details. **03 Hrs.**

Tunnels:

1) Definition, components, advantages and disadvantages. **02 Hrs.**
2) Tunnel surveying, transfer of level and grade on surface survey, equipment used. **04 Hrs.**
3) Cross sections of tunnels for various purposed (with sketches). **04 Hrs.**
4) Methods of tunneling in soils including shield tunneling, tunnel borer and lining of tunnels. **10 Hrs.**
5) Methods of tunneling in rock, drilling patterns explosives. **04 Hrs.**
6) Tunnel ventilation and drainage. **02 Hrs.**

Reference books:

1) Srinivasan R., "Harbours Docks and Tunnel Engineering", Charotar Publishing House Pvt. Ltd.
2) Oza and Oza, "Harbours and Docks", Charotar Publishing House Pvt. Ltd.

15UCVE617	Railway and Airport Engineering	(4-0-0)4

Contact Hours: 52

Course Learning Objective (CLOs): In this course, salient features of permanent way, geometric design of railway, design of turnout are dealt. Further, aspects related to airport planning, design of runway and taxiway are taught. The delivering of topics will be made through lecture classes.

Course Outcomes (COs):

ID	Description of the Course Outcome:	Mapping to POs(1,12)/ PSOs (13,15)

	At the end of the course the student will be able to:	Substantial Level (3)	Moderate Level (2)	Slight Level(1)
CO-1	Calculation of quantity of materials required for railway track.		2	1
CO-2	Geometric design of railway track		3	2
CO-3	Determination of tractive resistance and hauling capacity of railway engine.	3	2	
CO-4	Design of turnouts, points and crossings.	3	2	1
CO-5	Airport planning and important factors for site selection of airport.		1	
CO-6	Geometric design of taxiway and airport marking.	3	2	

POs→	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	**1.33**	**1.8**	**2.75**												

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Highway Engineering

Course Contents:

A. RAILWAY ENGINEERING

1 Introduction: Role of railways in transportation, selection of routes. **02hrs**

2. **Permanent way**: Gauges in railways, railway track, cross sections, coning of wheels, rails, rail sections, ballast, sleepers, wear on rails, rail joints, welding of rails, creep of rails, rail fixtures, calculation of quantity of materials required for laying of tracks, traction and tractive resistances, tractive power, hauling capacity. Problems on above. **07hrs**

3. **Geometric design of track**: grade, ruling gradient,minimum gradient, pusher grade, speed of train, super elevation, cant deficiency, negative

cant, speed calculation based on IR formulae for high speed tracks only. Problems on above. **09hrs**

4. **Points and Crossing:** turnout, design of turnout, stations and yards, signaling and interlocking, track defects, track maintenance, level crossing, Indian Railway standards and relevant problems. **09hrs**

B. AIRPORT ENGINEERING

1. **Airport planning:** Characteristics of aircraft, Airport- classifications and site selection, regional planning . **06hrs**
2. **Runway design**: Analysis of wind data, determination of the best orientation of the runway configurations, basic length of the runway, corrections to runway length by ICAO and FAA specification, runway cross sections. Windrose type I & II diagrams. Problemsonabove. **09 hrs.**
3. **Taxiway design:** Taxiway-Factors affecting the layout of the taxiway, geometrics of taxiway, design of exit taxiways. **06 hrs**
4. **Visual aids:** Airport Marking**,** Lightings, ILS. **04hrs**

Reference books:

1. Saxena S.C and Arora S. P., "Railway Engineering", Dhanpat Rai Publications, New Delhi.
2. Agarwal M.M., "Indian Railway Track", Prabha& Co., New Delhi.
3. Khanna S.K., Arora M.G and Jain S.S, "Airport Planning and Design", Nemchand Roorkee.
4. Mundrey J. S.**, "**Railway Track Engineering", Tata McGraw Hill Publications, New Delhi.
5. Horenjeff, "Planning and Design of Airports", McGraw Hill Publications, New Delhi.
6. Bindra S.P., "Elements of Bridge Tunnel and Railway Engineering" DhanpatRai Publications, New Delhi.

