B.V.V. S

BASAVESHWAR ENGINEERING COLLEGE, BAGALKOTE

B.E. in Civil Engineering

UG SCHEME OF TEACHING AND EXAMINATION

(Admitted from 2026-2027 onwards)

VISION

To be a Center of excellence in teaching, research and innovation, shaping globally competent Civil Engineers toward the sustainable development of society

MISSION

1. **Provide a student –centric learning environment, cultivating critical thinking and problem-solving skills in aspiring Civil Engineers**
2. **Promote Collaborative research and innovation to address societal and industrial challenges**
3. **Imbibe a strong sense of etics, social responsibility and environmental consciousness.**
4. **Encourage entrepreneurship and provide comprehensive consultancy**

Programme Outcomes (POs)

PO-1:	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO-2:	**Problem Analysis:** Identify, formulate, research literature, and analyze complex engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.
PO-3:	**Design and Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health, safety, and societal and environmental aspects.
PO-4:	**Conduct of Investigation:** Use research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of information, to provide valid conclusions for complex engineering problems
PO-5:	**Modern Tool Usage:** Create, select, and apply appropriate modern tools, software, and techniques, including those related to the modern engineering discipline of their choice, to model and simulate complex engineering activities with an understanding of the limitations.
PO-6:	**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.
PO-7:	**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.
PO-8:	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO-9:	**Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO-10:	**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.
PO-11:	**Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Programme Educational Objectives (PEO's)

PEO1: Graduates will apply Civil Engineering Principles to design sustainable infrastructure, utilizing modern tools and ensuring safety

PEO2: Graduates will possess strong communication and team work skills to collaborate effectively in diverse environments

PEO3: Graduates will engage in continuous professional development upholding ethical practices and adapting to evolving technologies as responsible leaders in Civil engineering

Programme Specific Objectives (PEO's)

PSO -1: Develop skills in surveying and Structural design for diverse Civil Engineering Structures

PSO -2: Specialize in foundation and superstructure engineering for residential, commercial, public, industrial buildings, and infrastructural projects.

PSO -3: Gain expertise in water management and environmental engineering to create sustainable solutions for water systems and environmental challenges

B.E. in Civil Engineering

Proposed Curriculum Framework for B.E. Program

For to students admitted in AY 2026-27 to 1st semester and through lateral entry in AY 2027-28 to 3rd semester

Sl. No.	Category	VTU	AICTE	BEC Present	BEC Revised
1.	**HSMC:** HSS (English:2,Kannada:1,UHV,:1Constitution:1,EV:1),HRM:3 (Offered by Dept) = 9AEC (Scientific foundations of Health:1, Innovation and design Thinking:1, SS:2, IKS:1, MOOCS: 3) = 08	14+8=22	15	9+10=19	7+8=15
2.	**BSC:** Basic Science Courses(Physics, Chemistry and Mathematics)	22	23	22	22
3.	**ESC/ETC:** Engineering Science Courses (Basic Elect. /Electronics/Computer/Mechanics/Workshop/Drawing, etc.)	18	17	18	16
4.	**PCC:** Professional Core Courses	57	61	56	65
5.	**PEC:** Professional Elective Courses relevant to the branch with at least one course either fully or partially supported by industry	12	12	12	12
6.	**OEC:** Open Electives Courses/Subjects from other Technical/Arts/Commerce (3 MOOCS+6)	9	12	09	09
7.	**Mini(2) and Major projects(9)/Industrial Internships (10)**	20	20	24	21
8.	**Mandatory Course:** PE, Yoga, NSS, Bridge course Maths 1and 2 (lateral Entry)	00	00	00	00
	Total	**160**	**160**	**160**	**160**

B.E. in Information Science and Engineering

Suggestive Break-up of Credits for B.E (Common to all Branches)

(For the Students admitted to first year from 2026-2027 onwards and to 2nd year lateral entry from 2027-2028 onwards)

Sem.	BSC	ESC/ ETC	HSMC	AEC	PCC	PEC	OEC	Project	Int.	Total
1.	08	06	01	1(SFH)	04					20
2.	08	10	01	1(IDT)						20
3.	03				17					20
4.	03		01		16					20
5.			01	2(SS)	09	03	03	02		20
6.				1(IKS)	13	03	03			20
7.			03		06	06		09		24
8.				3(MOOCS)			3 (MOOCS)		10	16
Total	**22**	**16**	**07**	**08**	**65**	**12**	**09**	**11**	**10**	**160**

Note:

- VII and VIII semester to be swapped
- The number of credits can be swapped between Project and Internship based on BoS recommendation
- MOOCS (6 credits) and Mandatory courses to be completed prior to commencement of VII semester and the same will be reflected along with Internship in 8th semester

B.E. in Civil Engineering

Scheme of Teaching and Examinations

(2026-27 Admitted batch and 2026-27 Academic year)

I SEMESTER CHEMISTRY														
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**(Hrs Teaching-Learning Scheme**				**Examination Duration (Hrs/Sem.)**		**Total Hours**	**Examination Scheme and Evaluation**			**Credits(C) = Total Hours/30**
				L Hrs/Week /Sem.)	**T Hrs/Week (Hrs/Sem.)**	**P Hrs/Week (Hrs/Sem.)**	**Term Work (TW) & Self Learning(SL), (TW+SL) Hrs/Sem.**	**CIE**	**SEE**		**CIE Marks**	**SEE Marks**	**Total Marks**	
01	ASC	1BMAC101C	Differential Calculus and Linear Algebra for CV Stream	42	0	26	44	5	3	120	50	50	100	**04**
02	ASC(IC)	1BCHC102C	Applied Chemistry for CV stream	42	0	26	44	5	3	120	50	50	100	**04**
03	ETC	1BAIA103C	Introduction to AI and Applications	28	0	26	28	5	3	90	50	50	100	**03**
04	ESC-I	1BMEA104N	Introduction to Mechanical Engineering	42	0	0	42	3	3	90	50	50	100	**03**
05	PLC(IC)	1BCSA105D	Introduction to C Programming	42	0	0	42	3	3	90	50	50	100	**04**
06	AEC	1BHSB106C	Communication Skills	14	0	0	13	2	1	30	50	50	100	**01**
07	AEC (NCMC)	1BHSC107M	Indian Constitution & Engineering Ethics	14	0	0	13	2	1	30	50	50	100	**PP**
08	AEC/SDC	1BCVA108P	Innovation and Design Thinking Lab	14	0	0	13	2	1	30	50	50	100	**01**
														20

B.E. in Civil Engineering

Scheme of Teaching and Examinations

(2026-27 Admitted batch and 2026-27 Academic year)

II SEMESTER PHYSICS														
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**(Hrs Teaching-Learning Scheme**				**Examination Duration (Hrs/Sem.)**		**Total Hours**	**Examination Scheme and Evaluation**			**Credits(C) =Total Hours/30**
				L Hrs/Week /Sem.)	**T Hrs/Week (Hrs/Sem.)**	**P Hrs/Week (Hrs/Sem.)**	**Term Work (TW) & Self Learning(SL), (TW+SL) Hrs/Sem.**	**CIE**	**SEE**		**CIE Marks**	**SEE Marks**	**Total Marks**	
01	ASC	1BMAC201C	Differential Calculus and Numerical Methods for CV Stream	42	0	26	44	5	3	120	50	50	100	**4**
02	ASC(IC)	1BPHC202C	Physics for Sustainable Structural Systems	42	0	26	44	5	3	120	50	50	100	**4**
03	ESC	1BMEA203C	Computer-Aided Engineering Drawing for CV	28	28	0	28	3	3	90	50	50	100	**3**
04	ESC-II	1Bxxx204N **1BEEA204N**	Engineering Science Course-II **Introduction to Electrical Engineering**	42	0	0	42	3	3	90	50	50	100	**3**
05	PSC	1BxxA205C **1BCVA205C**	Programme Specific Courses **Engineering Mechanics**	28	0	26	28	5	3	90	50	50	100	**3**
06	AEC (NCMC)	1BHSA206M	Soft Skills	14	0	0	13	2	1	30	50	50	100	**PP**
07	HSMC	1BHSA207C/ 1BHSB207C	Samskrutika Kannada/ Balake Kannada	14	0	0	13	2	1	30	50	50	100	**1**
08	AEC/ SDC	**1BCVA208P**	Inter disciplinary Project-Based Learning	14	0	0	13	2	1	30	50	50	100	**1**
09	PSC/ ESC	**1BCVA209L**	**Mechanics and Materials Lab**	14	0	0	13	2	1	30	50	50	100	**1**
														20

Course Code		:	**1BCVA104N**	**Introduction to Civil Engineering**	**Semester**	:	I
L:T:P*		:	**3 : 0 : 0**		**Course Type**	:	**ESC**
Hours/Sem.	**Teaching**	:	**42 Hrs.**		**CIE Marks**	:	50
	Learning (TW+SL)	:	**42 Hrs.**		**SEE Marks**	:	50
	Exam	:	**06 Hrs.**		**Total Marks**	:	100
	Total Hrs.	:	**90 Hrs.**		**Credits**	:	03

Professional Competency:

This course lays the engineering-science foundation for Civil Engineering practice by introducing students to the scope, disciplines and materials alongside the principles of engineering mechanics that govern structural behaviour.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Describe the scope and disciplines of civil engineering, common construction materials, and the structural elements of a building.

CO2: Resolve and compose coplanar force systems and compute moments of forces and couples using fundamental principles of statics.

CO3: Apply the principles of equilibrium and free body diagrams to determine support reactions for statically determinate beams.

CO4: Determine the centroid and moment of inertia of plane areas, including composite and built-up sections, using the method of integration.

Unit-I	**10 Hrs.**

Introduction and Scope of Civil Engineering: Basics and Importance of Engineering and Civil Engineering, Role of Civil Engineers in society, Broad disciplines of Civil Engineering.

Basic Materials of Construction: Stones, bricks, mortars, Concrete, Construction Chemicals, Steel, Carbon Composites, Plastics in Construction, 3D printing, Recycling of Construction & Demolition wastes, Sustainable Building Materials.

Structural elements of a building: Foundation, Plinth, Lintel, Chejja, Masonry wall, Column, Beam, Slab and Staircase.

Unit-II	**10 Hrs.**

Force Systems: Concept of idealization, System of forces, Principles of transmissibility of a force, Resolution and composition of forces, Law of Parallelogram of forces, Concurrent and non-concurrent coplanar force systems, Moment of forces, Couple, Varignon's theorem: Numerical examples.

Unit-III	**11 Hrs.**

Equilibrium and Support Reactions: Free body diagram, equations of equilibrium, Lami's Theorem, Equilibrium of Coplanar Concurrent and Non -concurrent force systems: Numerical examples. Types of loadings, beams and supports, Concept of Statically determinate and

indeterminate structures (Definitions with examples only), Support reactions: Numerical examples on Statically determinate beams.
Unit-IV **11 Hrs.**
Centroid of Plane areas: Introduction, Locating the centroid of rectangle, triangle, circle, semicircle and quadrant of a circle using method of integration, centroid of composite areas and simple built up sections: Numerical examples. **Moment of Inertia of Plane Areas**: Introduction, Moment of inertia about an axis, Parallel axes theorem, Perpendicular axes theorem, Polar moment of inertia, Radius of gyration. Second moment of inertia of square, rectangular, triangular and circular areas from the method of Integration, Moment of inertia of composite areas and simple built-up sections: Numerical Examples.
Text Books:
1. Kolhapure B K, "Elements of Civil Engineering and Engineering Mechanics", EBPB, 2014. 2. Sawant H. J. and Nitsure S. P., "Elements of Civil Engineering and Mechanics", Technical Publications, 2018 Scheme Edition, 2019.
Reference Books:
1. Beer F P and Johnston E R, "Vector Mechanics for Engineers: Statics and Dynamics", McGraw Hill, 12th Edition, 2019. 2. Hibbeler R C, "Engineering Mechanics: Principles of Statics and Dynamics", Pearson, 15th Edition, 2022. 3. Meriam J L, Kraige L G and Bolton J N, "Engineering Mechanics: Statics", Wiley Publications, 9th Edition, 2017.

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	2 (WK1 and WK3)	-	-	-	-	3 (WK7)	2 (WK5)	-	-	-	-	2	1
CO2	3 (WK1, WK2,	2 (WK2	-	-	-	-	-	-	-	-	-	2	-

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
	and WK3)	and WK3)											
CO3	3 (WK1 and WK3)	3 (WK2 and WK3)	2 (WK4)	-	-	-	-	-	-	-	-	3	-
CO4	3 (WK1, WK2, and WK3)	2 (WK2)	-	-	-	-	-	-	-	-	-	3	-

Course Code		**:**	**1BCVA205C**	**ENGINEERING MECHANICS**	**Semester**	**:**	**02**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PSC**
Hours/Sem	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Professional Competency:
Develop the ability to apply the principles of engineering mechanics to analyze and solve problems involving the equilibrium of rigid bodies.

Course Outcomes:

After completion of the course, student will be able to:

CO1. Understand the concept of coplanar and non-coplanar concurrent force system.
CO2. Apply the principles of force systems and equilibrium to determine support reactions.
CO3. Analyze the truss and frictional resistance offered by different planes.
CO4. Locate the centroid of simple and composite plane area using first principles.

UNIT–I	**12 Hrs.**

Introduction to Engineering Mechanics: Particle, continuum, rigid body, laws of motion, law of parallelogram, forces, polygon forces, classification of force system, resolution and addition of forces, Principle of transmissibility of force. Resultant of co-planar concurrent force system. Lami's theorem, Equilibrium of a particle.

Numerical Problems on Co-planar concurrent forces to find the resultant of system of forces by composition of forces including law of Parallelogram of forces, Triangle law of forces and Rectangular component method.

UNIT–II	**10 Hrs.**

Moment and couple: Definition of moment, moment of a couple, characteristics of a couple, equivalent force and couple system, Varignon's principle, resultant of coplanar non concurrent force system. Numerical problems.

Support reactions: Types of loadings, beams and supports, Concept of Statically determinate and
indeterminate structures, Support reactions: Numerical examples on Statically determinate beams subjected to various loads.

UNIT-III	10 Hrs.

Analysis of Trusses: Introduction, Classification of trusses, analysis of plane perfect trusses by the method of joints and method of sections, Numerical examples.

Friction: Introduction, laws of Coulomb friction, equilibrium of blocks on horizontal plane, equilibrium of blocks on inclined plane, Numerical examples.

UNIT-IV	10 Hrs.

Centroid of plane areas: Introduction, Locating the centroid of rectangle, triangle, circle, semicircle and quadrant of a circle using method of integration, centroid of composite areas and simple built up sections: Numerical examples.

Moment of Inertia of plane areas: Introduction, Moment of inertia about an axis, Parallel axes theorem, Perpendicular axes theorem, Polar moment of inertia, Radius of gyration. second moment of inertia of square, rectangular, triangular and circular areas from the method of Integration, Moment of inertia of composite areas and simple built-up sections: Numerical Examples.

Text Books:

1.Rangwala, Building Construction,33rd Edition, 2016, Charotar Publishing House Pvt. Ltd., ISBN-10 : 9385039040, ISBN-13 : 978-9385039041

2.Bansal R. K., Rakesh Ranjan Beohar and Ahmad Ali Khan, Basic Civil Engineering and Engineering Mechanics, 3rd Edition, 2015, Laxmi Publications, ISBN: 9789380856674.

3.Kolhapure B K, Elements of Civil Engineering and Engineering Mechanics, 11th Edition, 2018, Eastern Book Promoters Belgaum [EBPB], ISBN: 5551234003896

Reference Books:

1. Beer F.P. and Johnston E. R., Mechanics for Engineers: Statics and Dynamics, 4th Edition, 1987, McGraw Hill, ISBN: 9780070045842
2. Meriam J. L. and Kraige L. G, Engineering Mechanics-Statics, Vol I–6th Edition,2008, Wiley publication.
3. Irving H. Shames, Engineering Mechanics-Statics and Dynamics, 4th Edition, 2002, Prentice-Hall of India(PHI).
4. Hibbler R. C., Engineering Mechanics: Principles of Statics and Dynamics, 2017, Pearson Press, New Delhi.
5. Timoshenko S, Young D. H., Rao J. V., Sukumar Patil, Engineering Mechanics, 5th Edition, 2017,McGraw Hill Publisher, ISBN: 9781259062667
6. Bhavikatti S S, Engineering Mechanics, 4th Edition, 2018, New Age International Publications.
7. Reddy Vijaykumar K and Suresh Kumar K, Engineering Mechanics, 3rd Edition 2013, BS Publications

Question paper pattern for SEE

1. Total of Eight Questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each Question should not have more than four sub divisions.
3. Any FIVE Full questions are to be answered choosing at least one from each unit.

Web links and Video Lectures (e-Resources):

1.https://www.youtube.com/watch?
v=nGfVTNfNwnk&list=PLOSWwFV98rfKXq2KBphJz95rao7q8 PpwT

2.https://www.youtube.com/watch?v=nkg7VNW9UCc&list=PLOSWwFV98rfKXq2KBphJz95rao
7q8PpwT&i ndex=2

3.https://www.youtube.com/watch?v=ljDIIMvxeg&list=PLOSWwFV98rfKXq2KBphJz95rao7q
8PpwT&index=5

4.https://www.youtube.com/watch?
v=VQRcChR9IkU&list=PLOSWwFV98rfKXq2KBphJz95r ao7q8PpwT&index=18

5.https://www.youtube.com/watch?v=3YBXteL-qY4

6.https://www.youtube.com/watch?
v=z95UW4wwzSc&list=PLOSWwFV98rfKXq2KBphJz95r ao7q8PpwT&index=10

7.https://www.youtube.com/watch?
v=lheoBL2QaqU&list=PLOSWwFV98rfKXq2KBphJz95rao 7q8PpwT&index=7

8.https://www.youtube.com/watch?v=atoP5_DeTPE

9.https://www.youtube.com/watch?v=ksmsp9OzAsI

10.https://www.youtube.com/watch?v=x1ef048b3CE

11.https://www.youtube.com/watch?v=l_Nck-X49qc

12.https://play.google.com/store/apps/details?id=appinventor.ai_jgarc322.Resultant_Force
https://www.youtube.com/watch?v=RIBeeW1DSZg

13.https://www.youtube.com/watch?v=R8wKV0UQtlo

14.https://www.youtube.com/watch?v=0RZHHgL8m_A

15.https://www.youtube.com/watch?v=Bls5KnQOWkY

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Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK2, WK3)	3 (WK2, WK3)	-	-	-	-	-	-	-	-	1	2	1
CO2	3 (WK2, WK3	3 (WK2, WK3	2(WK3)	-	2(WK3)			-	-	-	1	2	1
CO3	2 (WK3)	2 (WK3)	2 (WK3)	2 (WK3)	2 (WK6)		-	-	-	-	1	3	2
CO4	3 (WK2, WK3)	3 (WK2, WK3)		2 (WK3)	-		-	-	-	-	1	2	1

Course Code		**:**	**1BCVA209L**	**Mechanics and Materials Lab**	**Semester**	**:**	**02**
L:T:P		**:**	**0:0:2**		**Course Type**	**:**	**PSC/ ESC**
Hours/Sem	**Teaching**	**:**	**00 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**26 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**04 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**30 Hrs**		**Credits**	**:**	**01**

Professional Competency:

Develop the ability to analyze the behavior of rigid bodies and evaluate the mechanical properties of engineering materials through experimental testing and interpretation of results.

Course Outcomes:

After completion of the course, student will be able to:

CO1. Analyse coplanar force systems by analytical and graphical methods and verifying Lami's theorem.

CO2. Compute support reactions in simply supported beams experimentally and analytically.

CO3. Identify and understand the properties of various construction materials.

List of Experiments
Part A

PART A -COVENTIONAL EXPERIMENTS

1. Verification of Lami's Theorem.
2. Equilibrium of concurrent forces.
3. Parallel force system- Simply supported beam.
4. Verification of Varignon's theorem.
5. Specific Gravity of a) Fine aggregates. b) Coarse aggregates. c) Cement. d) Soil.
6. Sieve analysis of soil-Graphical representation of the gradation curve and Visual identification of building materials: Bricks, Stones, Tiles, M-Sand, Bitumen, Fly-Ash, GGBS, Steel Bars of Various Sizes

Part B

PART B - TYPICAL OPEN-ENDED EXPERIMENTS

Open-ended experiments are a type of laboratory activity where the outcome is not predetermined, and students are given the freedom to explore, design, and conduct the experiment based on the problem statements as per the concepts defined by the course coordinator. It encourages creativity, critical thinking, and inquiry-based learning.

1. Reactions.
2. Field tests on cement.
3. Particle size distribution.
4. Gap graded.
5. Uniformly graded.
6. Well graded.

Text Books:

Suggested Learning Resources: (Text Book/ Reference Book/ Manuals):

1. M. L. Gambhir : Concrete Manual : Dhanpat Rai & sons New – Delhi, ISBN-135551234001965.
2. Bansal R. K., Rakesh Ranjan Beohar and Ahmad Ali Khan, Basic Civil Engineering and Engineering Mechanics, third edition, 2015, Laxmi Publications, ISBN: 9789380856674
3. Ramamrutham.S, Engineering Mechanics, Dhanpat Rai Books, 2013,ISBN: 9789352164271.
4. Soil Mechanics and foundation Engineering by B C Punmia, Ashok kumar jain, Arun kumar jain, 18th edition, 2023, Laxmi Publications New Delhi..

Reference Books:

1. Meriam J. L. and Kraige L. G, Engineering Mechanics-Statics, Vol I–sixth Edition,2008, Wiley publication.
2. Rattan S.S., Strength of Materials, Third edition, 2017, McGraw Hill Education; New Delhi. ISBN 13978- 9385965517.
3. Bansal R K, Strength of Materials, Laxmi Publications. 2023, 4th Edition, ISBN:978-8131808146.
4. IS 4031 (Part 11):1988 – Specific gravity test for hydraulic cement.
5. IS 383:1970 – Specification for coarse and fine aggregates from natural sources for concrete.
6. IS 2386(Part 3):1963 Methods of test for aggregates for concrete: Part 3 Specific gravity, density, voids, absorption and bulking.
7. IS 2720 (Part 3/Sec 1):1980 – Determination of specific gravity of soil.