Academic Calendar for UG Programmes

Sl. No.	Particulars	Date
1	Registration	27-07-2019 to 31-07-2019
2	Induction program for First Semester (Tentative)	01-08-2019 to 14-08-2019
3	Teaching Commences for odd semester except I Sem	01-08-2019
4	Last date for registration with late fee	06-08-2019
5	Teaching Commences for I semester	16-08-2019
6	Display of attendance	16-09-2019
7	Internal Assessment – IA– I	18-09-2019 to 20-09-2019
8	Communication of performance to the parents	26-09-2019
9	Last date to drop the course	27-09-2019
10	Display of attendance	02-11-2019
11	Internal Assessment –IA– II	04-11-2019 to 06-11-2019
12	Students Feedback	11-11-2019 to 15-11-2019
13	Communication of performance to the parents	13-11-2019
14	Last date to withdraw the course	13-11-2019
15	Teacher – Parents Meet	16-11-2019
16	Internal Assessment –IA– III	27-11-2019 to 29-11-2019
17	Last day of teaching for Odd Semester	30-11-2019
18	Final Lab Assessments	03-12-2019 to 10-12-2019
19	Display of consolidated Continuous Internal Evaluation (CIE) & Attendance	05-12-2019
20	Communication of performance to the parents	05-12-2019
21	Semester End Examination	13-12-2019 to 27-12-2019
22	Inter Semester Recess	28-12-2019 to 12-01-2020
23	Declaration of Results	09-01-2020
24	Communication of performance to the parents by putting on website	10-01-2020
25	Makeup SEE for odd semesters	11-01-2020 to 18-01-2020
	Commencement of Even Semester :	**13-01-2020**

Dean (Academic Program) **PRINCIPAL**

Academic Calendar (Tentative) for Even Semester 2019-20 B.E. & M.Tech

Sl. No.	Particulars	Date
1	Registration	09-01-2020 to 11-01-2020
2	Commencement of Teaching	13-01-2020
3	Last date for registration with late fee	18-01-2020
4	Display of attendance	18-02-2020
5	Internal Assessment – IA– I	24-02-2020 to 26-02-2020
6	Communication of performance to the parents	03-03-2020
7	Last date to drop the course	04-03-2020
8	Parents Meet	14-03-2020
9	Insignia – 2020	20-03-2020 & 21-03-2020
10	Display of attendance	30-03-2020
11	Internal Assessment – IA– II	01-04-2020 to 03-04-2020
12	Last date to withdraw the course	08-04-2020
13	Communication of performance to the parents	11-04-2020
14	Feedback by Students	20-04-2020 to 25-04-2020
15	Internal Assessment –IA– III	04-05-2020 to 06-05-2020
16	Last day of teaching for Even Semester	06-05-2020
17	Final Lab Assessments	09-05-2020 to 20-05-2020
18	Display of consolidated Continuous Internal Evaluation (CIE) marks & Attendance for 8^{th} semester	09-05-2020
19	Semester End Examination for 8^{th} semester	11-05-2020 to 19-05-2020
20	Display of consolidated CIE marks & Attendance for 2^{nd}, 4^{th} & 6^{th} semesters (Both for UG & PG)	13-05-2020
21	Communication of performance to the parents	14-05-2020
22	Project exam for 8^{th} semester	21-05-2020 to 26-05-2020
23	Semester End Examination for 2^{nd}, 4^{th} & 6^{th} semesters (Both for UG & PG)	22-05-2020 to 05-06-2020
24	Results for 8^{th} semester	30-05-2020
25	Summer vacation	06-06-2020 to 31-07-2020
26	Announcement of Results for 2^{nd}, 4^{th} & 6^{th} semester (Both for UG & PG)	12-06-2020

Supplementary Semester: 12-06-2020 to 27-07-2020
Commencement of next Academic Year 2020 - 21: 01-08-2020
Dean (Academic Program) **PRINCIPAL**

Supplementary Semester Calendar for B.E./M.Tech/MBA – 2020

Sl. No.	Particulars	VII & VIII Sem (B.E.)	I to VI Sem (B.E.), M.Tech & MBA
1	Registration	01-06-2020 to 03-06-2020	06-06-2020 to 08-06-2020
2	Teaching Commences	01-06-2020	12-06-2020
3	Registration with special permission by Principal	04-06-2020	12-06-2020
4	Internal Assessment (IA) – I	13-06-2020 & 15-06-2020	24-06-2020 & 25-06-2020
5	Internal Assessment (IA) – II	25-06-2020 & 26-06-2020	03-07-2020 & 04-07-2020
6	Internal Assessment (IA) – III	10-07-2020 & 11-07-2020	13-07-2020 & 14-07-2020
7	Display of consolidated Continuous Internal Evaluation (CIE) marks & Attendance	13-07-2020	16-07-2020
8	Supplementary SEE	14-07-2020 to 17-07-2020	18-07-2020 to 23-07-2020
9	Declaration of results	22-07-2020	27-07-2020

Dean (Academic Program) **PRINCIPAL**

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