Web links and Video Lectures (e-Resources):
1. https://www.nptel.ac.in/courses/122104015/ 2. https://nptel.ac.in/courses/112103109/ 3. http://vlab.co.in/ Teaching-Learning Process (Innovative Delivery Methods): The following are sample strategies that educators may adopt to enhance the effectiveness of the teaching learning process and facilitate the achievement of course outcomes. 1. Active Learning Techniques 2. Problem-Based Learning (PBL) 3. Team-Based Learning (TBL) 4. Hands-On Experiments and Simulations Assessment Structure: The assessment for each course is equally divided between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each component carrying 50% weightage (i.e., 50 marks each). The CIE CIE Practical component will be 20 marks. The CIE marks awarded shall be based on the continuous evaluation of the laboratory report using a defined set of rubrics. Each experiment report can be evaluated for 30 marks. The laboratory test (duration 02 hours) at the end of the last week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 20 marks. For both CIE and SEE, the student is required to conduct one experiment each from both Part A and Part B.

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	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK2, WK3)	3 (WK2, WK3)	-	2 (WK3)	2 (WK6)	-	-	1	1	-	1	2	1
CO2	3 (WK2, WK3)	3 (WK2, WK3)	-	2 (WK3)	2 (WK6)	-	-	1	1	-	1	2	1
CO3	2 (WK3)	2 (WK3)	2 (WK5)	3 (WK3)	2 (WK6)	2 (WK5)	-	1	1	-	1	3	2

B.E. in Civil Engineering

Scheme of Teaching and Examinations

(2025-26 Admitted batch and Academic year 2026-27)

III SEMESTER														
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**(Hrs Teaching-Learning Scheme**				**Examination Duration (Hrs/Sem.)**		**Total Hours**	**Examination Scheme and Evaluation**			**Credits (C)=Total Hours/30**
				L Hrs/Week /Sem.)	**T Hrs/Week (Hrs/Sem.)**	**P Hrs/Week (Hrs/Sem.)**	**Term Work (TW) & Self Learning(SL), (TW+SL) Hrs/Sem.**	**CIE**	**SEE**		**CIE Marks**	**SEE Marks**	**Total Marks**	
01	BSC	1BMAC301C	Mathematics for Civil Engineering Stream	28	0	26	28	5	3	90	50	50	100	**3**
02	PCC	1BCVA302C	Mechanics of Materials	28	0	26	28	5	3	90	50	50	100	**3**
03	PCC	1BCVA303C	Surveying	28	0	26	28	5	3	90	50	50	100	**3**
04	PCC	1BCVA304C	Concrete Technology	28	0	26	28	5	3	90	50	50	100	**3**
05	PCC	1BCVA305C	Building Materials and Construction Technology	28	0	26	00	3	3	60	50	50	100	**2**
06	PCC	1BCVA306C	Engineering Geology	28	0	26	28	5	3	90	50	50	100	**3**
07	PCC	1BCVA307L	Engineering Geology Lab	00	0	0	26	2	2	30	50	50	100	**1**
08	PCC	1BCVA308L	Building Planning and drawing using CAD	00	0	0	26	2	2	30	50	50	100	**1**
09	PCC	1BCVA309L	Surveying Practices	00	0	0	26	2	2	30	50	50	100	**1**
10	MC	1BMAB300M	Bridge Course Mathematics-I	42	0	0	48	3	0	60	100	00	00	**0**
11	MC	**1BHS001/002/ 003M**	NSS/Yoga/PE	00	0	0	02	2	100	00	100	00	100	**0**
														20

B.E. in Civil Engineering

Scheme of Teaching and Examinations

(2025-26 Admitted batch and Academic year 2026-27)

IV SEMESTER														
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**(Hrs Teaching-Learning Scheme**				**Examination Duration (Hrs/Sem.)**		**Total Hours**	**Examination Scheme and Evaluation**			**Credits (C)=Total Hours/30**
				L Hrs/Week /Sem.)	**T Hrs/Week (Hrs/Sem.)**	**P Hrs/Week (Hrs/Sem.)**	**Term Work (TW) & Self Learning(SL), (TW+SL) Hrs/Sem.**	**CIE**	**SEE**		**CIE Marks**	**SEE Marks**	**Total Marks**	
01	BSC	1BBTA402C	Biology for Engineers	28	0	26	28	5	3	90	50	50	100	**3**
02	PCC	1BCVA403C	Analysis of Statically Determinate Structures	28	0	26	28	5	3	90	50	50	100	**3**
03	PCC	1BCVA404C	Soil Mechanics	28	0	26	28	5	3	90	50	50	100	**3**
04	PCC	1BCVA405C	Highway Engineering	28	0	26	28	5	3	90	50	50	100	**3**
05	PCC	1BCVA406C	Fluid Mechanics & Hydraulics	56	0	0	58	3	3	120	50	50	100	**4**
06	PCC	1BCVA407L	Basic materials and concrete testing lab	00	0	0	26	2	2	30	50	50	100	**1**
07	PCC	1BCVA408L	Highway Materials Testing Lab	00	0	0	26	2	2	30	50	50	100	**1**
08	PCC	1BCVA409L	Fluid Mechanics Lab	00	0	0	26	2	2	30	50	50	100	**1**
09	HSMC	**1BHSA424C**	UHV-II	14	0	0	13	2	1	30	50	50	100	**1**
10	MC	**1BHS001/002/ 003M**	NSS/Yoga/PE											**0**
11		AAP	AICTE Activity Points											**0**
														20

Course Code		**:**	**1BMAC301C**	**MATHEMATICS FOR CIVIL ENGINEERING STREAM**	**Semester**	**:**	**03**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**BSC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Apply complex analysis, statistics and probability distributions to solve engineering problems.

Course Outcomes:

After completion of the course, student will be able to

CO1: Determine the analyticity of complex functions using the principles of complex differentiability and Cauchy–Riemann equations.

CO2: To evaluate complex integrals by using the principles of Cauchy's integral theorem and residue theorem.

CO3: Apply correlation and regression analysis to fit appropriate mathematical models to statistical data.

CO4: Employ the basic concepts of probability and probability distribution.

UNIT–I	**11 Hrs**

Complex Variables: Analytic function, Cauchy-Riemann equations in Cartesian and polar forms. Construction of analytic function (Cartesian and polar forms), Bilinear transformations. Confirmal mapping ($e^z, z^2, z + \frac{1}{z}$)

UNIT–II	**10Hrs**

Complex Integration: Line integral, Cauchy's theorem – corollaries (without proof), Cauchy's integral formula. Taylor's and Laurent's series (statements only), singularities, poles, calculation of residues, Cauchy's residue theorem (without proof) - problems.

UNIT-III	**10 Hrs**

Curve fitting, Correlation and Regressions: Principles of least squares, Curve fitting by the method of least squares in the form y = a + bx, y= a+ bx + cx^2, and y = ab^x. Correlation, Regression and Rank correlation.

UNIT-IV	**11 Hrs**

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples.

Text Books:

1. **Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye** "Probability & Statistics for Engineers & Scientists", Pearson Education, 9th edition, 2017.
2. **Peter Bruce, Andrew Bruce & Peter Gedeck** "Practical Statistics for Data Scientists" O' Reilly Media, Inc., 2nd edition **2020**.

Reference Books:

1. **Erwin Kreyszig**, "Advanced Engineering Mathematics", John Wiley & Sons, 9thEdition, 2006.
2. **B. S. Grewal** "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021.
3. **G Haribaskaran** " Probability, Queuing Theory & Reliability Engineering", Laxmi Publication , Latest Edition, 2006
4. **Irwin Miller & Marylees Miller,** John E. Freund's "Mathematical Statistics with Applications" Pearson. Dorling Kindersley Pvt. Ltd. India, 8th edition, 2014.

5. **S C Gupta and V K Kapoor** , "Fundamentals of Mathematical Statistics", S Chand and Company , Latest edition.
6. **Robert V. Hogg, Joseph W. McKean & Allen T. Craig**. "Introduction to Mathematical Statistics", Pearson Education 7th edition, 2013.
7. **Jim Pitman**. Probability, Springer-Verlag , 1993.
8. **Sheldon M. Ross,** "Introduction to Probability Models"11th edition. Elsevier, 2014.

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3)						1			1		
CO2	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3)						1			1		
CO3	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3)						1			1		
CO4	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3)						1			1		

Sri B.V.V.S.
Basaveshwar Engineering College, Bagalkote
Scheme (from 2026-27)

Sl. No.	Course Code	Course Title	Teaching-Learning Scheme				Examination Duration (Hrs/Sem.)		Total Hours	Examination Scheme and Evaluation			Credits (C)= Total Hours/ 30
			L Hrs/ Week (Hrs/ Sem.)	T Hrs/ Week (Hrs/ Sem.)	P Hrs/ Week (Hrs/ Sem.)	Term Work (TW) and Self Learning (SL) (TW+SL) Hrs/Sem.	CIE	SEE		CIE Marks	SEE Marks	Total Marks	
1	1BMAC301C	Mathematics for Civil Engineering Stream	3(42)	0	0	42	3	3	90	50	50	100	3= 90/30

Course Code		**:**	**1BCVA302C**	**Mechanics of Materials**	**Semester**	**:**	**III**
L:T:P*		**:**	**3:0:0**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs.**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs.**		**SEE Marks**	**:**	**50**
	Exam	**:**	**6 Hrs.**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs.**		**Credits**	**:**	**03**

Professional Competency:

Apply the principles of mechanics of materials to analyze stress, strain, deformation, bending, shear and buckling in structural members for safe and economical engineering design.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Evaluate the fundamental concepts of stress, strain, Hooke's law, and elastic constants to analyze the deformation of bars and composite members.

CO2: Determine the principal stresses and principal planes, and construct shear force and bending moment diagrams for beams subjected to different loading conditions.

CO3: Determine the bending stresses and shear stresses in beams of various cross-sections by applying the flexural formula and shear stress formula.

CO4: Evaluate the deflection of beams using appropriate methods and determine the buckling load of columns under different end conditions.

Unit-I **10 Hrs.**

Simple Stresses and Strains: Introduction, Properties of Materials, Stress, Strain, Hooke's law, Poisson's Ratio, Stress – Strain Diagram for structural steel, Principles of superposition, Total elongation of tapering bars of circular and rectangular cross sections. Composite section, Volumetric strain, expression for volumetric strain, Elastic constants, state of simple shear, relationship among elastic constants.

Unit-II **12 Hrs.**

Compound Stresses: Introduction, state of stress at a point, General two-dimensional stress system, Principal stresses and principal planes.

Bending moment and shear force diagrams in beams: Introduction to shear force and bending moment, definitions and sign conventions, Relationship between loading, shear force and bending moment, Shear force and bending moment equations, development of Shear Force Diagram (SFD) and Bending Moment Diagram (BMD) with salient values for cantilever, simply supported and overhanging beams for point loads, UDL (Uniformly Distributed Load), UVL (Uniformly Varying Load), Couple and their combinations.

Unit-III **10 Hrs.**

Bending and Shear Stresses in Beams: Introduction, pure bending theory, Assumptions, derivation of bending equation, modulus of rupture, section modulus, flexural rigidity. Expression for transverse shear stress in beams, Bending and shear stress distribution diagrams for rectangular, 'I', circular and 'T' sections.

Unit-IV **10 Hrs.**

Deflection of Beams: Definition of slope, Deflection and curvature, Sign conventions, Derivation of moment- curvature equation. Double integration method and Macaulay's method: Slope and deflection for standard loading cases and for determinate prismatic beams subjected to point loads, UDL, UVL and couple.

Columns and Struts: Introduction, short and long columns. Euler's theory; Assumptions, Derivation for Euler's Buckling load for different end conditions, Limitations of Euler's theory. Rankine-Gordon's formula for columns.
Text Books:
1. Punmia, B. C., Jain, A. K., & Jain, A. K. (2018), *Strength of Materials* (10th ed.), Laxmi Publications. 2. Bansal, R. K. (2010), *A Textbook of Strength of Materials* (4th ed., revised), Laxmi Publications. 3. Basavarajaiah, B. S., & Mahadevappa, P. (2010), *Strength of Materials in SI Units* (3rd ed.), University Press. 4. Rattan, S. S. (2017), *Strength of Materials* (3rd ed.), McGraw Hill Education (India) Pvt. Ltd. 5. Vazirani, V. N., Ratwani, M. M., & Duggal, S. K. (2009), *Analysis of Structures Vol. I* (17th ed.), Khanna Publishers. 6. Rajput, R. K. (2018), *Strength of Materials* (7th ed.), S. Chand Publishing. 7. Bhavikatti, S. S. (2021), *Strength of Materials* (5th ed.), Vikas Publishing House.
Reference Books:
1. Beer, F. P., Johnston, E. R., DeWolf, J. T., & Mazurek, D. F. (2020), *Mechanics of Materials* (8th ed.), McGraw-Hill Education. 2. Hibbeler, R. C. (2024), *Mechanics of Materials* (11th ed.), Pearson publications.
Web links and e-Resources:
1. NPTEL (IITs): "Strength of Materials", "Mechanics of Materials", "Solid Mechanics" – full lecture series. 2. MIT OCW / other MOOCs: Open course materials on "Solid Mechanics" and "Mechanics of Materials" for additional concept explanation and problem practice.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	-	-	-	-	-	-	-	-	2
CO2	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	-	-	-	-	-	-	-	-	2

CO3	**3 (WK1, WK2, WK3, and WK4)**	**3 (WK1, WK2, WK3, and WK4)**	**3 (WK1, WK2, WK3, and WK4)**	**3 (WK1, WK2, WK3, and WK4)**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**3 (WK1, WK2, WK3, and WK4)**	**3 (WK1, WK2, WK3, and WK4)**	**3 (WK1, WK2, WK3, and WK4)**	**3 (WK1, WK2, WK3, and WK4)**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

Course Code	1BCVA303C	**SURVEYING**	**Semester**	III
L: T:P -	42: 0: 0		**Course Type**	PCC
Teaching	42 Hrs		**CIE Marks**	50
Learning (TW + SL)	48 Hrs		**SEE Marks**	50
Exam	3 Hrs		**Total Marks**	100
Total Hours	90 Hrs		**Credits**	3

Professional Competency:

Develop proficiency in conducting modern surveying operations using conventional and advanced surveying instruments, performing field measurements, processing spatial data, and preparing accurate survey plans and contour maps for civil engineering applications.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Apply the principles of surveying and levelling techniques to determine elevations and reduced levels for engineering works.

CO2: Determine heights, distances, and terrain characteristics using trigonometric levelling and contouring techniques for civil engineering applications.

CO3: Demonstrate the use of Total Station and curve setting methods for coordinate measurement, survey data processing, and infrastructure layout.

CO4: Demonstrate the use of DGPS and GIS for geospatial data collection, processing, mapping, and analysis in civil engineering applications.

UNIT-I	**10 Hrs.**

Introduction: Definition of surveying, Objectives and importance of surveying. Classification of surveying, Principles of surveying, Units of measurements, Chain and tape types, Surveying measurements and errors Theodolite and types.

Levelling: Basic terms and definitions, Methods of levelling-Spirit levelling, Types of levels-Dumpy level, auto level, digital and laser levels-Instrument setup, Booking and reduction of levels-HI method, Rise and fall method. Differential levelling, profile levelling, fly levelling, check levelling, reciprocal levelling, Numerical problems.

UNIT–II	**10 Hrs.**

Trigonometric Levelling: Determination of Heights and Distances: of an accessible object, Inaccessible object by single plane and double plane methods, Numerical problems.

Contouring – definition, characteristics and uses of contours; contour interval; methods of contouring (direct, indirect); interpolation of contours. Uses of contour maps – determination of indivisibility, gradient, catchment area, capacity of reservoir (qualitative); applications in highway and railway alignment.

UNIT–III	**10 Hrs.**

Total Station and Curves

Total Station – components and features; integration of electronic theodolite and EDM; coordinate

measurement system. Total Station operations – setup and orientation, measurement of coordinates, distance and angles; data recording and download; applications in infrastructure projects. Coordinate systems – local coordinates, grid coordinates; coordinate transformation; azimuth and bearing computations.

Curves: Curves setting for infrastructure – horizontal curves (simple circular curves); elements of curves; setting curves by offsets, deflection angle method using Rankine method of deflection angles. Vertical curves – types; elements; computation of elevations along vertical curves tangent correction method for highway and railway alignment.

UNIT–IV	**10 Hrs.**

Introduction to DGPS: Principle, components, working methodology, Base and Rover concept, field survey procedure, collection and processing of DGPS data, plotting and mapping using CAD/GIS software, coordinate systems, accuracy and error sources, advantages, limitations, Engineering applications in topographic surveying, route alignment, land surveying, construction layout, utility mapping, and GIS.

Introduction to Geographic Information Systems (GIS) – definition, components (hardware, software, data, people, procedures); spatial and attribute data. • GIS data models – vector data (points, lines, polygons), raster data (grid cells, pixels); topology; data structures and formats (shape files, geo databases).

Text Books *

1. B.C. Punmia, Surveying, Vol. 1 , 16th Edition, Laxmi Publications, New Delhi.2005
2. S. S. Bhavikatti, 'Surveying & Leveling Vol-I', I. K. International New Delhi, 2008
3. S.K. Duggal, “Surveying Vol. I & II”, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
4. Kanetkar, T. P., & Kulkarni, S. V. Surveying and Levelling (Volumes I and II). Pune Vidyarthi Griha Prakashan.
5. Satheesh Gopi, R. S. Kumar and N. Madhu**,** *Advanced Surveying: Total Station, GIS and Remote Sensing*, Pearson Education. R Subramanian, Surveying and Leveling, Second edition, Oxford University Press, New Delhi.

Reference *

1. David Clerk, Plane and Geodetic Surveying Vol1 and Vol2, CBS publishers
2. B Bhatia, Remote Sensing and GIS, Oxford University Press, New Delhi.
3. T.M Lillesand, R.W Kiefer,. and J.W Chipman, Remote sensing and Image interpretation, 5th edition, John Wiley and Sons India
4. James M Anderson and Adward M Mikhail, Surveying theory and practice, 7th Edition, Tata McGraw Hill Publication
5. Kang-tsung Chang, Introduction to geographic information systems, McGraw Hill Higher Education.

6. Burrough, P. A., McDonnell, R., & Lloyd, C. D. Principles of Geographical Information Systems (3rd Edition). Oxford University Press.
7. IS Codes – IS 1024 (Chain Surveying), IS 1760 (Total Station), Survey of India publications.
8. Shan, J., & Toth, C. K. Topographic Laser Ranging and Scanning: Principles and Processing (2nd Edition). CRC Press.

CO–PO–PSO Matrix

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1:	**3** (WK1, WK2, WK3)	**2** (WK2, WK3)	–	–	**2** (WK6)	–	–	–	–	–	–	**3** (WK3, WK6)	**2** (WK6)	**1** (WK5)
CO2:	**2** (WK2, WK3)	**3** (WK2, WK3, WK4)	**2** (WK4)	**2** (WK6)	**2** (WK6)	–	**1** (WK7)	–	–	–	–	**3** (WK4, WK6)	**2** (WK4, WK6)	**2** (WK5, WK7)
CO3:	–	**2** (WK4)	**3** (WK4, WK5)	**2** (WK6)	**3** (WK4, WK6)	–	**1** (WK7)	**1** (WK8)	**1** (WK9)	–	–	**3** (WK4, WK6)	**3** (WK4, WK6)	**2** (WK5)
CO4:	–	**2** (WK4)	**2** (WK4, WK5)	**2** (WK6)	**3** (WK4, WK6, WK8)	**2** (WK7)	**3** (WK5, WK7)	**2** (WK8, WK9)	**1** (WK9)	**1** (WK9)	–	**2** (WK4, WK6)	**2** (WK4, WK6)	**3** (WK5, WK7, WK8)

CourseCode		:	1BCVA304C	CONCRETE TECHNOLOGY	Semester	:	03
L:T:P		:	3:0:0		CourseType	:	PCC
Hours/Sem	Teaching	:	42Hrs		CIEMarks	:	50
	Learning (TW+SL)	:	42Hrs		SEEMarks	:	50
	Exam	:	06Hrs		Total Marks	:	100
	TotalHrs.	:	90Hrs		Credits	:	03

ProfessionalCompetency:

Develop ability to test the concrete and its constituent materials as per relevant IS codes. Design concrete mixes.

CourseOutcomes:

Aftercompletionofthecoursestudentwillbeableto;

CO1:**Explain**themanufacturingprocess,types,chemicalcomposition,andhydrationofcement; **analyze** the properties and grading of aggregates; and **perform** relevant standard tests on cement and aggregates.

CO2:**Describe** the properties of fresh concrete including workability, segregation,and bleeding; **demonstrate** various methods for measuring workability; and **illustrate** the concrete manufacturing process.

CO3:**Classify** different chemical and mineral admixtures used in concrete; **evaluate** the testing procedures for hardened concrete to determine its mechanical properties.

CO4:**Define** and **discuss** the factors affecting the durability of concrete; **apply** the IS10262:2019 guidelines to **design** concrete mixes and **solve** numerical problems related to mix design.

UNIT–I	10Hrs.

Cement and Aggregates:

Cement, Chemical Composition, Hydration of Cement. Types of cement, Manufacture of cement, Testing of cement - Field-testing. Fineness by Sieve test and Blaine's air permeability test, Normal consistency test, Setting time test and Soundness test.

Fine aggregates- Grading of aggregates, Specific gravity, Bulking, Moisture content and deleterious materials.

Coarse aggregates-Importanceofsize,shape and texture.Gradingofaggregates, sieveanalysis, and Specific gravity. Flakiness and Elongation index, Crushing, Impact and Abrasion tests.

UNIT–II	10Hrs.

Fresh Concrete Properties

Workability - Factors affecting workability, Measurement of workability Slump Test, Flow test, CompactingFactorTestandVee-beeConsistometerTest.SegregationandBleeding.Manufacturing process of concrete-Batching, mixing, transporting, placing, compaction and curing.

UNIT-III	10Hrs.

Admixtures - Chemical admixtures - plasticizers, accelerators, retarders and air entraining agents. Mineraladmixtures- Fly ash, silica fume and rice husk ash. Water proofing compounds.

Hardened Concrete Properties: Testing of hardened concrete Compressive strength, Split tensile strengthand Flexural Strength test. Factors affecting strength. w/c ratio, aggregate properties. Relation betweenCompressive strength and Tensile strength, Bond strength, Modulus of rupture and Elasticity.

UNIT-IV	12Hrs.

Durability - Definition, Factors affecting, environmental exposure conditions, Permeability Definition,factors affecting permeability. Shrinkage, factors affecting shrinkage; Creep - factors affecting creep, effect of creep.

Concrete Mix Design

Concept of mix design, variables in proportioning, exposure conditions. Procedure of mix design as per IS 10262:2019. Numerical examples of mix design on mix design for OPC concrete mixes and Fly ash concrete mixes.

TextBooks:

1. M. S. Shetty Concrete Technology Theory and Practice, S. Chand and Co, New Delhi,2002.
2. P. Kumar Mehta & Paul J.M, Concrete Technology, Monterio Indian Concrete Institute USA- 1999.
3. N. V. Nayak, A. K. Jain Hand book on advanced Concrete Technology, ISBN:978-818487-186-9.
4. Concrete Technology, A.R. Santhakumar, Oxford University Press, 2006.

ReferenceBooks:

1. Neivelle A. M and Brooks, Concrete Technology, J.JELBS Edition, London Delhi, 4th Edition, 2004.
2. Concrete Technology: Theory and Practice, 6th Edition, M L Gambhir& Sandeep Chaudharyby M L Gambhir, Sandeep Chaudhary, McGraw-Hill.
3. IS 10262:2019 for concrete mix design.
4. IS 456 – 2000, Plain and Reinforced Concrete Code of Practice.
5. IS 383 Part 2016 Coarse and Fine aggregates for Concrete Specifications
6. IS 2386 1963 Part 1 to 8 Methods of tests for aggregates forconcrete.

Table5:Matrix to describe the mapping of Cos withPOs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	1 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	-	1 (WK1, WK3, WK4, WK5, WK6)	-	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)
CO2	2 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4, WK5, WK6)	-	1 (WK1, WK3, WK4, WK5, WK6)	-	1 (WK1, WK3, WK4, WK5, WK6)	-	-	2 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	-
CO3	2 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	1 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	-	1 (WK1, WK3, WK4, WK5, WK6)	1 (WK1, WK3, WK4, WK5, WK6)	1 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	- -
CO4	3 (WK1, WK2, WK3, WK4, WK5, WK6)	3 (WK1, WK2, WK3, WK4, WK5, WK6)	3 (WK1, WK2, WK3, WK4, WK5, WK6)	3 (WK1, WK2, WK3, WK4, WK5, WK6)	2 (WK1, WK2, WK3, WK4, WK5, WK6)	1 (WK1, WK2, WK3, WK4, WK5, WK6)	2 (WK1, WK2, WK3, WK4, WK5, WK6)	- -	1 (WK1, WK2, WK3, WK4, WK5, WK6)	1 (WK1, WK2, WK3, WK4, WK5, WK6)	2 (WK1, WK2, WK3, WK4, WK5, WK6)	2 (WK1, WK2, WK3, WK4, WK5, WK6)	2 (WK1, WK2, WK3, WK4, WK5, WK6)	- -

Note:

1. IfthereisnomappingbetweenCOandPO,put"-"
2. Alltheknowledgeprofileelement(s)(WKs)associatedtoaProgram Outcome(PO) maynot be covered by every Course Outcome (CO) of a course. For example, in Table 5, PO5 is mainly addressedbyCO2andCO3throughWK6. AlthoughWK2 isalsoassociatedwithPO5 at the program level, it is not addressed by any of the Course Outcomes (CO1, CO2, CO3, and CO4) in the course Fluid Power Systems for Industry 4.0.

Course Code		:	**1BCVA305C**	**BUILDING MATERIALS AND CONSTRUCTION TECHNOLOGY**	**semester**	:	**03**
L:T:P		:	**2 : 0: 0**		**Course Type**	:	**PCC**
Hours/Sem.	**Teaching**	:	**28 Hrs**		CIE Marks	:	**50**
	Learning (TW+SL)	:	**26 Hrs**		SEE Marks	:	**50**
	Exam	:	**06 Hrs**		Total Marks	:	**100**
	Total Hrs	:	**60 Hrs**		Credits	:	**02**

UNIT-I	**07Hrs**

Building materials: Bricks: Classification of bricks, Tests on bricks.
Other Building Materials: Reinforcing steel, Structural steel.
Foundations: Safe bearing capacity of soil, Plate load test, Classification of foundations, introduction to spread, combined, strap, mat and pile foundation.

UNIT–II	**07 Hrs.**

Masonry: Definition of terms used in masonry, Types of bonds in brickwork, Coursed and Uncoursed rubble masonry, Ashlar masonry.
Stairs, doors, windows, and ventilators: Technical terms in stairs, Requirements of a good stair, Geometric design of RCC dog legged and open well stairs (plan and sectional elevation of stairs),
Doors: Different types of doors, Windows, and Ventilators.

UNIT–III	**07 Hrs.**

Floors: Types of flooring (Materials and methods of laying): Granolithic, Ceramic, Marble, Polished Granite flooring
Roofs: Flat Roof (R.C. Flat terraced roofing), Lean to roof, Wooden truss (King post and Queen post truss).

UNIT–IV	**07Hrs.**

Arch, Lintel, Chejja: Classification of arches and Lintels: Types and classifications, Chejja, Functions.
Plastering and painting: Purpose of plastering, Materials used for plastering, Lime mortar, Cement Mortar, Methods of plastering, Purpose of Painting, Application of paints to new and old surfaces, Distemper, Plastic emulsion, Enamel Powder coated painting to walls and steel surfaces, Polishing of wood surface.

Reference Books *

1. Punmia, B. C., Jain, A. K., & Jain, A. K. (2023), *Building Construction* (12th ed.), Laxmi Publications Pvt. Ltd.
2. Rangwala, S. C. (2022), *Building Construction* (34th ed.), Charotar Publishing House Pvt. Ltd.
3. Kumar, S. (2023), *Building Construction* (20th ed. Reprint), Standard Publishers & Distributors.
4. Rangwala, P. C. (c. 2020), *Engineering Materials* (43rd ed.), Charotar Publishing House Pvt. Ltd.
5. Sushil Kumar, Engineering Materials, Standard Publication and Distributors, New Delhi

Course Outcomes**

After completion of the course students will be able to

1. Identify and classify common building materials such as bricks and steels and explain testing methods and foundation types based on soil bearing capacity.
2. Describe masonry terms, differentiate between types of bonds and masonry, and interpret design elements of stairs, doors, windows, and ventilators.
3. Explain flooring types and laying methods, identify roof types and trusses, and classify arches, lintels, and chejjas with their functions.
4. Select appropriate plastering and painting materials and demonstrate application techniques for various surfaces in buildings.

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3(WK 1, 2, 3, 4, 5, 6, 7)	2(WK 1, 2, 3, 4, 5, 6, 7)	2(WK 1, 2, 3, 4, 5, 6, 7)	**1**(WK 1, 3, 4, 5, 6, 7)	2(WK 1, 2, 3, 4, 5, 6, 7)	2(WK 1, 2, 3, 4, 5, 6, 7)	**2**(WK 1, 2, 3, 4, 5, 6, 7)	-	-	-	2(WK 1, 3, 4, 5, 6, 7)	1(WK 3, 4, 5, 7)	-	-
CO2	3(WK 1, 2, 3, 4, 5, 6, 7)	2(WK 1, 2, 3, 4, 5, 6, 7)	3(WK 1, 2, 3, 4, 5, 6, 7)	-	2(WK 1, 2, 3, 4, 5, 6, 7)	2(WK 1, 2, 3, 4, 5, 6, 7)	**2**(WK 1, 2, 3, 4, 5, 6, 7)	-	**1**(WK 1, 2, 3, 4, 5, 6, 7)	2(WK 1, 3, 4, 5, 6, 7)	-	1(WK 3, 4, 5, 7)	-	-
CO3	3(WK 1, 3, 4, 5, 6, 7)	2(WK 1, 2, 3, 4, 5, 6, 7)	3(WK 1, 3, 4, 5, 6, 7)	**1**(WK 1, 3, 4, 5, 6, 7)	2(WK 1, 3, 4, 5, 6, 7)	2(WK 1, 3, 4, 5, 6, 7)	**3**(WK 1, 3, 4, 5, 6, 7)	-	-	2(WK 1, 3, 4, 5, 6, 7)	2(WK 1, 3, 4, 5, 6, 7)	1(WK 3, 4, 5, 7)	-	-
CO4	2(WK 1, , 3, 4, 5, 6, 7)	2(WK 1, 2, 3, 4, 5, 6, 7)	3(WK 1, , 3, 4, 5, 6, 7)	-	2(WK 1, , 3, 4, 5, 6, 7)	2(WK 1, , 3, 4, 5, 6, 7)	**3**(WK 1, , 3, 4, 5, 6, 7)	-	1(WK 1, 2, 3, 4, 5, 6, 7)	2(WK 1, , 3, 4, 5, 6, 7)	2(WK 1, 3, 4, 5, 6, 7)	1(WK 3, 4, 5, 7)	-	-

Course Code		:	1BCVA306C	ENGINEERING GEOLOGY	Semester	:	03
L:T:P		:	3:0:0		Course Type	:	PCC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Ability to apply geological principles to engineering projects to ensure they are safe, sustainable, and economically viable

Course Outcomes:

After completion of the course, student will be able to:

CO1 : Explain the fundamental concepts of geology, Earth's structure, and the properties of common rock-forming and ore-forming minerals relevant to civil engineering.

CO2 : Analyze different types of rocks, soils, and geological processes (weathering, earthquakes, landslides) in relation to civil engineering structures.

CO3 : Evaluate geological structures such as folds, faults, joints, and unconformities for their significance in selecting sites for dams, reservoirs, and tunnels.

CO4 : Assess groundwater conditions and environmental geology issues to recommend sustainable solutions for engineering construction and mining.

UNIT–I	10 Hrs.

Introduction: Geology- its branches; Engineering geology, its importance in civil engineering; Work activities of engineering geologist. Internal structure and composition of earth.

Mineralogy: Definition, importance and general classification of minerals; Study of physical properties, chemical composition and uses of common rock forming and ore forming minerals; Stability of the minerals.

UNIT–II	12 Hrs.

Petrology: Introduction, definitions and general classification of rocks; Rock cycle; Mode of occurrence, structures, textures, classification, descriptions and engineering usage of important igneous, sedimentary and metamorphic rocks

Geomorphology and Geo-dynamics: Epigene and hypogene geological agents; Weathering of rocks, types of weathering; Significance of Weathering in Civil Engineering. Soil – its formation, profile, classification, erosion and conservation. Earthquakes - Causes and effects, plate tectonics and elastic rebound theory; Seismic resistant structures. Stability of slopes-Landslides: Causes, effects and preventive measures.

UNIT-III	10 Hrs.

Structural Geology: Basic definitions - outcrop, inlier, outlier, dip and strike; Use of Clinometer compass and Brunton compass. Study of important Geological structures - Faults, Folds, Joints and Unconformities - definition, classification, recognition in the field and significance in civil engineering. Selection of sites for civil engineering projects - dams, reservoirs and tunnels.

UNIT-IV	10 Hrs.

Hydrogeology: Hydrological cycle, mode of occurrence and sources of groundwater; Water bearing properties of rocks and soils; Aquifers and their types. Influence of groundwater in engineering construction; groundwater exploration by geophysical method; Artificial recharge of groundwater.

Environmental Geology: Definition and fundamental concepts of environmental geology; Interaction between human, geology and environment; Global warming and greenhouse effect; Environmental impacts of mining; Concept of eco friendly mining.

Text Books:

1. Parbin Singh-A **Text book of Engineering & General Geology**; S.K. Kataria & Sons, 8th Revised Edn. New Delhi.2008
2. Santoshkumar Garg – **Physical and Engineering Geology;** Khanna Publishers, 3rdrevised and enlarged Edn New Delhi. 1999.
3. P. K. Mukerjee-A **Textbook of Geology;** The World Press,11th reviser Edn Pvt Ltd Calcutta.1990.
4. K. M. Bangar- **Principals of Engineering Geology;** Standard Publishers and Distributors, New Delhi.2004.
5. D. Venkat Reddy-**Engineering Geology for Civil Engineers;** Oxford & IBH Publishers, New Delhi.1997.
6. N. Chennakesavalu - Text Book of Engineering Geology; Macmillan Publishers2nd Edn India Ltd. New Delhi. 2009.
7. Vasudev Kanithi – Engineering Geology; Universities Press (India) Pvt. Ltd. Hyderabad. 2018.
8. Subinoy Gangopadhyay- Engineering Geology; Oxford Universities Press New Delhi. 2013.
9. F. G. H. Blyth, M.H.de Freitas –Geology for Engineers; Elsevier publications 7th Edn 1988.
10. KVGK Gokhale - Principles of Engineering Geology; B S Publications, Hyderabad.

Reference Books:

1. N. W. Gokhale **- Theory of Structural Geology;** CBS Publishers & Distributors, New Delhi2nd Edn. 2003.
2. H. H. Read- **Rutley's, Elements of Mineralogy;** CBS Publishers & Distributors, New Delhi 26th Edn 1984.
3. G. W. Tyrrel- **Principles of Petrology;** BI Publications Pvt Ltd, New Delhi 1st Edn 1987.
4. S. K. Duggal, H.K.Pandey, N.Rawal – Engineering Geology, Mc Graw Hill Education

publications 2017

5. K.S.Valdiya– Geology, Environment and Society; University Press (India) Pvt.Ltd., Hyderabad.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4)	2 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	-	2 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	-	-	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-
CO2	3 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4, WK5, WK6	2 (WK1, WK3, WK4, WK5, WK6)	-	2 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4, WK5, WK6)	-	-	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-
CO3	2 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	-	-	2 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4, WK5, WK6)	-	-	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-
CO4	2 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK2, WK3)	-	2 (WK1, WK3, WK4, WK5, WK6)	-	-	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-

Course Code		**:**	**1BCVA307L**	**ENGINEERING GEOLOGY LAB**	**Semester**	**:**	**03**
L:T:P		**:**	**0:0:2**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**26 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**-**		**SEE Marks**	**:**	**50**
	Exam	**:**	**04 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**30 Hrs**		**Credits**	**:**	**01**

Professional Competency:

Develop the practical ability to identify earth materials and interpret geological data to solve engineering challenges.

Course Outcomes:

After completion of the course, student will be able to:

CO1: ***Identify*** common rock-forming and ore-forming minerals using their physical properties through megascopic examination.

CO2: ***Classify*** igneous, sedimentary, and metamorphic rocks based on their geological characteristics and field appearances.

CO3: ***Interpret*** geological maps and ***solve*** dip and strike problems, borehole data, and thickness problems relevant to subsurface geology.

CO4: ***Apply*** geological knowledge to analyze and ***evaluate*** subsurface conditions for civil engineering projects using practical data.

LIST OF EXPERIMENTS

1. Megascopic Identification of Minerals based on their Physical properties; Quartz and its varieties.
2. Megascopic Identification of Minerals based on their Physical properties; Felspars, Micas, Hornblende, Olivine, Serpentine, Asbestos, Kyanite, Talc, Garnet, Corundum and Barite.
3. Megascopic Identification of Minerals based on their Physical properties; Carbonates and Ore minerals.
4. Megascopic Identification of Igneous Rocks based on Geological properties: Granite, Syenite, Diorite, Gabbro, Dunite, Porphyries, Dolerite, Pegmatite, Basalt and Pumice.
5. Megascopic Identification of Sedimentary Rocks based on Geological properties: Sandstone, Limestone, Shale, Breccia, Conglomerate and Laterite.
6. Megascopic Identification of Metamorphic Rocks based on Geological Properties: Gneiss, Quartzite, Marble, Slate, Phyllite, Schist and Charnockite.
7. Study and interpretation of standard geological maps.
8. Dip and Strike problems.
9. Bore hole Problems (On Level Ground).
10. Thickness Problems.

Reference Books:

1. B.S. Satyanarayanswamy- Engineering Geology lab Manual, Eurasia Publication, New Delhi. 2003.
2. M. T. Maruthesha Reddy- Engineering Geology Practicals, New Age International Pvt Ltd , 1st Edn, New Delhi 2002.
3. N. W. Gokhale-Manual of Geological Maps, CBS Publishers & Distributors, 1st Edn, New Delhi.1987.
4. N.W .Gokhale-Exercises on geological Maps & Dip-Strike Problems, CBS Publishers &Distributors, 1st Edn, New Delhi.1996.
5. N. W. Gokhale - A Guide to Field Geology, CBS Publishers & Distributors, 1stEdn. New Delhi.2001

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes CO	Programme Outcomes(POs)											Program Specific Outcomes(PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK3, WK6)	3 (WK1, WK3, WK6)	2 (WK1, WK3, WK6)	2 (WK1, WK3, WK6)	-	2 (WK1, WK3, WK6)	2 (WK1, WK3, WK6)	-	-	-	-	-	1 (WK1, WK3, WK6)	-
CO2	3 (WK1, WK3, WK6)	3 (WK1, WK3, WK6)	3 (WK1, WK3, WK6)	2 (WK1, WK3, WK6)	-	2 (WK1, WK3, WK6)	3 (WK1, WK3, WK6)	-	-	-	-	-	1 (WK1, WK3, WK6)	-
CO3	2 (WK1, WK3, WK6)	3 (WK1, WK3, WK6)	2 (WK1, WK3, WK6)	-	-	2 (WK1, WK3, WK6)	3 (WK1, WK3, WK6)	-	-	-	-	-	1 (WK1, WK3, WK6)	-
CO4	2 (WK1, WK3, WK6)	2 (WK1, WK3, WK6)	2 (WK1, WK3, WK6)	2 (WK1, WK3, WK6)	3 (WK1, WK3, WK6)	-	2 (WK1, WK3, WK6)	-	-	-	-	-	1 (WK1, WK3, WK6)	-

Course Code		**:**	**1BCVA308L**	**Building Planning and Drawing using CAD**	**Semester**	**:**	**03**
L:T:P		**:**	**0:0:2**		**Course Type**	**:**	**PCC**
Hours/Sem	**Teaching**	**:**	**00 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**26 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**04 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**30 Hrs**		**Credits**	**:**	**01**

Professional Competency:

The ability to plan functional building layouts according to local bylaws and translate them into precise, standardized engineering drawings using CAD software.

Course Outcomes:

After completion of the course, student will be able to:

CO1. To understand the basic concept on Cad software tools.

CO2. To prepare working drawing for various components of a building

CO3. To prepare, read and interpret the detailed drawing for residential building in a professional set up.

CO4. To prepare the single line diagram for various public buildings.

List of Experiments

1. Indian Standard- Specifications of Drawings, Introduction to Auto CAD
2. Cross section of stepped wall Foundation for masonry wall
3. Cross section of masonry wall for two story building
4. Plan and cross section of Dog legged staircase
5. Plan and cross section of Open well staircase
6. Plan,Elevation & Cross section-Single Storied Residential Building with two bed room
7. Preparation of 3D Model of Single Storied Residential Building using Revit Software.
8. Planning of Primary health center – Single Line Diagram
9. Planning of Primary school building. – Single Line Diagram
10. Planning of PWD division office. – Single Line Diagram
11. Planning of Tahshildar Office. – Single Line Diagram

Text Books:
1. Shah M.H and Kale C.M., Building Drawing, Tata McGraw Hill Publishing co Ltd., New Delhi,4th Edi,2008. 2. Gurucharan Singh, Building Construction, Standard Publishers &distributors, New Delhi, 4thEdn. 1989.
Reference Books:
1.Sushil Kumar, Building Construction, Standard Publications, New Delhi, 19th Edn. May 2018. 2.National Building Code, BIS, New Delhi, Dec 1986.

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK2, WK3)	2 (WK2, WK3)	-	-	3 (WK6)	-	-	1	1	-	1	2	2
CO2	2 (WK3)	2 (WK3)	3 (WK5)	-	3 (WK6)	1 (WK5)	-	1	1	-	1	3	2
CO3	2 (WK3)	3 (WK3)	3 (WK5)	3 (WK5)	3 (WK6)	1 (WK5)	-	1	2	-	1	3	3
CO4	2 (WK3)	2 (WK3)	2 (WK3)	-	3 (WK6)	1 (WK5)	-	1	1	-	1	3	2

Course Code	1BCVA303C	SURVEYING PRACTICES LAB	Semester	III
L: T:P -	0: 0:28		Course Type	PCC
Teaching	28 Hrs		CIE Marks	50
Learning (TW + SL)	2 Hrs		SEE Marks	50
Exam	2 Hrs		Total Marks	100
Total Hours	30 Hrs		Credits	1

Course Outcomes

After completion of the course, student will be able to:

CO1: Demonstrate the use of basic surveying instruments (chain, tape, compass, and level) for linear and angular measurements, and setting out of simple geometrical figures such as a hexagon.

CO2: Conduct various levelling techniques including differential, fly, reciprocal, and profile levelling, and interpret the results to generate elevation profiles and contour maps.

CO3: Utilize theodolite for measuring horizontal and vertical angles and determine elevations and distances for both accessible and inaccessible locations.

CO4: Operate a Total Station & DGPS for data collection, area measurement, topographic survey, and layout of parallel lines; perform data transfer and compilation of contour maps using software tools.

List of Experiments

1. Demonstration of basic surveying instruments like (Chain, Tape, Compass, Theodolite etc…)
2. **Levelling**
   - Differential Levelling
   - Fly levelling and Fly back leveling
   - Profile and cross section levelling
   - Block Contouring, Reciprocal leveling
3. **Total Station**
   - Introduction → Taking Out Basic Measurements (SHV, REM, MLM)
   - Station orientation, back sighting, Instrument Synchronization & Data recording.
   - Works on Total Station→ Area Measurement → Topographic survey
   - Set out Parallel Lines → Downloading a contour map using auto plotter
4. **DGPS (Differential Global Positioning System)**
   - Introduction to DGPS equipment → Establishment of a Base Station.
   - Collection of field coordinates using a Rover → Downloading and processing DGPS data.
   - Plotting survey points in AutoCAD/QGIS → Preparation of a contour map from DGPS observations.

Reference Books*

1. B.C. Punmia, Surveying, Vol. 1 Laxmi Publications, New Delhi.2005
2. A.M. Chandra, Plane Surveying, Vol-1, Newage International ® Ltd. 2nd Edn 2006
3. K. R. Arora, Plane Surveying, S. Chand and Company Ltd., New Delhi. Laboratory 1998
4. Dr.K.R.Arora, Plane and Advanced Surveying, Standerd Book House, New Delhi, 7th Edition-2009
5. GIS and Remote Sensing by Angireddi- 3rd Edition, Indian Publications, Hyderabad-2014.

Course Articulation Matrix(CAM)

Sl. No.	Course Outcomes (CO's)	Program outcomes (PO's)											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
01	CO1	3	2	-	2	1	-	-	-	2	2	1	-	-	-
02	CO2	3	3	-	3	2	-	-	-	2	2	1	-	-	-
03	CO3	3	3	-	3	3	-	-	-	2	2	2	-	-	-
04	CO4	3	3	2	3	3	-	-	-	3	3	2	-	-	-

LABORATORY ASSESSMENT:

1. Each Laboratory subject is evaluated for 100 marks (50 CIE and 50 SEE).
2. Allocation of 50 marks for CIE

- Performance and journal write - up:
- Marks for each experiment = 30 marks/ No. of proposed experiments.
- One Practical test for 20 Marks. (5write-ups, 10 conduction, calculation, results etc. 5viva-voce)

3. Allocation of 50 marks for SEE.

- 25% write-up, 50% conduction, calculation, results etc., 25% viva-voce.

Course Code		:	BMAB300M	BRIDGE COURSE MATHEMATICS-I	Semester	:	III
L:T:P		:	3 : 0 : 0		Course Type	:	MC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	100
	Learning (TW+SL)	:	45 Hrs		SEE Marks	:	00
	CIE Exam	:	3 Hrs		Total Marks	:	100
	SEE Exam	:	----				
	Total Hrs.	:	90 Hrs		Credits	:	00

Professional Competency:

Apply calculus, linear algebra, Laplace transform, and numerical techniques to solve engineering and mathematical problems efficiently.

Course Outcomes

After completion of the course student will be able to

CO1: Apply the concepts of calculus
CO2: Apply the principles of linear algebra to solve system of linear equations.
CO3: Apply the Laplace transform techniques to solve differential equations.
CO4: Apply the Numerical techniques to solve engineering problems.

Partial Derivatives and Ordinary Differential equations — **11 Hrs.**

Partial differentiation, total derivative –differentiation of composite functions, Jacobian.
Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations. Integrating factors on (1/N) (∂M / ∂y- ∂N/ ∂x) and (1/M) (∂N / ∂x- ∂M/ ∂y).

Linear Algebra — **10Hrs.**

Elementary transformations, Rank of a matrix, consistency of a system of linear equations, solution of homogeneous and non homogeneous equations, Gauss-elimination method, Gauss-seidel method, Eigen values and eigen vectors by Rayleigh's power method.

Laplace Transform — **11Hrs.**

Introduction, Definition of Laplace Transform, Laplace Transform of standard functions, Properties: Shifting,
differentiation, Integral and division by t. Periodic function, Heaviside's Unit step function.
Inverse Laplace transform, properties(Shifting, Partial fractions, Logarithmic functions).Solutions of linear differential equations.

Numerical Methods — **10 Hrs.**

Introduction to root finding problems, Newton-Raphson's method. Finite differences, forward and backward difference operators (no derivations on relations between operators) Newton-Gregory forward and backward interpolation formulae (Without proof), Lagrange's interpolation formulae (without proof). Simpson's 1/3rd and 3/8th rule(no derivation)-problems. Runge-Kutta 4 th order method -problems.

Text Books

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna Publishers, 44thEd., 2021.
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.
3. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C.Bhunia**: "Engineering Mathematics" Oxford University Press, 3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A Textbook of Engineering Mathematics" Laxmi

Publications, 10th Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co., New York, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
7. **Gareth Williams:** "Linear Algebra with Applications", Jones Bartlett Publishers Inc., 6th Ed., 2017.

Table: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3, and WK4)						1			1		
CO2	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3, and WK4)						1			1		
CO3	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3, and WK4)						1			1		
CO4	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3, and WK4)						1			1		

Sri B.V.V.S.
Basaveshwar Engineering College, Bagalkote
Scheme (from 2025-26)

Sl. No.	Course Code	Course Title	Teaching-Learning Scheme				Examination Duration (Hrs/Sem.)		Total Hours	Examination Scheme and Evaluation			Credits (C)=Total Hours/30
			L Hrs/Week (Hrs/Sem.)	T Hrs/Week (Hrs/Sem.)	P Hrs/Week (Hrs/Sem.)	Term Work (TW) and Self Learning (SL) (TW+SL) Hrs/Sem.	CIE	SEE		CIE Marks	SEE Marks	Total Marks	
1	BMAB 300M	BRIDGE COURSE MATHEMATICS-I	0(42)	0	0	42	3	0	87	100	00	100	00= 100/42

Course Code		:	1BBTA402C	BIOLOGY FOR ENGINEERS	Semester	:	04
L:T:P*		:	3:0:0		Course Type	:	PCC
Hours/Sem.	Teaching	:	42Hrs.		CIE Marks	:	50
	Learning (TW+SL)	:	42Hrs.		SEE Marks	:	50
	Exam	:	6Hrs.		Total Marks	:	100
	Total Hrs.	:	90Hrs.		Credits	:	03

Professional Competency:

Understanding fundamentals of biological processes and apply to solve engineering problems, bridging the technical engineering with living systems.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Explain the structure and functions of cells and biomolecules, properties and applications of special biomolecules in engineering and industrial contexts.

CO2: Interpret bio-inspired models and natural mechanisms and correlate them with engineering designs and technological innovations.

CO3: Analyze the functional architecture of human organ systems as models to design and evaluate engineering solutions**.**

CO4: Apply the concept of bioprinting, artificial intelligence, and microbial processes in the design and development of innovative solutions for healthcare, food science, and sustainable infrastructure.

UNIT-I	10 Hrs.

Introduction to Biology:

The cell: Structure, and functions of a cell. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, Proteins and Lipids. Importance of special biomolecules: Enzymes, vitamins and hormones -properties and functions.

Biomolecules and their Applications:

Carbohydrates in bioplastics production, Proteins in food production, Lipids in biodiesel.

UNIT-II	10 Hrs.

Bio Inspiration Models Used in Engineering:

Bio inspiration - Introduction, Alliance between Engineering and Biology, Biomimicry - Science mimicking nature. Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Gecko Feet, Plant burrs (Velcro), Shark skin (Friction reducing swimsuits), Kingfisher beak (Bullet train), Fire fly LED.

Nature Bioinspired Mechanisms:

BioEcholocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf), Respiration (MFCs) .

UNIT-III	12 Hrs.

Human Organ Systems and Bio Designs

Brain as a CPU system -architecture, CNS and Peripheral Nervous System, signal transmission, EEG. Engineering solutions for Parkinson's disease.

Heart as a pump system -architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators.

Lungs as purification system gas exchange mechanisms, spirometry, Ventilators.

Eye as a Camera system, bionic eye. **Kidney** as a filtration system - dialysis systems.

UNIT-IV	**10 Hrs.**

Trends In Bioengineering

Bioprinting techniques and materials, 3D printing of ear, bone and skin, electrical tongue and electrical nose in food science, Self-healing bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes), Biomining via microbial surface adsorption. Artificial Intelligence for disease diagnosis. Biochips & their applications. Biosensors & their applications.

Reference Books

1. Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao, "Biology for Engineers" N Publishing, Bengaluru, 2023.
2. S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., *Biology for Engineers*, Tata McGraw-Hill, New Delhi, 2012.
3. Arthur T. Johnson, *Biology for Engineers*, 2nd Edition, CRC Press, Taylor & Francis Group, Boca Raton, FL, 2019.
4. Sohini Singh and Tanu Allen, *Biology for Engineers*, Vayu Education of India, New Delhi, 2014.
5. Yoseph Bar-Cohen, *Biomimetics: Nature-Based Innovation*, 1st edition, CRC Press., 2012
6. Ibrahim Ozbolat, *3D Bioprinting: Fundamentals, Principles and Applications*, Academic Press (Elsevier), 2016.
7. Rodríguez Méndez, M. L. (Ed.), *Electronic Noses and Tongues in Food Science***,** 1st Edition, Academic Press (Elsevier), Cambridge, MA, USA, 2016**.**

Web links and Video Lectures (e-Resources)

- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology

- https://www.futurelearn.com/courses/biology-basic-concepts

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	PSO1	PSO2	PSO3
CO 1	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	3 (WK5)	2 (WK8)	2 (WK2,WK6)	2 (WK1,WK5,WK7)	2 (WK9)	2			3 (WK8)	3	2	2
CO 2	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	3 (WK5)	2 (WK8)	3 (WK2,WK6)	3 (WK1,WK5,WK7)	2 (WK9)	2			3 (WK8)	3	2	2
CO 3	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	3 (WK5)	2 (WK8)	3 (WK2,WK6)	3 (WK1,WK5,WK7)	3 (WK9)	2			3 (WK8)	3	2	2
CO 4	3 (WK1, WK2, WK3, and WK4)	3 (WK1, WK2, WK3, and WK4)	3 (WK5)	2 (WK8)	3 (WK2,WK6)	3 (WK1,WK5,WK7)	3 (WK9)	2			3 (WK8)	3	2	2

Course Code		:	1BCVA403C	Analysis of Statically Determinate Structures	Semester	:	04
L:T:P		:	3:0:0		CourseType	:	PCC
Hours/Sem.	Teaching	:	42Hrs		CIEMarks	:	50
	Learning (TW+SL)	:	42Hrs		SEEMarks	:	50
	Exam	:	03Hrs		Total Marks	:	100
	TotalHrs.	:	90Hrs		Credits	:	03

Professional Competency:

Apply the principles of structural mechanics to analyze statically determinate structures subjected to various loading conditions. Develop the ability to evaluate structural behavior, determine internal forces and deflections, and interpret results for safe and efficient engineering design.

CourseOutcomes:

After completion of the course student will be able to

1. Compute degree of static and kinematic indeterminacy of structures and determine slopes and deflections for statically determinate beams.
2. Analyze statically determinate beams and trusses for deflections.
3. Analyze three hinged parabolic arches and cables for internal forces.
4. Draw influence lines and determine SF and BM due to rolling loads on simply supported beams.

UNIT–I	10Hrs.

Introductory Concepts: Structural systems, Forms of structures. One, two and threedimensional structures. Compatibility and Constitutive relations. Material and Geometric linearity and nonlinearity. Determinate and indeterminate structures- Degree of Indeterminacy (Static and Kinematic).

Deflection of beams by Moment-Area & Conjugate beam methods: Moment area theorems and conjugate beam theorems. Analysis of statically determinate beams. Numerical problems

UNIT–II	10Hrs.

Deflection of beams and trusses by strain Energy methods: Strain Energy and Complementary strain energy, Strain energy due to axial load, bending. Principle of virtual work; Castigliano's theorems- I. Numerical problems on deflections of statically determinate beams using Castigliano's theorem-I and unit load methods.. Deflection of trusses.

UNIT-III	10Hrs.

Analysis of Arches: Three hinged parabolic arches with supports at same and different levels; determination of thrust, shear and bending moment.

Analysis of Cables: Analysis of cables under point load and udl, length of cables, supports at same and different levels

UNIT-IV	12Hrs.

Rolling Loads and Influence Lines: Rolling Loads, Influence line diagram for reaction, shear force and bending moment at a section for simply supported beams due to point loads and uniformly distributed loads. Uses of Influence lines for analysis of simply supported beam for single and several point loads, uniformly distributed loads

TextBooks:

1. B C Punmia, Ashok Kumar Jain, Aran Kumar Jain Theory of structures Vol-I & II Laxmi Publications, New Delhi-2004
2. C S Reddy-Basic Structural Analysis, 2 Edition, Tata Mc Graw Hill, New Delhi-2003.
3. Ramamrutham, R Narayan-Theory of structures,Dhanpt Rai Publishing Company,8 Edition New Delhi-2008

ReferenceBooks:

1. K.U. Muthu, H.Narendra etal, "Determinate Structural Analysis", IK International Publishing Pvt. Ltd

Matrix to describe the mapping of Cos with Pos (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1								1	2	2	
CO2	2	2	2	1								1	2	2	
CO3	2	2	2	1								1	2	2	
CO4	2	2	2	1								1	2	2	

Course Code		**:**	**1BCVA404C**	**Geotechnical Engineering**	**Semester**	**:**	**04**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Apply the principles of soil mechanics and geotechnical engineering to investigate subsurface conditions and design safe, economical, and sustainable foundations, retaining structures, and earthworks for civil engineering projects.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Plan and interpret subsurface exploration programs by selecting appropriate soil exploration techniques, conducting and analyzing field tests, evaluating soil samples and sample quality, and preparing bore logs and geotechnical investigation reports for engineering applications.

CO2: Analyze stress distribution in soils due to various loading conditions and evaluate the stability of soil slopes using analytical and graphical methods for safe geotechnical engineering design.

CO3: Analyze and determine lateral earth pressures acting on retaining structures using theoretical and graphical methods, and apply these principles to the design and stability assessment of earth-retaining systems.

CO4: Analyze the bearing capacity and settlement characteristics of shallow foundations and design suitable foundation systems by applying analytical and field-based methods for safe and economical geotechnical engineering practice.

UNIT–I	**07 Hrs.**

Subsurface exploration- Introduction and methods of exploration: Boring, Sounding tests- Standard Penetration test, Static Cone penetration test and Dynamic Cone penetration test, Geophysical methods-electrical resistivity and seismic refraction methods.

Samples and types of samples- undisturbed, disturbed and representative samples, Samplers, Sample Disturbance- area ratio, recovery ratio, clearance, Subsurface exploration program - Preparation of bore logs and preparation of exploration report

UNIT–II	**07Hrs.**

Stress in Soils- Introduction, Boussinesq's and Westergaard's theory of concentrated load, circular and rectangular load, equivalent point load method, pressure distribution diagrams and contact pressure, Newmark's chart.

Stability of Soil Slopes: Types of slopes- Types of slope failures- Slip circle method, Determination of centre of critical slip circle- Taylor's stability charts and their use

UNIT-III	07 Hrs.
Lateral Earth Pressures: Lateral earth pressure theory, Different types of earth pressures, Rankine's active and passive earth pressures, pressure distribution diagram for lateral earth pressures against retaining walls for different conditions in cohesionless and cohesive soils, Coulomb's active and passive earth pressure theory, Culmann's graphical construction, Problems	
UNIT-IV	**07 Hrs.**
Shallow Foundations and Bearing Capacity: Types of shallow foundations and choice Bearing capacity of foundation: Bearing capacity – Basic Definitions, Factors affecting bearing capacity, Estimation of Bearing capacity by different methods, Analytical measures – Terzaghi's and Meyerhof methods and calculations, Field measures- Plate load tests. Settlement of foundation: Settlement analysis – Types of foundation settlement, Components of settlements - their estimation, Allowable settlement values	

Text Books:

1. Braja M. Das and Sobhan K. "Principles of Geotechnical Engineering" Cengage India Private Limited, New Delhi, 10th Ed., (2021).
2. G. Ranjan and A.S.R Rao. "Basic and Applied Soil Mechanics" New Age International (P) Ltd., New Delhi, 5th Ed., (2022).
3. B.C. Punmia "Soil Mechanics and Foundation Engg" Laxmi Publications Co., New Delhi, 17th Ed., (2021).
4. V.N.S. Murthy "Soil Mechanics and Foundation Engineering" UBS Publishers and Distributors, New Delhi, 4th Ed., (2018)
5. C. Venkatrahmaiah "Geotechnical Engineering" New Age International (P) Ltd., New Delhi, 6th Ed., (2018).

Reference Books:

1. Singh and Chowdhary G.R. "Soil Engineering in Theory and Practice" CBS Publishers and Distributors Ltd., New Delhi, (2017)
2. J.E. Bowles "Foundation Analysis and Design" McGraw Hill Pub. Co. New York, 5th Ed., (2017).

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	**Program Outcomes and (WKs)**											**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3(WK3, WK4)	3(WK3, WK4)	-	-	-	1(WK7)	-	-	1	-	1(WK8)	-	3	-
CO2	3(WK3, WK4)	3(WK3, WK4)	1	-	-	-	-	-	1	-	1(WK8)	-	3	-
CO3	3(WK3, WK4)	3(WK3, WK4)	1	-	-	-	-	-	-	-	1(WK8)	-	3	-
CO4	-	3(WK3, WK4)	2	2(WK8)	-	2(WK7)	-	-	-	-	1(WK8)	-	3	-

BCVA404C	Soil Mechanics	Credits: 03
L:T:P - 3 : 0: 0		CIE Marks: 50
Total Hours/Week: 3		SEE Marks: 50

UNIT-I	10 Hrs.
Introduction: Formation of soil, phase diagram, basic definitions and their interrelationships. **Index Properties**-Definitions and their determination, particle size analysis (sieve and Hydrometer analysis) consistency limits and indices, plasticity chart, activity of clay, field identification tests, BIS soil classification (IS: 1498-1970). **Clay Mineralogy**: Soil structure- single grained, honeycombed, flocculent and dispersed structures, soil-water system, electrical diffuse double layer, adsorbed water, base-exchange capacity, Isomorphous substitution. Common clay minerals in soil and their structures-Kaolinite, Illite and Montmorillonite and their application in engineering.	
UNIT-II	**10 Hrs.**
Flow Through Soils: Darcy's law-assumption and validity, coefficient of permeability and its determination (laboratory and field), factors affecting permeability, permeability of stratified soils, seepage velocity, superficial velocity and coefficient of percolation, capillary phenomena. **Seepage Analysis:** Laplace equation, assumptions, limitations and its derivation. flow nets-characteristicsandapplications.Flownetsforsheetpilesandbelowthedamsection.Unconfined flow, phreaticline (Casagrande's method–with and without toefilter), flow through dams, design of dam filters.	
UNIT–III	**10 Hrs.**
Compaction of Soil: Definition, principle of compaction, standard and modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, field compaction control- compactive effort & method of compaction, lift thickness and number of passes, Proctor's needle, compacting equipments and their suitability. **Consolidation of Soil**: Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory-assumption and limitations (no derivation), normally consolidated, under consolidated and over consolidated soils, pre-consolidation pressure and its determination by Casagrande's method. Consolidation characteristics of soil (C_C, a_V, $m_V$and C_V), Time rate of consolidation.	
UNIT–IV	**10 Hrs.**
Shear Strength of Soils: Concept of shear strength, Mohr's strength theory, Mohr-coulomb theory, conventional and modified failure envelops, total and effective shear strength parameters, concept of pore pressure, factors affecting shear strength of soils, sensitivity and thixotropy of clay. Measurement of shear parameters- direct shear test, unconfined compression test, triaxial compression test and vane shear test, Test under different drainage conditions.	
Reference Books *	

1. G. Ranjan and A.S.R Rao (2022), Basic and Applied Soil Mechanics (4th Edition), New Age International (P) Ltd., New Delhi.
2. B. M. Das (2021), Principles of Geotechnical Engineering (10th Edition), Cengage India Pvt. Ltd.
3. J. Knappett and R. F. Craig (2019), Craig's Soil Mechanics (9th Edition), CRC Press.
4. B. C. Punmia, A. K. Jain and A. K. Jain (2017), Soil Mechanics and Foundation Engineering (17th Edition), Laxmi Publications Co, New Delhi.

Course Outcomes**

After completion of the course student will be able to

1. Analyse and interpret soil properties and clay mineralogy to effectively apply engineering principles in practical scenarios.
2. Apply Darcy's law, seepage phenomena, and utilize flow nets to solve practical engineering problems related to flow through soils and seepage analysis.
3. Apply the principles of compaction and consolidation to effectively control soil behaviour in engineering projects.
4. Determine settlement of soils and utilize testing methods to find shear strength parameters.

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3	1						1					3	
CO2	2	1											3	**1**
CO3	3	2		1				1					3	
CO4	2	2		1				1					3	
	2.5	1.5		1.0				1.0					3	**1**

CourseCode		**:**	1BCVA405C	**Highway Engineering**	**Semester**	**:**	IV
L:T:P*		**:**	**3 :0: 0**		**CourseType**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs.**		**CIEMarks**	**:**	50
	Learning (TW+SL)	**:**	**42 Hrs.**		**SEEMarks**	**:**	50
	Exam	**:**	**06 Hrs.**		**Total Marks**	**:**	100
	TotalHrs.	**:**	**90 Hrs.**		**Credits**	**:**	03

ProfessionalCompetency:

The course develops professional competency to plan, geometrically design, evaluate, construct and maintain highway infrastructure in accordance with Indian standards and contemporary engineering practice, considering safety, sustainability, economy, climate resilience and life-cycle performance.

CourseOutcomes:

Aftercompletionofthecourse,studentwillbeableto:

CO1: Explain the principles of highway planning and classify road networks in India as per IRC guidelines.

CO2: Apply IRC codal provisions to design cross-sectional elements, horizontal and vertical alignment of a highway.

CO3: Evaluate highway construction materialsthrough standard laboratory tests for their suitability and design the pavement.

CO4: Evaluate the highway drainage conditions and highway economics by a few select methods.

Unit-I	**11 Hrs.**

Principles of Transportation Engineering: Importance of transportation, Different modes of transportation, Characteristics of road transport,Jayakar committee, Current Road development Programs in India (Bharatmala Pariyojana, NHDP, Expressways, Economic corridors and Rural road connectivity), Highway Development and Planning, Road Classification and patterns, Saturation system, Planning Surveys, HighwayAlignment and Survey, Engineering Surveys - conventional and modern surveying methods, Drawings and Reports.

Unit-II	**11 Hrs.**

Highway Geometric Design: Cross-sectional elements, Sight distances, Horizontal alignment– Curves, Superelevation, Extra widening, Transition curves, Radius of curve, Design of vertical alignment– Gradients, Summit and Valley curves.

Unit-III	**10 Hrs.**

Pavement: Desirable properties and tests on Subgrade soil, Aggregates and Bituminous Binders &Mixes, Pavement Quality Concrete, Sustainable and emerging highway materials, Pavement types with comparison,Factors affecting pavementdesign, Flexible pavement design as per IRC 37, Pavement Construction– materialsand quality control.

Unit-IV	10 Hrs.
Highway Drainage: Significance and requirements, Surface drainage system, Sub-surface drainagesystem,Types of cross drainage structures, Design of longitudinal drain. **Highway Economics:** Highway user benefits, VOC, Economic analysis –AnnualCost and Benefit Cost Ratio method, Highway financing-PPP models, Use of computer software packages, Road investment decision packages.	
TextBooks:	
1. Khanna, S.K., and Justo, C.E.G., "Highway Engineering", Nem Chand & Bros, Roorkee, 10th Edition, 2017. 2. Kadiyali, L.R., "Principles and Practice of Highway Engineering", Khanna Publishers, New Delhi, 6th Edition, 2018.	
ReferenceBooks:	
1. R. Srinivasan, "Highway Engineering", Universities Press, 2011. 2. Garber, N.J., and Hoel, L.A., "Traffic and Highway Engineering", Cengage Learning, Boston, 5th Edition, 2014. 3. Indian Roads Congress, "IRC:37-2018 – Guidelines for the Design of Flexible Pavements", IRC, New Delhi, 2018. 4. Indian Roads Congress, "IRC:58-2015 – Guidelines for the Design of Plain Jointed Rigid Pavements for Highways", IRC, New Delhi, 2015.	

Table5: Matrix to describe the mapping of Cos with Pos (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK1, WK3, and WK4)	-	-	-	-	2 (WK7)	1 (WK7)	-	1	1	-	3	-
CO2	3 (WK1, WK2, WK3,	2 (WK1, WK2, WK3,	3 (WK5)	-	2 (WK6)	-	1 (WK7)	-	-	-	1 (WK5)	3	2

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
	and WK4)	and WK4)											
CO3	**2** (WK1, WK3, and WK4)	**3** (WK1, WK2, WK3, and WK4)	**3** (WK5)	**3** (WK8)	**2** (WK6)	**-**	**-**	**-**	**1**	**-**	**-**	**2**	**3**
CO4	**2** (WK1, WK3, and WK4)	**3** (WK1, WK2, and WK4)	-	**2** (WK8)	-	**2** (WK7)	**2** (WK7)	**-**	**-**	**-**	**2** (WK5)	**2**	**2**

Course Code		:	1BCVA406C	Fluid Mechanics and Hydraulics	Semester	:	04
L:T:P		:	3:0:0		CourseType	:	PCC
Hours/Sem.	Teaching	:	42Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42Hrs		SEEMarks	:	50
	Exam	:	06Hrs		Total Marks	:	100
	Total Hrs.	:	90Hrs		Credits	:	03

UNIT-I	**13Hrs.**

Properties of fluids: Density, Specific volume, specific weight, Relative density, and viscosity. Surface tension and Capillarity, Newton's law of viscosity, Types of fluids: Newtonian & Non-Newtonian fluids, Ideal and Real fluids. Numerical some properties, Newton's law of viscosity.

Fluid pressure and it's measurement: Derivation of Pascal's law, and Hydrostatic law. Numericals. Types of pressure. Manometers and their classification, theory, derivation and numericals, Mechanical pressure gauges and Bourdon's pressure gauge.

UNIT–II	**13Hrs.**

Fluid statics: Definition of Total pressure , Centre of pressure ,Derivation of total hydrostatic force and depth of centre of pressure on a plane surface (Inclined) and numerical.

Fluid kinematics: Lagrangian and Eulenian approaches of fluid flow analysis, Classification of flows. Continuity equation, Derivation of Continuity equation in three dimensions, Numericals.

UNIT–III	**13Hrs.**

Pipe flow: Definition, Classification of flows, HGL and TEL, major and minor losses in pipe flows. Derivation of equation for head loss due to friction (Darcy-Weisbach equation).Flow through compound pipes, (Series Parallel, Equivalent size).Problems on major and minor head losses Derivation for pressure rise due to gradual And sudden closure of valve and numerical.

UNIT–IV	**11Hrs.**

Open channel flow: Definition and classification, Derivation of Chezy's and Manning's equations and Numerical. Most economical rectangular, trapezoidal sections Derivations and numerical.

Specific energy: Specific energy curve, Derivation of critical depth, critical velocity and minimum specific energy, Numerical. Froude's number and its significance. Hydraulic jump depth : derivation and numericals.

ReferenceBooks*

1. James F Cruise,Vijay P.Singh, ElementaryHydraulics(1stEdition),MohsanM.Sherif,ThomsonLearning.April2006.
2. K.R.Arora Fluid Mechanics, Hydraulic and Hydraulics, Standard BookHouse,NewDelhi-2007.
3. JohnF.Douglas FluidMechanics.PearsonEducationNewDelhi,2011.
4. V.L.Streeter&B.Wylie Fluid MechanicsLakshmiPublications, NewDelhi,2007.
5. H.M.Raghunath Fluid MechanicsCBSPublicationNewDelhi.2008.
6. M.Manohar,Fluid Mechanics.Vol-IVikasPublishinghousePvtLtdNewDelhi,2008.
7. Dr.R.K.Bansal " A Text book on Fluid Mechanics and Hydraulic Machines" , 9th edition , Laxmi Publications pvt limited , New Delhi 2010.

Course Outcomes

Aftercompletionofthecoursestudentwillbeableto:

1. Students should be able to use fluid properties basics to solve fluid Mechanics problems and compute hydrostatic pressure using various devices available
2. Students should be ableapplyconceptsofhydrostaticsandkinematicstoreallifefluidmechanicsproblems.
3. Should be able to apply Bernoulli's principle in fluid mechanics problems and Compute pressure heads and losses in different types of pipe connections.
4. Studentswillbeabletodesignopenchannelsectionsandcomputeenergylossesinhydraulicjumps.

Course Outcomes	Programme Outcomes											Programme specific Objectives		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	2	1	1	1	-	-	-	-	-	2	2	2
CO 2	3	3	2	1	2	2	-	-	-	-	-	2	2	2
CO 3	3	3	2	2	2	3	-	-	-	-	-	2	2	2
CO 4	3	2	2	2	2	2	-	-	-	-	-	2	2	2

Course Code	1BCVA407L	BUILDING MATERIALS AND CONCRETE TESTING LAB	Semester	IV
L: T:P -	0: 0:28		Course Type	PCC
Teaching	28 Hrs		CIE Marks	50
Learning (TW + SL)	2 Hrs		SEE Marks	50
Exam	2 Hrs		Total Marks	100
Total Hours	30 Hrs		Credits	1

Course Outcomes

After completion of the course, student will be able to:

CO1: Analyze the physical characteristics, and behavior of common building materials.

CO2: Reproduce the basic knowledge of mathematics and engineering in finding the strength in tension, compression, shear and torsion for steel

CO3: Evaluate the impact of engineering solutions on the society and also will be aware of contemporary issues regarding failure of structures due to unsuitable materials.

CO4: Recognize the importance of ethical conduct, integrity, and accuracy in materials testing and reporting.

List of Experiments

MAJOR TESTS

1. Tension test on mild steel and HYSD bars
2. Torsion test on mild steel circular sections.
3. Bending test on wood under two-point loading.

MINOR TESTS

1. Test on bricks - Compressive strength and Absorption
2. Flexural test on tiles
3. Tests on Fine aggregates - Sieve Analysis, Moisture content, Bulk density, Bulking and Silt Content
4. Tests on Coarse aggregates - Sieve Analysis, Water absorption, Moisture content and Bulk density
5. Shear Test on Mild steel - single and double shear.
6. Impact test on Mild Steel (Charpy & Izod).

Hardness tests on ferrous and non-ferrous metals - Brinell's, Rockwell and Vicker's.

Reference Books*

1. Davis, Troxell and Hawk, Testing of Engineering Materials, International Student Edition McGraw Hill Book Co. New Delhi.1982
2. Fenner, Mechanical Testing of Materials, George Newnes Ltd. London.1965
3. Holes K A, English, Experimental Strength of Materials, Universities Press Ltd.London.2010
4. Suryanarayana A K, Testing of Metallic Materials, Prentice Hall of India Pvt. Ltd. New Delhi.2007
5. Kukreja C B- Kishore K. Ravi Chawla, Material Testing Laboratory Manual,Standard Publishers & Distributors 1996.
1. 6. M.L.Gambhir, Concrete Manual, Dhanpat Rai & Sons- New Delhi.2004

Course Articulation Matrix (CAM)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3 (WK1, WK2, WK3)	–	–	–	–	3 (WK6)	3 (WK7)	3 (WK8)	3	3	3	2 (WK3, WK6)	3 (WK4, WK5)	–
CO2	3 (WK1, WK2, WK3)	–	–	2 (WK4)	2 (WK5)	3 (WK6)	3 (WK7)	3 (WK8)	3	3	–	2 (WK3, WK6)	3 (WK4, WK5)	–
CO3	3 (WK1, WK2, WK3)	–	–	–	–	3 (WK6)	3 (WK7)	3 (WK8)	3	3	–	2 (WK3, WK6)	3 (WK4, WK5)	–
CO4	3 (WK1, WK2, WK3)	–	–	–	–	3 (WK6)	3 (WK7)	3 (WK8)	3	3	–	2 (WK3, WK6)	3 (WK4, WK5)	–

Course Code		**:**	**1BCVA408L**	**Highway Materials Testing Lab**	**Semester**	**:**	IV
L:T:P*		**:**	**0:0:2**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**26 Hrs.**		**CIE Marks**	**:**	50
	Learning (TW+SL)	**:**	**26 Hrs.**		**SEE Marks**	**:**	50
	Exam	**:**	**4 Hrs.**		**Total Marks**	**:**	100
	Total Hrs.	**:**	**30 Hrs.**		**Credits**	**:**	01

Professional Competency:

The Highway Materials Testing Laboratory demonstrates reliable quality control, technical expertise, and compliance to support safe, durable, and high-performance highway infrastructure.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Acquires capability of choosing the appropriate aggregates for construction and design the pavement as per standard practices.

CO2: Acquires capability of choosing the appropriate bitumen for construction and design the pavement as per standard practices.

CO3: Select the appropriate soil for construction and design the pavement as per standard practices.

CO4: Able to interpret the experimental results of highway materials based on laboratory tests and design the pavement as per IRC guidelines.

List of Experiments OR Programs List

1. **Tests on Aggregates**
    - **a.** Crushing Strength Test
    - **b.** Los Angeles abrasion test
    - **c.** Impact test
    - **d.** Shape tests
    - **e.** Specific gravity test
2. **Tests on Bituminous Materials**
    - **a.** Penetration test
    - **b.** Ductility test
    - **c.** Softening point test
    - **d.** Specific gravity test
    - **e.** Viscosity test by tar viscometer
    - **f.** Flash and fire point test

3. **Tests on Soil**

    a. CBR Test on soil

4. Bituminous Mix Design by Marshall Method (Demonstration only)

TextBooks:

Text Book format:

1. Khanna, S.K. Justo, C.E.G. and Veeraragavan , A . "Highway Engineering lab Manual", Nem Chand & Bros. 2015
2. Relevant Indian Roads Congress Codes – Geometric Aspects: IRC:38, 69, 73, 86, SP-23. Pavements: IRC:37, 58, 15, 44 Others: IRC:SP-42, SP-88, MORT&H Specifications

Reference Books:

ReferenceBookformat:

1. Specifications for Roads and Bridges-MoRT&H, IRC, New Delhi.
2. C. JotinKhisty, B. Kentlal, "Transportation Engineering", PHI Learning Pvt. Ltd. New Delhi.

12.LabTemplateformatwithi)Part-Aii)Part-Bandiii)OpenEndedExperiment(s)OROpen-Ended Program(s) Applicable from AY 2024-25 onwards (for all 8 semesters)

CourseCode		:		LabTitle	Semester	:	
L:T:P*		:	::		CourseType	:	****
Hours/Sem.	Teaching	:	Hrs.		CIEMarks	:	
	Learning (TW+SL)	:	Hrs.		SEEMarks	:	
	Exam	:	Hrs.		Total Marks	:	
	TotalHrs.	:	Hrs.		Credits	:	

ProfessionalCompetency:
Note(forguidanceonly): COURSEOUTCOMES(MICROLEVEL)ARETHESUBSETOFCOMPETENCY(MACROLEVEL).In other words, a competency is a single macro-level statement, and while writing it, the course outcomes (micro level) of the specific course should be duly considered. Writing professional competencyinthe context of acourse/practical refers tothe **job or taskthata studenthasto DO at the entry level in industry**, after successfully completing the concerned course or practical. **This note is meant only for understanding and guidance and should be deleted before mentioning the professional competency statement.**
CourseOutcomes:
Aftercompletionofthecourse,studentwillbeableto: **CO1:** **CO2:** **.**
PART-A
1. **2.** **3.** **.**
PART-B
1. **2.** **3.** **.**
OpenEndedExperiment(s)orOpen-EndedProgram(s)

1. **2.** **.** **IfOpenEndedExperiment(s)orOpen-EndedProgram(s)is notapplicable,kindlydeletethesetwo rows.**
TextBooks:
TextBookformat: Author(s)name,“Titleofthe TextBook”,NameofPublisher,Edition,Year. While listing text/reference books for a course, include the latest editions also, preferably those publishedwithinthelast10years, as thisisakeyaspect carefullyreviewedbytheNBAevaluationteam (AlsosuggestedbyProf.JaykumarofIITDharwadintheworkshopatBEC,Bagalkot).

This note is meantonly for understanding and guidance and should be deleted before listing the references.
ReferenceBooks:
ReferenceBookformat: Author(s)name,“TitleoftheTextBook”,NameofPublisher,Edition,Year. **IFTEXTBOOKSANDREFERENCEBOOKSARENOTAPPLICABLETOTHEMENTIONEDPRACTICAL, KINDLYDELETETHESETWOSECTIONS.**
WebLinksandVideoLectures(e-Resources):
IfWebLinksandVideoLecturesarenotapplicable,pleasedeletethesetworowsbeforethe submission of syllabus copy.

Course Code		**:**	**1BCVA409L**	**Fluid Mechanics Lab**	**Semester**	**:**	**04**
L:T:P		**:**	**0:0:2**		**CourseType**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**0 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**26 Hrs**		**SEEMarks**	**:**	**50**
	Exam	**:**	**04Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**30 Hrs**		**Credits**	**:**	**02**

Course Learning objectives: This course will enable students to

1. Learn the Principles of Kinematics, hydro dynamics and its applications
2. Study the Flow measurements
3. Understand the design of open channels and energy concepts
4. Understand the Workingprinciplesofhydraulicturbinesandpumps

ListofExperiments		
1	Calibration of Venture meter	L1,L2
2	Calibration of Orificemeter	L1,L2
3	Determination o f hydraulic coefficientsofsmallverticalorificemouthpiece	L1,L2
4	CalibrationofRectangularnotch	L1,L2
5	Calibrationoftriangularnotch	L1,L2
6	CalibrationofTrapezoidalnotch	L1,L2
7	Determinationofmajorlossesin pipes	L1,L2
8	Determinationofminorlossesinpipes	L1,L2
9	DeterminationofCdforogeecrested weir	L1,L2
10	DeterminationofCdforbroadcrestedweir	L1,L2
11	Determinationofefficiencyofjetonflatandcurvedvanes	L1,L2
12	Demoofdeterminationofefficiencyofcentrifugal pump	L1,L2
13	DemoofdeterminationofefficiencyofFrancis/Kaplanturbine	L1,L2
14	DemoofdeterminationofefficiencyofPeltonwheel	L1,L2

SuggestedLearningresources

TextBooks:

1. P.N.ModiandS.M.Seth-HydraulicsandFluidMechanics,includingHydraulicmachines, standard Book House, New Delhi
2. KSubramanya-FluidMechanicsandHydraulicMachines,TataMcGraw-Hill,NewDelhi
3. R.K.Bansal-AtextbookofFluidMechanicsandHydraulicMachines-LaxmiPublications,New Delhi
4. VictorL. Streeter, Benjamin WyileE andKeithW. Bedford- FluidMechanics,Tata McGraw Hill publishing Co Ltd, New Delhi

CourseOutcomes:

1. Calibratedischargemeasuringapparatuswhenfluidflowsthroughit.
2. Determinethemajorandminorinthe pipes
3. Determinetheimpactofwaterjetflatandhemisphericalvanes.
4. CalculatetheHydraulicCoefficients

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3			1			2			3	2	
CO2	3	3	3			1			2			3	2	
CO3	3	3	3			1			2			3	1	
CO4	3	3	3			1			2			3	2	

B.E. in Civil Engineering

Scheme of Teaching and Examinations

(2024-25 Admitted batch and Academic year 2026-27)

V SEMESTER														
Sl. No.	Course Category	Course Code	Course Title	(Hrs Teaching-Learning Scheme				Examination Duration (Hrs/Sem.)		Total Hours	Examination Scheme and Evaluation			Credits (C)=Total Hours/30
				L Hrs/Week /Sem.)	T Hrs/Week (Hrs/Sem.)	P Hrs/Week (Hrs/Sem.)	Term Work (TW) & Self Learning(SL), (TW+SL)	CIE	SEE		CIE Marks	SEE Marks	Total Marks	
01	PCC	BCVA501C	Water Treatment and Supply Engineering	28	0	26	28	5	3	90	50	50	100	**3**
02	PCC	BCVA502C	Analysis of Statically Indeterminate Structures	28	0	26	28	5	3	90	50	50	100	**3**
03	PCC	BCVA503C	Applied Geotechnical Engineering	42	0	00	42	3	3	90	50	50	100	**2**
04	PEC	BCV**X**504E	Professional Elective Course-I	28	0	26	28	5	3	90	50	50	100	**3**
05	OEC	BCV**X**505N	Open Elective Course-I	28	0	26	28	5	3	90	50	50	100	**3**
06	PCC	BCVA506P	Mini project(Extensive survey)	00	0	26	00	3	3	60	50	50	100	**2**
07	PCC	BCVA507L	Geotechnical Engineering lab	00	0	00	26	2	2	30	50	50	100	**1**
08	HSMC	BBTA523C	Environmental Studies	14	0	00	13	2	2	30	50	50	100	**1**
09	AEC	**BHSA**	Quantitative Aptitude and Professional Skills	28	0	00	26	3	3	60	50	50	100	**2**
10	MC	**BHS001/002 /003M**	NSS/Yoga/PE/Music											
11		AAP	AICTE Activity Points											
														20

Professional Elective Course -I					Open Elective- 1				
Code	Title	L	T	P	Code	Title	L	T	P
BCV**A**504E	Alternative Building Materials and Technologies	3	0	0	BCV**A**505N	Groundwater Hydrology	3	0	0
BCV**B**504E	Water Resources Engineering	3	0	0	BCV**B**505N	Remote Sensing and GIS	3	0	0
BCV**C**504E	Air pollution and control	3	0	0	BCV**C**505N	Process Economics and Plant Design	3	0	0
BCV**D**504E	Highway Geometric Design	3	0	0	BCV**D**505N	Sustainable Development	3	0	0
BCV**E**504E	Advanced Surveying	3	0	0	BCV**E**505N	Air Pollution and Control	3	0	0
BCV**F**504E	Masonry Structures	3	0	0	BCV**F**505N	Urban Transport Planning	3	0	0

B.E. in Civil Engineering

Scheme of Teaching and Examinations

(2024-25 Admitted batch and Academic year 2026-27)

VI SEMESTER														
Sl. No.	Course Category	Course Code	Course Title	(Hrs Teaching-Learning Scheme				Examination Duration (Hrs/Sem.)		Total Hours	Examination Scheme and Evaluation			Credits (C)=Total Hours/30
				L Hrs/Week /Sem.)	T Hrs/Week (Hrs/Sem.)	P Hrs/Week (Hrs/Sem.)	Term Work (TW) & Self Learning(SL), (TW+SL) Hrs/Sem.	CIE	SEE		CIE Marks	SEE Marks	Total Marks	
01	PCC	BCVA601C	Design of RC Structures	28	0	26	28	5	3	90	50	50	100	**3**
02	PCC	BCVA602C	Irrigation Engineering	42	0	0	42	3	3	90	50	50	100	**2**
03	PCC	BCVA603C	Estimation and Costing	28	0	26	28	5	3	90	50	50	100	**3**
04	PCC	BCVA604C	Wastewater Engineering	28	0	26	28	5	3	90	50	50	100	**3**
05	PEC	BCV**X**605E	Professional Elective Course-II	28	0	26	28	5	3	90	50	50	100	**3**
06	OEC	BCV**X**606N	Open Elective Course-II	28	0	26	28	5	3	90	50	50	100	**3**
07	PCC	BCVA607L	Software Application Lab	42	0	00	42	3	3	90	50	50	100	**1**
08	PCC	BCVA608L	Environmental Engg lab	42	0	00	42	3	3	90	50	50	100	**1**
09	AEC	**BHSA600C**	Indian Knowledge System	14	0	00	13	2	2	30	50	50	100	**1**
10	MC	BHS001/002 /003M	NSS/Yoga/PE/Music											**0**
		AAP	AICTE Activity Points											**20**

Professional Elective Course-II					Open Elective–II				
Code	Title	L	T	P	Code	Title	L	T	P
BCV**A**605E	Traffic Engineering	3	0	0	BCV**A**606N	Energy efficient buildings	3	0	0
BCV**B**605E	Matrix Methods of Structural Analysis	3	0	0	BCV**B**606N	Disaster Management and Mitigation	3	0	0
BCV**C**605E	Geomorphology	3	0	0	BCV**C**606N	Public Health Engineering	3	0	0
BCV**D**605E	Advance Concrete Technology	3	0	0	BCV**D**606N	Occupational Health and Safety	3	0	0
BCV**E**605E	Ground Improvement Techniques	3	0	0					1

Course Code		:	BBTA523C	Environmental Studies	Semester	:	05
L:T:P		:	1:0:0		Course Type	:	MC
Hours/Sem.	Teaching	:	14 Hrs.		CIE Marks	:	50
	Learning (TW+SL)	:	13 Hrs.		SEE Marks	:	50
	Exam	:	03 Hr.		Total Marks	:	100
	Total Hrs.	:	30 Hrs.		Credits	:	01

Professional Competency:

Develop the ability to analyze environmental issues and implement sustainable solutions by applying environmental science principles, pollution control measures, and environmental legislation.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Identify natural resources and its uses.

CO2: Understand pollution and its effects on environment and to implement sustainable future in the work place.

CO3: Analyze current environmental issues.

CO4: Apply the waste management techniques in various fields.

UNIT – 1	03 Hrs.

Natural Resources:

Human activities and their impacts. Environmental Impact Assessment, **Renewable Energy**: Solar, Wind, Hydropower, Tidal, Ocean thermal, Geo thermal, Biomass energy, Biogas, Biodiesel, Bioethanol, Hydrogen as fuel.

Non renewable Energy: Coal, Petroleum, Natural gas, Nuclear energy.

UNIT – 2	04 Hrs.

Environmental Pollution:

Water pollution, water quality standards, water borne diseases, Fluoride problem, Air pollution, Noise pollution. Effect of electromagnetic waves.

Sustainable future: Concept of sustainable development, threats to sustainability, strategies for sustainable development, Sustainable development goals (SDGs). Environment economics – concept of green building, Circular Economy.

UNIT – 3	03 Hrs.

Current Environmental Issues of concern:

Greenhouse Effect- Greenhouse gases and Global Warming, Climate change, ozone layer depletion, Acid rain, Eutrophication

Environmental policy legislation rules & regulations

UNIT – 4	04Hrs.

Fundamentals of Waste management:

Solid waste management: Sources, classification, characteristics, collection & transportation, disposal, and processing methods. Hazardous waste management and handling.

Concept of waste water treatment, Bioremediation.

Industrial waste management (Case studies: Cement, plastic, chemical, E–waste, food & construction industry waste management).

Text books

1. Benny Joseph, Environmental Studies, 3rd Edition, McGraw Hill Education (India) Pvt. Ltd., 2017.
2. Manjunath, D. L., Environmental Studies, 1st Edition, Pearson Education, New Delhi, 2007.
3. Anubha Kaushik and C. P. Kaushik, *Perspectives in Environmental Studies*, 8th Edition, New Age International (P) Ltd., New Delhi, 2025.
4. P. Meenakshi, Elements of Environmental Science and Engineering, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.

Course Outcomes	Program Outcomes											Program Specified Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO 1	2 (WK1, WK2, WK3, and WK4)		2 (WK5)			3 (WK1, WK5 and WK7)					3 (WK8)	3		3
CO 2	2 (WK1, WK2, WK3, and WK4)		2 (WK5)			3 (WK1, WK5 and WK7)					3 (WK8)	3		3
CO 3	2 (WK1, WK2, WK3, and WK4)		2 (WK5)			3 (WK1, WK5 and WK7)					3 (WK8)	3		3
CO 4	2 (WK1, WK2, WK3, and WK4)		2 (WK5)			3 (WK1, WK5 and WK7)					3 (WK8)	3		3

Question Paper Pattern for SEE:

Question is of Objective type

Duration of exam is 1 hour
50 questions covering all the four units. Each question carries one mark.

Course Code		:	BCVA501C	Water Treatment and Supply Engineering	Semester	:	05
L:T:P		:	3:0:0		Course Type	:	PCC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Plan, design, operate, and evaluate wastewater collection, treatment, and disposal systems using engineering principles and environmental standards to protect public health and the environment

Course Outcomes:

After completion of the course student will be able to

CO1: Apply knowledge of basic science for testing and analyze the drinking water quality parameters from public health consideration as per standards.

CO2: Analysis of forecasting population to determine total quantity of water to meet demands of the community.

CO3: Design various water treatment units to remove selected impurities in raw water.

CO4: Select miscellaneous treatment methods and analyze the community pipe network of water distribution.

UNIT–I **10 Hrs.**

Quality of water: Wholesome, potable and palatable water, waterborne diseases. Examination of Water - Objectives –Physical, Chemical and Microbiological Examinations. Drinking water quality standards - BIS & WHO guidelines. Health significance of Fluoride, Nitrates and heavy metals like Mercury, Cadmium, Arsenic etc. Sampling of water and types of water sampling.

Water demand and quantity: Types of water demand - domestic, institutional, commercial, public, and water losses. Estimation of Fire demand and Per-capita demand- factors affecting. Numerical problems.

Self-Study Component: Sources of water and different intake structures.

UNIT–II **11 Hrs.**

Population forecasting: Different methods with merits & demerits, variations in demand of water, peak factors, design periods. Design period, factors affecting for design period. Numerical problems.

Sedimentation: Introduction, objectives, types of settling, factors affecting settling. Theory of settling, settling velocity, Stroke's equation, types of settling tanks, design of circular, rectangular tanks.

Modern water supply scheme: Necessity, planning and execution of modern water supply scheme.

Self-Study Component: Treatment flow-charts for surface and ground water.

UNIT–III **11 Hrs.**

Coagulation and Flocculation: Coagulant aided sedimentation: Objectives, common coagulants, factors affecting, jar test, chemical feeding, flash mixing, flocculation and clari-flocculation.

Filtration: Slow-sand, rapid-sand and pressure filters including construction, operation, cleaning and design (excluding under drainage system), numerical problems. operational troubles in filters.

Disinfection: Types of disinfectants, chlorination, chlorine demand, residual chlorine, use of bleaching powder, numerical problems. Minor methods of disinfection.

Self-Study Component: Different methods of coagulant feeding, inlet and outlet arrangement for

sedimentation tanks	
UNIT–IV	**10 Hrs.**
Miscellaneous Treatment Methods: Softening - Lime soda process and Zeolite process, numerical problems. Reverse Osmosis & Membrane Filtration. Removal of Iron and Manganese. Colour, odour and taste removal. Fluoridation, Defluoridation and Desalination. **Distribution Systems:** System of supply, service reservoirs and their capacity determination, numerical problems, pipe appearances, pipefitting, layout of water supply pipes in buildings. **Self-Study Component:** Nalgonda and Prasanti Techniques for defluoridation.	
Reference Books *	
1. Environmental Engineering-Howard S. Peavy, Donald R. Rowe, George Tecno Bano Glous, McGraw Hill International Edition, 2017. 2. Environmental Engineering-I – B.C. Punmia & Ashok Jain, Lakshmi Publications (P) Ltd. 3. Water supply Engineering – S.K.Garg, Khanna Publishers, New Delhi.2015 4. Manual on Water supply and treatment – CPHEEO, Ministry of Urban Development, New Delhi.2007 5. Water Supply and Sanitary Installations, Panchadhari. A.C.New Age International Publishers, New Delhi. 6. Handbook on Water Supply and Drainage, SP 35 (1987): (with Special Emphasis on Plumbing) [CED 24: Public Health Engineering.] 7. World Health Organization and IS10500: 2012 Drinking water standards.	

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**3** (WK1, WK2, WK3, WK4)	**2** (WK1, WK2, WK3)	–	**3** (WK8)	**2** (WK6)	**2** (WK1, WK5, WK7)	**2** (WK7)	–	–	**1**	–	**3**	**2**
CO2	**3** (WK1, WK2, WK3)	**3** (WK1, WK2, WK3, WK4)	**2** (WK5)	**1** (WK8)	–	**2** (WK1, WK5, WK7)	**2** (WK7)	–	–	**1**	**1**	**3**	**2**
CO3	**3** (WK1, WK2, WK3, WK4)	**3** (WK1, WK2, WK3)	**3** (WK5)	**2** (WK8)	**2** (WK6)	**2** (WK1, WK5, WK7)	**3** (WK7)	–	**1**	**1**	**1**	**3**	**3**
CO4	**3** (WK1, WK2, WK3)	**3** (WK1, WK2, WK3, WK4)	**3** (WK5)	**2** (WK8)	**2** (WK6)	**2** (WK1, WK5, WK7)	**2** (WK7)	–	**1**	**1**	**2**	**3**	**3**

Note:

If there is no mapping between a CO and a PO, indicate "–".

The WKs (Knowledge Profile elements) shown are indicative and should align with the relevant Program Outcomes addressed by each Course Outcome.

Course Code		:	BCVA502C	Analysis of Statically Indeterminate Structures	Semester	:	05
L:T:P		:	3:0:0		CourseType	:	PCC
Hours/Sem.	Teaching	:	42Hrs		CIEMarks	:	50
	Learning (TW+SL)	:	42Hrs		SEEMarks	:	50
	Exam	:	03Hrs		Total Marks	:	100
	TotalHrs.	:	90Hrs		Credits	:	03

ProfessionalCompetency:

CourseOutcomes:

After completion of the course student will be able to

1. Determine the moment in indeterminate beams and frames having variable moment of inertia and subsidence using slope defection method
2. Determine the moment in indeterminate beams and frames of no sway and sway using moment distribution method.
3. Construct the bending moment diagram for beams and frames by Kani's method.
4. Construct the bending moment diagram for beams using flexibility method and stiffness method.

UNIT–I	10Hrs.

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

UNIT–II	10Hrs.

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

UNIT-III	10Hrs.

Kani's Method: Introduction, Concept, Relationships between bending moment and deformations, Analysis of continuous beams with and without settlements, Analysis of frames with and without sway

UNIT-IV	12Hrs.

Matrix Method of Analysis (Flexibility Method) : Introduction, Axes and coordinates, Flexibility matrix, Analysis of continuous beams using system approach, with static indeterminacy ≤ 3
Matrix Method of Analysis (Stiffness Method): Introduction, Stiffness matrix, Analysis of continuous using system approach, with kinematic indeterminacy ≤ 3

TextBooks:

1. B C Punmia, A K Jain and A K Jain- Theory of structures, 12th edition, Laxmi Publications, New Delhi, 2004.
2. Pandit G S, Gupta S P and Gupta R- Theory of Structures, 2nd edition, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2008.
3. Negi L S and Jangid R S- Structural Analysis, Tata McGraw-Hill Publishing Company

Ltd, New Delhi, 2004

ReferenceBooks:

1. K.U. Muthu, H.Narendra etal, "Indeterminate Structural Analysis", IK International Publishing Pvt. Ltd.
2.

Matrix to describe the mapping of Cos with Pos (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1								2	2	2	
CO2	2	2	2	1								2	2	2	
CO3	2	2	2	1								2	2	2	
CO4	2	2	2	1								2	2	2	

Course Code		**:**	**BCVA503C**	**Applied Geotechnical Engineering**	**Semester**	**:**	**05**
L:T:P		**:**	**2:0:0**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**28 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**26 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**60 Hrs**		**Credits**	**:**	**02**

Professional Competency:

Apply the principles of soil mechanics and geotechnical engineering to investigate subsurface conditions and design safe, economical, and sustainable foundations, retaining structures, and earthworks for civil engineering projects.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Plan and interpret subsurface exploration programs by selecting appropriate soil exploration techniques, conducting and analyzing field tests, evaluating soil samples and sample quality, and preparing bore logs and geotechnical investigation reports for engineering applications.

CO2: Analyze stress distribution in soils due to various loading conditions and evaluate the stability of soil slopes using analytical and graphical methods for safe geotechnical engineering design.

CO3: Analyze and determine lateral earth pressures acting on retaining structures using theoretical and graphical methods, and apply these principles to the design and stability assessment of earth-retaining systems.

CO4: Analyze the bearing capacity and settlement characteristics of shallow foundations and design suitable foundation systems by applying analytical and field-based methods for safe and economical geotechnical engineering practice.

UNIT–I	**07 Hrs.**

Subsurface exploration- Introduction and methods of exploration: Boring, Sounding tests- Standard Penetration test, Static Cone penetration test and Dynamic Cone penetration test, Geophysical methods-electrical resistivity and seismic refraction methods.
Samples and types of samples- undisturbed, disturbed and representative samples, Samplers, Sample Disturbance- area ratio, recovery ratio, clearance, Subsurface exploration program - Preparation of bore logs and preparation of exploration report

UNIT–II	**07Hrs.**

Stress in Soils- Introduction, Boussinesq's and Westergaard's theory of concentrated load, circular and rectangular load, equivalent point load method, pressure distribution diagrams and contact pressure, Newmark's chart.

Stability of Soil Slopes: Types of slopes- Types of slope failures- Slip circle method, Determination of centre of critical slip circle- Taylor's stability charts and their use

UNIT-III	07 Hrs.
Lateral Earth Pressures: Lateral earth pressure theory, Different types of earth pressures, Rankine's active and passive earth pressures, pressure distribution diagram for lateral earth pressures against retaining walls for different conditions in cohesionless and cohesive soils, Coulomb's active and passive earth pressure theory, Culmann's graphical construction, Problems	
UNIT-IV	**07 Hrs.**
Shallow Foundations and Bearing Capacity: Types of shallow foundations and choice Bearing capacity of foundation: Bearing capacity – Basic Definitions, Factors affecting bearing capacity, Estimation of Bearing capacity by different methods, Analytical measures – Terzaghi's and Meyerhof methods and calculations, Field measures- Plate load tests. Settlement of foundation: Settlement analysis – Types of foundation settlement, Components of settlements - their estimation, Allowable settlement values	

Text Books:

1. Braja M. Das and Sobhan K. "Principles of Geotechnical Engineering" Cengage India Private Limited, New Delhi, 10th Ed., 2021.
2. G. Ranjan and A.S.R Rao. "Basic and Applied Soil Mechanics" New Age International (P) Ltd., New Delhi, 5th Ed., 2022.
3. B.C. Punmia "Soil Mechanics and Foundation Engg" Laxmi Publications Co., New Delhi, 17th Ed., 2021.
4. V.N.S. Murthy "Soil Mechanics and Foundation Engineering" UBS Publishers and Distributors, New Delhi, 4th Ed., 2018.
5. C. Venkatrahmaiah "Geotechnical Engineering" New Age International (P) Ltd., New Delhi, 6th Ed., .2018..

Reference Books:

1. Singh and Chowdhary G.R. "Soil Engineering in Theory and Practice" CBS Publishers and Distributors Ltd., New Delhi, 2017.
2. J.E. Bowles "Foundation Analysis and Design" McGraw Hill Pub. Co. New York, 5th Ed., 2017.

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3(WK3, WK4)	3(WK3, WK4)	-	-	-	1(WK7)	-	-	1	-	1(WK8)	-	3	-
CO2	3(WK3, WK4)	3(WK3, WK4)	1	-	-	-	-	-	1	-	1(WK8)	-	3	-
CO3	3(WK3, WK4)	3(WK3, WK4)	1	-	-	-	-	-	-	-	1(WK8)	-	3	-
CO4	-	3(WK3, WK4)	2	2(WK8)	-	2(WK7)	-	-	-	-	1(WK8)	-	3	-

Course Code		**:**	BCVA506P	**EXTENSIVE SURVEY PROJECT**	**Semester**	**:**	V
L:T:P*		**:**	**0:0 :2**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**52 Hrs.**		**CIE Marks**	**:**	50
	Learning (TW+SL)	**:**	**02 Hrs.**		**SEE Marks**	**:**	50
	Exam	**:**	**06 Hrs.**		**Total Marks**	**:**	100
	Total Hrs.	**:**	**60 Hrs.**		**Credits**	**:**	02

Professional Competency:

Ability to plan and execute comprehensive field surveys using conventional and modern surveying instruments; collect, process, analyse, and interpret spatial data; prepare contour maps, route alignments, plans, profiles, and project drawings; and work effectively in teams to solve real-world civil engineering problems while adhering to professional standards, accuracy requirements, safety practices, and ethical responsibilities.

Course Outcomes:

After completion of the course, student will be able to:

CO1: To apply the concepts of surveying practically in the field
CO2: To design new water treatment project and enhancement of capacity of existing project.
CO3: To apply the concepts of surveying in highway project.
CO4: To draw layout and access the requirements of water supply and sanitary projects

PART-A

1. **NEW TANK PROJECTS**: The work shall consist of;
    a. Reconnaissance survey for selection of site and conceptualization of project.
    b. Alignment of Centre line of the proposed bund, Longitudinal and cross sections of the centre line.
    c. Detailed survey required for project execution like Capacity surveys, Details at Waste weir and sluice points, Canal alignment etc. as per requirement
    d. Design and preparation of drawing with report.
2. **WATER SUPPLY AND SANITARY PROJECT**: The work shall consist of;
    a. Reconnaissance survey for selection of site and conceptualization of project.
    b. Examination of sources of water supply, Calculation of quantity of water required based on existing and projected population.
    c. Preparation of village map by using total station.
    d. Survey work required for laying of water supply and UGD pipelines
    e. Location of sites for water tank. Selection of type of water tank to be provided (ground level, overhead and underground)
    f. Design of all elements and preparation of drawing with report.
3. **HIGHWAY PROJECT**: The work shall consist of;
    a. Reconnaissance survey for selection of site and conceptualization of project.
    b. Preliminary and detailed investigations to align a new road (min. 1.5 to 2 km

stretch) between two obligatory points. The investigations shall consist of topographic surveying of strip of land for considering alternate routes and for final alignment. Surveying by using conventional instruments and total station.

c. Report should justify the selected alignment with details of all geometric designs for traffic and design speed assumed.
d. Drawing shall include key plan, alignment, and longitudinal section along alignment, typical cross sections of road.

Text Books:

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, *"Surveying, Volume I"*, Laxmi Publications Pvt. Ltd., 17th Edition, 2016.
2. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, *"Surveying, Volume II"*, Laxmi Publications Pvt. Ltd., 17th Edition, 2016.
3. R. Subramanian, *"Surveying and Levelling"*, Oxford University Press, 2nd Edition, 2012.

Course Code		:	**BCVA507L**	**Geotechnical Engineering Lab**	**Semester**	:	**V**
L:T:P*		:	**0:0:2**		**Course Type**	:	**PCCL**
Hours/Se	**Practical**	:	**26**		**CIE Marks**	:	**50**
	Learning (TW+SL)	:	**-**		**SEE Marks**	:	**50**
	Exam	:	**4Hrs.**		**Total Marks**	:	**100**
	Total Hrs.	:	**30Hrs.**		**Credits**	:	**01**

Professional Competency:

Demonstrate the ability to conduct geotechnical laboratory investigations, analyze and interpret soil test data, and utilize the results for solving practical geotechnical engineering problems related to site characterization, foundation design, and earth-retaining structures.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Determine and classify soils based on their index properties such as water content, specific gravity, grain size distribution, and Atterberg limits, following relevant standard testing procedures.

CO2: Determine the engineering properties of soils, including compaction characteristics, permeability, shear strength, and compressibility, and interpret the results for geotechnical engineering applications and foundation design.

PART-A

Index properties of soils

1. Determination of moisture content
2. Determination of specific gravity
3. Grain size analysis
4. Determination of consistency limits
5. Determination of relative density
6. Determination of field density

PART-B

Engineering Properties of soils

7. Determination of Co-efficient of permeability
8. Standard compaction test (light compaction only)
9. Determination of shear strength of soil by Direct shear test
10. Determination unconfined compressive strength of soils
11. Laboratory vane shear test
12. Triaxial test (unconsolidated undrained test only)
13. Field Identification of soil
14. Demonstration of Standard penetration test & Boring equipment
15. Demonstration of Proctors Needle

Text Books:

1. Das B.M. “Soil Mechanics Laboratory Manual”, London, OUP USA, 10th Ed., 2022
2. S. Mittal and J.P. Shukla “Soil Testing for Engineers” 2020
3. Head K.H. “Manual of Soil Laboratory Testing” Princeton Press, London (1986)- Vol. I, II, III, 2006
4. Punmia B C, “Soil Mechanics and Foundation Engineering,” Laxmi Publications co., New Delhi. 2017

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	**Program Outcomes and (WKs)**											**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	2(WK3, WK4)	2(WK3, WK4)	-	-	-	1(WK7)	-	1	1	-	1(WK8)	-	2	-
CO2	2(WK3, WK4)	2(WK3, WK4)	1	-	-	-	-	1	1	-	1(WK8)	-	2	-

BVV Sangha's

Basaveshwar Engineering College, Bagalkote Civil Engineering Department

	Course Code	**:**	**BCVA504E**	**ALTERNATIVE BUIDLING MATERIALS AND TECHNOLOGIES**	**Semester**	**:**	**05**
	L:T:P	**:**	**2:0:0**		**Course Type**	**:**	**PEC**
Hours/Sem.	**Teaching**	**:**	**32 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**32 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**70 Hrs**		**Credits**	**:**	**02**

UNIT-I	**10Hrs.**
Energy in building materials, Environmental issues concerned to building materials, Embodied energy and life-cycle energy, Global warming and construction industry, Greenconceptsinbuildings,Greenbuildingratings–IGBC andLEEDmanuals–mandatoryrequirements, Rainwaterharvesting,Environmentalfriendlyandcosteffectivebuildingtechnologies,Requirements forbuildingsofdifferentclimatic regions.	
UNIT–II	**10Hrs.**
FibreReinforced Concrete(FRC)-Fibers-metalandsynthetic,Propertiesandapplications. Fibers organicandsynthetic, Propertiesandapplications,behavior of FRC memberunderFlexure,ShearandTensionconditions. NumericalProblems onFRC.	
UNIT–III	**10Hrs.**
Ferrocement–Materialsusedinferrocement,definition,materialspropertiesofferrocement,castingofferrocementmembers,propertiesofferrocementmembers, Building materials from agro and industrial wastes ,Types of agro wastes, Types of industrial and minewastes,Properties andapplications.	
UNIT–IV	**10Hrs.**
AlternativeBuildingTechnologies: AlternateRoofingSystems:-Concepts,Fillerslabs,Compositebeampanelroofs **Prefabricated structures**: Introduction, Need, equipments used, method of casting prefabricatedbuildingcomponents,Advantages**.**	

ReferenceBooks*

1. KSJagadish, BVVenkataramaReddyandKSNanjundaRao, "AlternativeBuildingMaterialsandTechnologies",New Age Internationalpublications.
2. RJSSpenceandDJCook,"BuildingMaterialsinDevelopingCountries",Wileypub.
3. IGBCGreenHomesRatingSystem,CIIpublications
4. RelevantISCodes.

CourseOutcomes**

Afterstudyingthiscourse,studentswillbeableto:

1. SolvetheproblemsofEnvironmentalissuesconcernedtobuildingmaterialsandcosteffectivebuildingtechnologies;
2. Selectappropriatetypeofmasonryunitand mortarforcivilengineeringconstructions;.
3. Analyse different alternative building materials which will be suitable for specific climate and in an environmentally sustainable manner.
4. Recommend various types of alternative building materials and technologies and design a energy efficient building by considering local climatic condition and building material.

Course Outcomes	Programme Outcomes(POs)												ProgramSpecific Outcomes(PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	2	2	-	-	-	-	-	-	3		
CO2	2	2	3	-	2	1	-	-	-	-	-	-	3		
CO3	2	2	3	-	3	-	-	-	1	-	-	-	3		
CO4	2	1	1	-	2	1	-	-	1	-	-	1	3		

Course Code		:	BCVB504E	Water Resource Engineering	Semester	:	05
L:T:P		:	3:0:0		Course Type	:	PEC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

UNIT-I

Introduction: Hydrologic cycle,water balance equation, world water quantities.

Precipitation: Types of precipitation, data analysis-study of characteristics of rainfall stormbyrainfallhyetographandDepthAreaDuration(DAD)methodsIntensityDurationFrequency curves (Brief discussion only) Measurement of rainfall by tipping bucket method, , rain gauge networks-definition , finding optimum number of rain gauges by sample standard deviation and coefficient of variation methods, ; computation of average depth of precipitation by arithmetic mean method, isohyetal method, numerical on above concepts.

UNIT–II

Infiltration: Process,measurement-usingdoubleringinfilterometer,infilterionindices-W_{index}, φindex Horton's equation; Evaporation, Pan evaporation, empirical equations for estimatingevaporation–Meyer'smethod,Rohwer'sformula,Numericals,Evapo-transpiration-defn, measurement using Lysimeter (Brief discussion of theory only, no numerical)

UNIT–III

Runoff and Hydrographs: Rainfall runoff process, runoff calculation using fundamental relation for precipitation and discharge in a basin, using runoff coefficient and using infilteration indices,Estimation of concentration time of a catchment using rational formula for small catchment areas,Unit Hydrograph (UH), its analysis, S-curve hydrograph Numericals

UNIT–IV

Floods –Definition, general causes of floods, Determination of peak flood discharge by Rational method, envelop curves method, Concept of return period, flood frequency analysis-Determination of discharges for different frequency floods by probability method involving risk factor only, Numerical,

Groundwater Hydrology: Defn of ground water, basic terms- permeability, porosity, transmissibility, specific yield, zones of ground water, Aquifer Types (theory only) of aquifers, Darcy's law on groundwater flow velocity for, laminar flow in unconfined aquifer(without recharge),Numerical

TEXTBOOKS:

1. **Dr.P.Jayaramireddi, "A Textbook of Hydrology",Laxmi Publications, 3rd edition,January-2016,New Delhi.**

3.R.K.Sharma,T.K.Sharma,"IrrigationEngineering(IncludingHydrology),SChandPublications, -Revised Edition-2007, New Delhi.

4. **Dr.K.Subramanya,"EngineeringHydrology",McGGrawhillpublications,5th edition-September-2020, New Delhi**

5 Santoshkumar Garg " Hydrology and Water Resources Engineering",2nd Edition, Laxmi Publications, New 6. Delhi -2003.

ReferenceBooks*

1. Santosh.Kumar.garg,"**IrrigationEngineeringandHydraulicStructures**",KhannaPublications, ,Volume-II,1st edition,2006,NewDelhi.

2. VenteeChow,**"openChannelHydraulics"**,**McGGrawhillpublications**,2nd edition, January-2009

3. David.Keith.Todd"**GroundwaterHydrology**",WieleyPublications,3rd edition,2005

4. NPTELNOTESONWaterresourcesengineeringandGroundwater Management.

Learningobjectives:

1. Understandconceptsofhydrology,Hydrologicalcycleanditscomponents.
2. Understandbasicsofinfiltrationandevapotrnspirationprocesses
3. Learntheconceptsofsurfacerunoffandhydrographs
4. LearnbasicconceptsofFloods,peakfloodandgroundwaterhydrology

Aftercompletionofthecoursestudentwillbeableto:

1. Measure and quantify precipitation
2. measure and compute infiltration evaporation and transpiration
3. Estimate runoff and generate hydrographs
4. Perform Flood routing and estimate peak flood sand flow to bore wells.

2. Dr.S.K.Garg,"HydrologyandWaterresourcesEngineeringVol-1",KhannaPublications, January-1, 2015

Course Outcomes	Programme Outcomes												Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO 1	3	2	2	1	1	1	-	-	-	-	-	-	2	2	2
CO 2	3	3	2	1	2	2	-	-	-	-	-	-	2	2	2
CO 3	3	3	2	2	2	3	-	-	-	-	-	-	2	2	2
CO 4	3	2	2	2	2	2	-	-	-	-	-	-	2	2	2
Average	**3**	**2.5**	**2**	**1.5**	**1.75**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

Course Code		:	BCVC504E	AIR POLLUTION AND CONTROL	Semester	:	05
L:T:P		:	3:0:0		Course Type	:	PEC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Develop the ability to identify, analyze, and evaluate sources, impacts, and control measures of air pollution using engineering principles and environmental standards. Apply appropriate air pollution monitoring, modeling, and emission control technologies to design sustainable solutions for protecting public health and the environment

Course Outcomes:

After studying this course, students will be able to:

1. Identify the major sources of air pollution and understand their effects on health and environment.
2. Evaluate the dispersion of air pollutants in the atmosphere and to develop air quality models.
3. Ascertain and evaluate sampling techniques for atmospheric and stack pollutants.
4. Choose and design control techniques for particulate and gaseous emissions

UNIT-I	10 Hrs.

Introduction:

Definition, Sources, classification and characterization of air pollutants. Effects of air pollution on health, vegetation & materials. Atmosphere and water bodies, Photo-chemical Smog, .

UNIT–II	10 Hrs.

Meteorology:

Temperature lapse rate & stability, wind velocity & turbulence, plume behavior, measurement of meteorological variables, wind rose diagrams, Plume Rise, estimation of effective stack height and mixing depths. Development of air quality models-Gaussian dispersion model and Numerical problems.

UNIT–III	10Hrs.

Sampling:

Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants ($PM_{2.5,}$ PM_{10}, SO_X, NO_X, CO, NH_3) and Air pollution emission standards and Numerical problems

UNIT–IV	10 Hrs.

Control Techniques:

Air pollution control devices, equipment and their design. Particulate matter and gaseous pollutants- settling

chambers, cyclone separators, scrubbers, filters & ESP. Including Numerical problems. Indoor air quality-sources, types and control of air pollutants
Reference Books *
1. M. N. Rao and H V N Rao, "Air pollution", Tata Mc-G raw Hill Publication. 2. H. C. Perkins, "Air pollution". Tata McGraw Hill Publication 3. Mackenzie Davis and David Cornwell," Introduction to Environmental Engineering" McGraw-Hill Co. Noel 4. De Nevers, "Air Pollution Control Engineering" , Waveland Pr Inc. 5. Anjaneyulu Y, "Text book of Air Pollution and Control Technologies", Allied Publishers

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3, and WK4)	-	-	-	-	-	1	-	-	1	-		2
CO2	-	2 (WK1, WK2, WK3, and WK4)	3 (WK5)	-	3 (WK6)	1 (WK1, WK5 and WK7)	1 (WK9)	1	1	-	1 (WK8)	-		2
CO3	-	2 (WK1, WK2, WK3, and WK4)	3 (WK5)	-	3 (WK6)	1 (WK1, WK5 and WK7)	-	1	1	-	1 (WK8)	-		2
CO4	-	2 (WK1, WK2, WK3, and WK4)	2 (WK5)	-	-	1 (WK1, WK5 and WK7)	-	1	1	-	1 (WK8)	-		2

CourseCode		:	BCVD504E	**Highway Geometric Design**	**Semester**	:	V
L:T:P*		:	**3 :0: 0**		**Course Type**	:	**PCE**
Hours/Sem.	**Teaching**	:	**42 Hrs.**		**CIEMarks**	:	50
	Learning (TW+SL)	:	**42 Hrs.**		**SEEMarks**	:	50
	Exam	:	**06 Hrs.**		**Total Marks**	:	100
	TotalHrs.	:	**90 Hrs.**		**Credits**	:	03

Professional Competency:

The course develops professional competency to build the ability to plan, analyze, and design the physical, three-dimensional layout of roadways—such as alignments, curves, and cross-sections—to ensure maximum traffic safety, capacity, and operational efficiency. It blends engineering principles, human factors.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Describe various geometric elements like speed, topography, traffic volume, Design hourly, traffic volume etc

CO2: Determine the various sight distances, evaluate extra widening required for horizontal curves

CO3: Design and setting out of Summit and Valley curves and describe different types of at-grade, grade separated intersection and channelization.

CO4: Design Rotary intersection, surface and subsurface drainage system.

Unit-I	**11 Hrs.**

INTRODUCTION: Geometric control factors like Topography- design speed- design vehicle- Traffic- Capacity- volume- environmental & other factors as per IRC & AASHTO standards & specifications- PCU concepts- factors controlling PCU for different design purpose.

CROSS SECTIONAL ELEMENTS: Pavement surface characteristics- friction- skid resistance- pavement unevenness- light reflecting characteristics-camber-objectives-types of camber- method of providing cambers in the field- problems- carriage way- kerb- median- shoulder- foot path- parking lanes- service roads- cycle tracks- Driveways- Right of way- Factors influencing right of way- Design of Road humps as per latest IRC provision.

Unit-II	**11 Hrs.**

SIGHT DISTANCE: Importants, types, SSD, OSD & Sight distances at uncontrolled intersections, derivations, factors affecting sight distance, IRC, AASHTO standards, problems on above. **HORIZONTAL ALIGNMENT:** Definition, Checking the stability of vehicle, while moving on horizontal curve, Super elevation, Ruling minimum & maximim radius, Assumptions- problems- methods of providing super elevation for different curves- Extra widening of pavement on curves- Objectives- Mechanical widening- Psychological widening- Transition curve- Objectives- Ideal requirments- Types of transition curves- Method of evaluating length of transition curve-

Setting the transition curve in the field, set back distance on horizontal curve & problems on above.

Unit-III	10 Hrs.

VERTICAL ALIGNMENT: Gradient- Types of gradient- Design criteria of summit & valley curve- Design of vertical curves based on SSD-OSD-Night visibility considerations-Design standards for hilly roads- problems on the above.

INTERSECTION DESIGN: Principle- At grade & Grade separated junctions- Types- Channelization- Features of channelizing Island- Median opening- Gap in median at junction

Unit-IV	10 Hrs.

ROTARY INTERSECTIONS: Elements- Advantages- Disadvantages- Design guide lines- problem on above- Grade seperated intersection- Three legged intersection- Diamond interchange- Half clover leaf- Clover leaf- Advantages- Disadvantages only

HIGHWAY DRINAGE: Importance – sub surface drinage- surface drinage- Design of road side drives- Hydrological- Hydraulic considerations and design of filter media, problems on above.

TextBooks:

1. Khanna, S.K. Justo, C.E.G. and Veeraghavan A "Highway Engineering", Nem Chand & Bros. 2015
2. Papacostas, C.S. and Prevedouros, P.D., "Transportation Engineering and Planning", Prentice Hall. 2002
3. JotinKhisty, C. and Kent Lall, B., "Transportation Engineering – An Introduction", Third edition, Pearson India 2016
4. K. Subramaniam, "Transportation Engineering", SciTech Publications, Chennai.
5. Relevant Indian Roads Congress Codes –
6. C. Jotin Khisty, B. Kentlal, "Transportation Engineering", PHI Learning Pvt. Ltd. New Delhi.
1. Right, Paul H. and Dixon, Karen K., "Highway Engineering", John Wiley and Sons Inc. 2004

ReferenceBooks:

1. R. Srinivasan, "Highway Engineering", Universities Press, 2011.
2. Garber, N.J., and Hoel, L.A., "Traffic and Highway Engineering", Cengage Learning, Boston, 5th Edition, 2014.
3. Indian Roads Congress, "IRC:37-2018 – Guidelines for the Design of Flexible Pavements", IRC, New Delhi, 2018.
4. Indian Roads Congress, "IRC:58-2015 – Guidelines for the Design of Plain Jointed Rigid Pavements for Highways", IRC, New Delhi, 2015.

Table5: Matrix to describe the mapping of Cos with Pos (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO1	**3** (WK1, WK2, WK3, and WK4)	**2** (WK1, WK2, WK3, and WK4)	**3** (WK5)	-	**2** (WK6)	-	**1** (WK7)	-	-	-	**1** (WK5)	**3**	**2**
CO2	**2** (WK1, WK3, and WK4)	**3** (WK1, WK2, and WK4)	-	**2** (WK8)	-	**2** (WK7)	**2** (WK7)	-	-	-	**2** (WK5)	**2**	**2**
CO3	**3** (WK1, WK3, and WK4)	-	-	-	-	**2** (WK7)	**1** (WK7)	-	**1**	**1**	-	**3**	-
CO4	**2** (WK1, WK3, and WK4)	**3** (WK1, WK2, WK3, and WK4)	**3** (WK5)	**3** (WK8)	**2** (WK6)	-	-	-	**1**	-	-	**2**	**3**

Course Code		:	BCVE504E	ADVANCED SURVEYING	Semester	:	05
L:T:P		:	3:0:0		Course Type	:	PEC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

UNIT-I	10 Hrs.

Tachometry: Definition, objectives, advantages and applications of tacheometry, types of tacheometry, types of telescopes and staff used in tacheometry Derivation of horizontal distance and elevation formulae for horizontal and inclined line of sight for fixed stadia hair system of tacheometry, , numerical problems.

UNIT–II	10 Hrs.

Total Station

Total Station – components and features; integration of electronic theodolite and EDM; coordinate measurement system. Total Station operations – setup and orientation, measurement of coordinates, distance and angles; data recording and download; applications in infrastructure projects. Coordinate systems – local coordinates, grid coordinates; coordinate transformation; azimuth and bearing computations.

UNIT–III	10 Hrs.

Introduction to GPS (Global Positioning System) : Definition, advantages, satellite constellation of GPS, segments of GPS, types of GPS, Issues in GPS Survey.

Introduction to DGPS: Principle, components, working methodology, Base and Rover concept, field survey procedure, collection and processing of DGPS data, plotting and mapping using CAD/GIS software, coordinate systems, accuracy and error sources, advantages, limitations, Engineering applications in topographic surveying, route alignment, land surveying, construction layout, utility mapping

Photogrammetry: Definition, need, different types of photogrammetry systems, basic terms of aerial photogrammetry, aerial camera basics, flight planning for aerial photogrammetry for a region, discussion of brief procedure of topographic map compilation through aerial photogrammetry method. Numerical problems on focal length of aerial camera, flight altitude and flight planning.

Introduction to drone survey: defn, classification of drones, procedure of drone survey in a region (theory only)

UNIT–IV	10 Hrs.

Remote Sensing: Definition, need, EMR, EMS, basic terms of remote sensing, process of remote sensing, advantages and applications.

Sensors: Definition, classification,

Plat forms: Air borne and space borne platforms (brief discussion only)

satellite specifications of CARTOSAT-1 and CARTOSAT-2

Introduction to Geographic Information Systems (GIS) – definition, components (hardware, software, data, people, procedures); spatial and attribute data. • GIS data models – vector data (points, lines, polygons)

Raster data (pixels and images)

Reference Books *

1. B.C. Punmia, Surveying, Vol. 1 , 16th Edition, Laxmi Publications, New Delhi.2005
2. S. S. Bhavikatti, 'Surveying & Leveling Vol-I', I. K. International New Delhi, 2008
3. S.K. Duggal, "Surveying Vol. I & II", Tata McGraw Hill Publishing Co. Ltd. New Delhi.
4. R Subramanian, Surveying and Leveling, Second edition, Oxford University Press, New Delhi.
5. David Clerk, Plane and Geodetic Surveying Vol1 and Vol2, CBSpublishers
6. B Bhatia, Remote Sensing and GIS, Oxford University Press, New Delhi.
7. T.M Lillesand, R.W Kiefer,. and J.W Chipman, Remote sensing and Image interpretation,5thedition, John Wiley and Sons India
8. James M Anderson and Adward M Mikhail, Surveying theory and practice, 7th Edition, TataMcGraw HillPublication
9. Kang-tsung Chang, Introduction to geographic information systems, McGraw HillHigherEducation.
10. **Satheesh Gopi, R. S. Kumar and N. Madhu**, *Advanced Surveying: Total Station, GIS and Remote Sensing*, Pearson Education.

Course Outcomes**
After completion of the course student will be able to
1.Explain the fundamental principles of surveying and perform linear and angular measurements using chain, tape, and compass while identifying and minimizing survey errors.
2.Apply levelling and contouring techniques to determine elevations, prepare contour maps, and interpret ground features for engineering applications.
3.Perform theodolite surveys and trigonometric levelling to measure horizontal and vertical angles and determine heights and distances of objects.
4.Compute areas and earthwork volumes and demonstrate the use of modern surveying instruments such as Total Station and DGPS for survey data collection, processing, and mapping using CAD/GIS software.

Course Outcomes	**Programme Outcomes**												**Programme Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	2	1	1	1	-	-	-	-	-	-	2	2	2
CO 2	3	3	2	1	2	2	-	-	-	-	-	-	3	2	2
CO 3	3	3	2	2	2	3	-	-	-	-	-	-	3	2	3
CO 4	3	2	2	2	2	2	-	-	-	-	-	-	2	2	3
Average	**3**	**2.5**	**2**	**1.5**	**1.75**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

CourseCode		:	BCVF504E	MASONRY STRUCTURES	Semester	:	05
L:T:P		:	3:0:0		CourseType	:	PEC
Hours/Sem	Teaching	:	42Hrs		CIEMarks	:	50
	Learning (TW+SL)	:	42Hrs		SEEMarks	:	50
	Exam	:	06Hrs		Total Marks	:	100
	TotalHrs.	:	90Hrs		Credits	:	03

Professional Competency:

Masonry Structures is the ability to safely, economically, and sustainably analyze and design load-bearing masonry elements and systems in compliance with structural engineering codes and standard practices.

Course Outcomes:

After completion of the course student will be able to:

CO1: Identify various materials used in masonry, their characteristics and the influence of various parameters on the stability of concentrically loaded masonry walls. Factors influence the compressive strength of masonry.

CO2: Apply boundary conditions to evaluate the effective height, length and thickness of wall in the design of masonry wall and column; Slenderness ratio: Determine the slenderness ratio of walls and reduction factors, to evaluate the permissible stresses.

CO3: Analyse the reduction of basic compressive strength due to slenderness ratio and eccentricity, elastic buckling of brittle columns. Design of masonry up to three storeys.

CO4: Design the cavity wall. Design the free-standing walls subjected to wind load perpendicular to plane of wall, and wind load acts in the plane of wall.

UNIT–I	11Hrs.

MASONRY UNITS, MORTARS, TYPES AND MASONRY CONSTRUCTION: Brick, stone, concrete block, stabilized mud block masonry units-strength, modulus of elasticity, and initial rate of absorption (IRA) of brick, classification and properties of mortar, workability of fresh mortar, water retentivity of mortar, stress-strain behavior of mortar, selection of mortars. Defects and errors in masonry construction, cracks in masonry, types, reasons for cracking and remedial measures.(5 Hrs)

STRUCTURAL MASONARY: Introduction, stresses in masonry in compression, factors influence compressive strength of masonry; effect of unit strength, unit height, hollowness and moisture absorption, effect of mortar strength, plasticity, joint thickness, type of masonry loading, modular ratio of unit and mortar and direction of loading. Strength formulae and mechanism of failure for masonry prism subjected to direct compression. (5 Hrs)

UNIT–II	11Hrs.

DESIGN CONSIDERATIONS: Boundary conditions and the effective height of wall in the design of masonry wall and column; effective length of wall based on conditions of support and, effective thickness for solid wall, cavity wall with and without stiffeners; slenderness ratio; assessment of eccentricity of loading on walls. (5 Hrs)

PERMISSIBLE STRESSES: Permissible compressive stress in masonry wall, stress reduction, area reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses in masonry wall. (4 Hrs)

UNIT–III	10Hrs.

DESIGN OF MASONRY WALLS: Reduction of basic compressive strength to allow slenderness ratio and eccentricity; elastic buckling of brittle columns. Design of load bearing masonry for building up to three storeys using IS: 1905-1987. (5 Hrs)

DESIGN OF SOLID WALLS: Design of axially loaded unstiffened solid wall; determination of safe load carrying capacity of wall. Design of solid wall with piers. Solid wall supported at the ends by cross wall. (4 Hrs)

UNIT–IV	10Hrs.

DESIGN OF CAVITY WALL: Design of cavity wall with and without piers. Design of cavity wall with cross wall. Determination of safe load carrying capacity of cavity wall. (5 Hrs)

DESIGN OF FREE-STANDING WALL: Transverse load acts perpendicular to plane of wall. Lateral load acts in the plane of wall. Design of free-standing walls with and without staggered, design of masonry tabular structure representing a chimney. (5 Hrs)

Text Books

1. Brick and Reinforced Brick Structures Dayaratnam P.: Oxford & IBH, 1987
2. Alternative Building Materials and Technologies K S Jagadish, B V Venkatarama Reddy, K S Nanjunda Rao, 2008
3. Design of Masonry structures Sinha B.P Davies S.R: E & FN spon, 1997

REFERENCE BOOKS

1. Structural Masonry Henry, A.W.: Macmillan Education Ltd, 1990
2. IS 1905-1987 Code of practice for structural use of un-reinforced masonry (3rd revision) BIS, New Delhi.
3. SP 20 (S&T)-1991, Hand book on Masonry design and construction (1st revision) BIS, New Delhi.

Table5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3
CO1	3	2	–	–	–	–	–	–	–	–	–	3	–	–
WKs	WK1, WK3, WK4, WK6	WK1, WK3, WK4	–	–	–	–	–	–	–	–	–	WK3, WK4, WK6	–	–
CO2	3	3	2	–	2	–	–	–	–	–	–	3	2	–
WKs	WK2, WK3, WK4, WK6	WK2, WK3, WK4	WK3, WK4	–	WK2, WK6	–	–	–	–	–	–	WK3, WK4, WK6	WK2, WK6	–
CO3	3	3	3	2	2	1	–	–	–	–	1	3	2	–
WKs	WK3, WK4	WK2, WK3, WK4	WK3, WK4, WK5	WK 8	WK2, WK6	WK5, WK7	–	–	–	–	WK8	WK3, WK4, WK6	WK2, WK6	–
CO4	3	2	3	–	2	2	–	–	–	–	–	3	2	–
WKs	WK2, WK3, WK4	WK2, WK3, WK4	WK3, WK4, WK5	–	WK2, WK6	WK5, WK7	–	–	–	–	–	WK3, WK4, WK5, WK6	WK2, WK6	–

Course Code		**:**	**BCVB505N**	**Remote Sensing and GIS**	**Semester**	**:**	**05**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PEC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

UNIT-I	**10Hrs.**
Basics: Fundamentals of Remote Sensing, Electromagnetic Spectrum, Process of remote sensing, Types of reflections, Energy Interactions with earth atmosphere and surface features, spectral reflectance curves-For Vegetation, soil & water, Idealised Remote Sensing System **Sensors**: Definition, Sensor Parameters,Types,Choice of sensor, Optical Remote Sensing,Acrossand Along track scanning systems. **Platforms:**Definition,Spaceborneplatformattitudes(onlydefinitions,NoProblems). **Indian RemoteSensingProgramme**:DefinitionandObjectives **SatelliteSpecifications**forIRS-1C, 1D,CARTOSAT-1& CARTOSAT-2-Ikonos,Quickbird,Risat.	
UNIT–II	**10Hrs.**
Visual Image Interpretation: Definition, Objectives, Keys & Elements of Visual Image interpretation.**DigitalImageProcessing(DIP)**:(Noproblems/programmingonDIP)Definition,ImageRectification& Restoration,imageenhancement(contrastmanipulation-GreyLevelThresholding,LevelSlicingonly), Supervised Image Classification using minimum distance to means classifier algorithm- GIS integration – stages & procedure., Image Filtering (spatial filters) -Low Pass and High pass image filters.(Brief discussion only, no problems or programming) **ApplicationsofREMOTEsensinginurbanapplicationsandwaterresourcemanagement**	
UNIT–III	**10Hrs.**
Maps and Projections: Map Projections Plane and geodetic , latitude and longitude map projections, types of map projections Spheroid, Datum (WGS84 Datum) and UTM (No Problems) **GIS**: History, Definition, Components, concept, Data acquisition for GIS input-Spatial (Vector, Raster & Surface data)& Non spatialdata, rectification, processing, verification& Data Editing, Storage and Output. ***GIS functions in vector and raster data- Input, Analysis and out put*** ***GISAnalysis***(**VectorData-**Buffering&Overlayanalysisusingoverlayoperators) ***GISAnalysis*****(RasterData**-Local Operations ***Cartography-Definition,basicmaplayout,significanceofcartography*** **DataStandardsinGIS**errors,precisionandaccuracy-DefinitionandTypes	
UNIT-IV **AdvancedConcepts**: GPS.-Definition,workingprinciple,segmentsanduses(BriefDiscussiononly) Drones- Classificationofdrones,Basicsofdronespart,basicsofdronesurveying,Propertymappingusing drones **Applications of GIS and RemoteSensing:** 1) Identifying suitabl esite for urban development 2) Planningofnetworkforsewagecollectionandtransport(layingofsewerlines) 3) LandUseLandCovermapping(LU/LC). 4)Urban development **Drainage Patterns**-Definition,Types,significance..	**10 HRS**

ReferenceBooks*

Textbooks:

1. Thomas.m.lillysand&ralph.w.keifer,"remotesensing&imageinterpretation"–-7th edition,weileyindia publications, new delhi, august 8, 2015.
2. Basudeb.bhatta,"remotesensingandgis",-2nd edition",oxfordpresspublications,2011.
3. M. Angireddy , " textbook of remote sensing and geographical information systems", 3rd edition, b.s.publications, hyderabad, january 12005, telangana, india. Isbn:978-81-7800-135-7.
4.c.p.loalbert.k.w.yeung,"conceptsandtechniquesingeographicinformationsystems",2nd edition,preinticehall publications,august10th 2006,ontoriousa..

Course Outcomes **

The student will be able to

1. Explore the advantages of remote sensing and procedure of using satellite image for various civil

2. engineering applications.

3. Apply, Method of rectifying and acquiring required data from satellite image and carry out analysis to get object specific results.

4. Integrate data from various data sources and extract relevant information related topography, by per forming GIS data analysis.

4. Use recent technologies like GIS and RS, for civil engineering applications , to meet project/work requirements in short time and on large scale.

Course Outcomes	**Programme Outcomes**												**Programme Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	2	1	2	2	-	-	-	-	-	-	2	2	2
CO 2	3	3	2	1	2	2	-	-	-	-	-	-	2	2	2
CO 3	3	3	2	2	2	3	-	-	-	-	-	-	2	2	2
CO 4	3	2	2	2	2	2	-	-	-	-	-	-	2	2	2
Average	**3**	**2.5**	**2**	**1.5**	**2**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

Course Code		:	BCVC505N	Process Economics and Plant Design	Semester	:	05
L:T:P		:	3:0:0		Course Type	:	PEC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Develop the knowledge and skills to evaluate process economics, perform techno-economic analysis, and design chemical process plants by integrating engineering, safety, environmental, and economic considerations. Apply engineering principles to optimize plant layout, equipment selection, cost estimation, and process efficiency for sustainable and economically viable industrial operations.

Course Outcomes:

After studying this course, students will be able to:

After studying this course, students will be able to:

1. To understand the process design of plant.
2. To study the feasibility survey for the plant design.
3. To Calculate the project profitability and alternative investment
4. To identify the cost analysis involved in the design of plant

UNIT-I	10 Hrs.

PROCESS DESIGN DEVELOPMENT:

Design project procedure, design information from the literature and other sources of information, flow diagrams, preliminary design and equipment design and specialization, safety factors specifications, and materials of construction.

GENERAL DESIGN CONSIDERATIONS:

Marketability of the product, availability of technology, raw materials, human resources, land and utilities, site characteristics, plant location, plant layout, plant operation and control, utilities, storage, materials handling, materials and fabrication selection.Waste disposal community factors. Safety and hazard control measures

UNIT–II	10 Hrs.

CAPITAL INVESTMENTS:

Fixed capital investments including land, building, equipment and utilities, installation costs,(including equipment, instrumentation, piping, electrical installation and other utilities),working capital investments.

MANUFACTURING COSTS AND PLANT OVERHEADS:

Manufacturing Costs: Direct Production costs (including raw materials, human resources, maintenance and

repair, operating supplies, power and other utilities, royalties, etc.), fixed charges Plant Overheads: Administration, safety and other auxiliary services, Conceptual numerical
UNIT–III **10Hrs.**
COST ANALYSIS: Cost Analysis: Factors involved in project cost estimation, methods employed for the estimation of the capital investment. Estimation of working capital and **DEPRECIATION**: Different type of depreciation methods of and calculations, Conceptual numerical
UNIT–IV **10 Hrs.**
PROFITABILITY ANALYSIS: Methods for the evaluation of profitability. Return on original investment, interest rate of return, Cash flow diagrams. Break-even analysis. Conceptual numerical.
Text Books:
1.Peters and Timmerhaus (1989) Plant Design and Economics for Chemical Engineers, 4th edn., McGraw Hill. 2.Rudd and Watson (1987) Strategy of Process Engineering, Wiley. 3.Poornima M C (2006) Entrepreneurship Development and Small Business Enterprises", Pearson education.
Reference Books:
1. Vasanth Desai (2007) Dynamics of Entrepreneurial Development & Management", Himalaya Publishing House. 2. Khanka SS (2004) Entrepreneurship Development, S Chand & Co. 3. Thomas W. Zimmer, Norman M. Scarborough.(2007), Essentials of Entrepreneurship and small Business Management

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3, and WK4)	-	-	-	-	-	1	-	-	1	-		2

CO2	**-**	**2 (WK1, WK2, WK3, and WK4)**	**3 (WK5)**	**-**	**3 (WK6)**	**1 (WK1, WK5 and WK7)**	**1 (WK9)**	**1**	**1**	**-**	**1 (WK8)**	**-**		**2**
CO3	**-**	**2 (WK1, WK2, WK3, and WK4)**	**3 (WK5)**	**-**	**3 (WK6)**	**1 (WK1, WK5 and WK7)**	**-**	**1**	**1**	**-**	**1 (WK8)**	**-**		**2**
CO4	**-**	**2 (WK1, WK2, WK3, and WK4)**	**2 (WK5)**	**-**	**-**	**1 (WK1, WK5 and WK7)**	**-**	**1**	**1**	**-**	**1 (WK8)**	**-**		**2**

BCVD505N	SUSTAINABLE DEVELOPMENT	Credits: 3
L:T:P -3: 0: 0		CIE Marks: 50
Total Hours/Week:3		SEE Marks: 50

UNIT-I	10 Hrs.

Sustainable Materials and SDGs : Sustainable Development, Triple Bottom Line, UN SDGs .Circular Economy and Resource Efficiency. Sustainable construction materials: SCMs, Geopolymer concrete, Bio-based materials, Recycled materials, Green steel. Embodied Energy, Embodied Carbon, Carbon Footprint. Environmental Product Declarations (EPDs). Sustainable material selection and green procurement. Overview of European Green Deal and US EPA Sustainable Materials Management

UNIT–II	10 Hrs.

Sustainable Construction Methods: Lean Construction, BIM, Digital Twin, Modular and Prefabricated Construction. Resource-efficient construction, Waste minimization, C&D waste management. Passive design and Renewable energy integration. Green building construction practices. ECBC, EPBD (Europe), US Green Building policies, and Circular Construction principles

UNIT–III	10Hrs.

Sustainable Building Operation and Maintenance: Building Energy Management Systems (BEMS) and Smart Building. Thermal comfort, Indoor Air Quality, Lighting and Acoustic comfort. Energy and Water efficiency measures. Preventive and Predictive maintenance. Carbon management: Carbon Credits, Carbon Cess/Tax, EU ETS, CBAM and India's Carbon Credit Trading Scheme (CCTS).

UNIT–IV	10 Hrs.

Life Cycle Assessment and Sustainability Evaluation: Life Cycle Assessment (ISO 14040/14044) and Life Cycle Costing. Whole Life Carbon and Circular Construction. Green building rating systems: LEED, GRIHA, IGBC, BREEAM, WELL. Assessment tools and databases: IIT Madras Embodied Carbon Database, EPD Databases, TallyLCA, One Click LCA, EC3. Case studies on Net Zero and Sustainable Buildings

Reference Books*

1. Civil and Environmental Engineering for the Sustainable Development Goals: Emerging Issues, Manuela Antonelli & Gabriele Della Vecchia (Springer, 2022)
2. Civil Engineering Innovations for Sustainable Communities with Net-Zero Targets, Sreevalsa Kolathayar et al. (Taylor & Francis, 2024)
3. Sustainable Civil Engineering: Principles and Applications, Varinder Kanwar, Sanjay K. Shukla & Siby John (Taylor & Francis, 2023)
4. An Introduction to Sustainable Development, Peter P. Rogers, Kazi F. Jalal & John A. Boyd (Earthscan, 2007)
5. The Role of Civil Engineering in Achieving UN SDGs, chapter in Advances in Sustainable Materials and Resilient Infrastructure (Springer, 2022)
6. Engineering for Sustainable Development: Delivering on the SDGs (UNESCO) – An interdisciplinary engineering-policy guide

Course Outcomes(Students will be able to…)**

CO1: Explain the principles of sustainable development, SDGs, and evaluate sustainable construction materials for minimizing environmental impacts..

CO2: Apply sustainable construction methods, green building practices, and international sustainability policies in planning and execution of construction projects.

CO3: Analyze building operation, maintenance strategies, and carbon management approaches to improve resource efficiency and reduce operational emissions.

CO4: Evaluate the environmental performance of buildings using Life Cycle Assessment (LCA), sustainability rating systems, and embodied carbon assessment tools for informed decision-making.

COs	Programme Outcomes (POs)												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	-	1	2	3	-	-	-	-	2	2	2	3
CO2	2	3	3	2	2	2	3	-	1	1	2	2	2	3	3
CO3	2	3	2	3	2	3	3	-	1	1	2	2	2	2	3
CO4	3	3	2	3	3	2	3	-	-	1	2	3	2	3	3
Average	**2.5**	**2.75**	**2.33**	**2.67**	**2**	**2.25**	**3**	**-**	**1**	**1**	**2**	**2.25**	**2**	**2.5**	**3**

Course Code		:	BCVE505N	AIR POLLUTION AND CONTROL	Semester	:	05
L:T:P		:	3:0:0		Course Type	:	PEC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Develop the ability to identify, analyze, and evaluate sources, impacts, and control measures of air pollution using engineering principles and environmental standards. Apply appropriate air pollution monitoring, modeling, and emission control technologies to design sustainable solutions for protecting public health and the environment

Course Outcomes:

After studying this course, students will be able to:

1. Identify the major sources of air pollution and understand their effects on health and environment.
2. Evaluate the dispersion of air pollutants in the atmosphere and to develop air quality models.
3. Ascertain and evaluate sampling techniques for atmospheric and stack pollutants.
4. Choose and design control techniques for particulate and gaseous emissions

UNIT-I	10 Hrs.

Introduction:

Definition, Sources, classification and characterization of air pollutants. Effects of air pollution on health, vegetation & materials. Atmosphere and water bodies, Photo-chemical Smog, .

UNIT–II	10 Hrs.

Meteorology:

Temperature lapse rate & stability, wind velocity & turbulence, plume behavior, measurement of meteorological variables, wind rose diagrams, Plume Rise, estimation of effective stack height and mixing depths. Development of air quality models-Gaussian dispersion model and Numerical problems.

UNIT–III	10Hrs.

Sampling:

Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants ($PM_{2.5,}$ PM_{10}, SO_X, NO_X, CO, NH_3) and Air pollution emission standards and Numerical problems

UNIT–IV	10 Hrs.

Control Techniques:

Air pollution control devices, equipment and their design. Particulate matter and gaseous pollutants- settling

chambers, cyclone separators, scrubbers, filters & ESP. Including Numerical problems. Indoor air quality-sources, types and control of air pollutants
Reference Books *
1. M. N. Rao and H V N Rao, "Air pollution", Tata Mc-G raw Hill Publication. 2. H. C. Perkins, "Air pollution". Tata McGraw Hill Publication 3. Mackenzie Davis and David Cornwell," Introduction to Environmental Engineering" McGraw-Hill Co. Noel 4. De Nevers, "Air Pollution Control Engineering" , Waveland Pr Inc. 5.Anjaneyulu Y, "Text book of Air Pollution and Control Technologies", Allied Publishers

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3, and WK4)	-	-	-	-	-	1	-	-	1	-		2
CO2	-	2 (WK1, WK2, WK3, and WK4)	3 (WK5)	-	3 (WK6)	1 (WK1, WK5 and WK7)	1 (WK9)	1	1	-	1 (WK8)	-		2
CO3	-	2 (WK1, WK2, WK3, and WK4)	3 (WK5)	-	3 (WK6)	1 (WK1, WK5 and WK7)	-	1	1	-	1 (WK8)	-		2
CO4	-	2 (WK1, WK2, WK3, and WK4)	2 (WK5)	-	-	1 (WK1, WK5 and WK7)	-	1	1	-	1 (WK8)	-		2

Course Code		**:**	BCVF505N	**Urban Transport Planning**	**Semester**	**:**	V
L:T:P*		**:**	**3 : 0 : 0**		**Course Type**	**:**	**PEC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs.**		**CIE Marks**	**:**	50
	Learning (TW+SL)	**:**	**42 Hrs.**		**SEE Marks**	**:**	50
	Exam	**:**	**06 Hrs.**		**Total Marks**	**:**	100
	Total Hrs.	**:**	**90 Hrs.**		**Credits**	**:**	03

Professional Competency:

Proficient in urban transport planning principles including traffic demand forecasting, modal split analysis, and mass transit system design, with working knowledge of transportation models and IRC/MoRTH guidelines. Skilled in integrating land-use planning with transport network design to develop sustainable, efficient, and safe urban mobility solutions.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Explain the urban transportation planning process, land use–transport interaction, and relevant policy frameworks (NUTP, Smart Cities Mission) in the Indian context.

CO2: Apply travel demand forecasting techniques (trip generation, trip distribution, modal split, and traffic assignment) to estimate and analyse urban travel demand.

CO3: Plan and design public transportation systems, non-motorised transport facilities, and parking systems in accordance with IRC/MoRTH guidelines.

CO4: Evaluate the environmental, economic, and sustainability impacts of urban transport projects and propose suitable TSM/TDM strategies for Indian cities.

Unit-I	**11 Hrs.**

Urban Transportation Systems and Planning Process: Urbanisation trends in India; urban transport problems (congestion, safety, pollution, equity); components of the urban transport system and their interaction. Urban structure types (centripetal, grid, linear, directional-grid) and land use–transport interaction. Evolution of the transportation planning process; systems approach; Urban Transportation Planning System (UTPS) approach. National Urban Transport Policy (NUTP), Smart Cities Mission, AMRUT, Service Level Benchmarks. Institutional framework: role of UMTA, Development Authorities and Urban Local Bodies. Comparison with international planning frameworks (MPO-based planning in the USA/UK).

Unit-II	**11 Hrs.**

Travel Demand Forecasting — Conventional Four-Stage Process: Data needs and inventories; study area definition, cordon/screen lines, zoning, sample size, O-D surveys, and secondary data sources. Trip Generation: aggregate and category analysis, regression, cross-classification. Trip Distribution: growth factor methods (Fratar, Furness), gravity model, opportunity models. Modal Split: pre-distribution, post-distribution, and diversion curve methods. Traffic Assignment: all-or-nothing, capacity-restrained, and user-equilibrium assignment; network coding basics. Introduction to disaggregate/discrete choice modelling (logit models) as used in advanced/international practice.

Unit-III	10 Hrs.
Public Transportation and Non-Motorized Transport Planning: Modes of public transport and their applicability to Indian cities; bus transit, BRTS, Metro Rail, Mono Rail, LRT — planning, capacity, and network design. Transit route and schedule planning; fleet sizing and operations management. Para-transit and Intermediate Public Transport (IPT) in the Indian context. Non-Motorized Transport (NMT): pedestrian and bicycle facility planning per IRC guidelines. Parking studies and management policies. Transit-Oriented Development (TOD) principles and NUTP-linked multimodal integration.	
Unit-IV	**10 Hrs.**
Transportation Impact Analysis and Sustainable Urban Mobility: Traffic impact assessment for new developments; environmental impact of transport — air, noise pollution, energy consumption. Transportation System Management (TSM) and Travel Demand Management (TDM) strategies. Financing and evaluation of urban transport projects: cost-benefit analysis, multi-criteria evaluation. Emerging trends: Intelligent Transportation Systems (ITS), shared mobility, electric vehicles, autonomous vehicles, and their planning implications. Sustainability and equity in transport planning — comparative perspective from global practice (congestion pricing, VMT-based evaluation) versus Indian applicability.	
Text Books:	
1. Khisty, C.J. and Lall, B.K., "Transportation Engineering: An Introduction", Pearson Education India, 4th Edition, 2022. 2. Ponnuswamy, S. and Victor, D.J., "Urban Transportation: Planning, Operation and Management", Tata McGraw-Hill Education, 1st Edition, 2012. 3. Kadiyali, L.R. and Kadiyali, N.L. (Rev.), "Traffic Engineering and Transportation Planning", Khanna Publishers, 10th Edition, 2020.	
Reference Books:	
1. Ortuzar, J.D. and Willumsen, L.G., "Modelling Transport", John Wiley & Sons, 5th Edition, 2024. 2. Papacostas, C.S. and Prevedouros, P.D., "Transportation Engineering and Planning", Pearson Education, 3rd Edition, 2015. 3. Sarkar, P.K., Maitri, V., and Joshi, G.J., "Transportation Planning: Principles, Practices and Policies", PHI Learning, 3rd Edition, 2020.	

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO1	3 (WK1, WK3)	2 (WK1, WK7)	-	-	-	2 (WK7)	1 (WK5)	-	-	-	-	2	-
CO2	2 (WK3)	3 (WK2, WK3)	-	2 (WK2)	3 (WK2, WK6)	-	-	-	-	-	-	2	2
CO3	2 (WK4)	-	3 (WK4, WK5, WK6)	-	2 (WK6)	-	2 (WK5)	1 (WK7)	-	-	-	2	2
CO4	-	2 (WK5)	-	-	-	3 (WK7)	3 (WK5)	2 (WK7)	-	-	2 (WK5)	-	2

Course Code		:	BCVA601C	**DESIGN OF RC STRUCTURES**	**semester**	:	**06**
L:T:P		:	**3 : 0: 0**		**Course Type**	:	**PCC**
Hours/Sem.	**Teaching**	:	**42 Hrs**		CIE Marks	:	50
	Learning (TW+SL)	:	**42 Hrs**		SEE Marks	:	50
	Exam	:	**06 Hrs**		Total Marks	:	100
	Total Hrs	:	**90 Hrs**		Credits	:	03

UNIT-I	**11 Hrs**

General features reinforced concrete: Introduction, Design loads, Materials for reinforced concrete, Code requirements of reinforcements, Elastic theory of RC sections, Moment of resistance of section, Balanced, under reinforced and over reinforced section.

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 torsional strength of RC sections, Concepts of development length and anchorage, Analysis examples for rectangular sections, flanged sections, doubly reinforced, sections, shear strength and development length.

UNIT–II	**11 Hrs.**

Limit state: General aspects, Deflection limits in IS: 456-2000, Calculation of deflection (Theoretical method), Cracking Serviceability in structural concrete members.

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 and cantilever beams (rectangular).

UNIT–III	**10 Hrs.**

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.

Design of stair case: General features, types of stair case, Loads on stair cases, effective span as perIS codal provisions, distribution of loading on stairs, design of stair cases.

UNIT–IV	**10 Hrs.**

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 subject to combined axial load and uniaxial moment using SP 16.

Design of footings: Introduction, Load for foundation, Design basis (limit state method), Design ofisolated square or rectangular footing for axial load.

Reference Books *

1. Unnikrishnan and Devadas Menon, Design of reinforced concrete structures, PHI, New Delhi.2013.
2. Karve S.R. and Shah V.L, Limit state theory and design of reinforced concrete, VidyarthiPrakashan, Pune. 2017.
3. A.K. Jain, Limit state method of design, Nemchand and Bros, Roorikee, Jan 2012.
4. Park and Paulay, Reinforced concrete, John Wiley & Sons. 1975.
5. Kong and Evans, Reinforced and prestressed concrete, ELBS, London
6. H.J. Shah, Reinforced concrete Vol. I, Charotor Publishing House, Anand. Jan 2016.
7. IS: 456-2000, SP-24, SP-16.

(Note: Use of IS: 456-2000 is permitted and SP-16 to be used in design of columns only).

Course Outcomes**
After completion of the course student will be able to **1.** Apply the principles and methods of Reinforced Concrete (RC) design to analyze and design various RC structural sections. **2.** Analyze serviceability requirements and design different types of reinforced concrete beam sections. **3.** Design reinforced concrete slabs and staircases in accordance with relevant design standards and engineering principles. **4.** Design reinforced concrete columns and isolated footings considering strength, stability, and serviceability requirements.

***Books to be listed as per the format with decreasing level of coverage of syllabus**

****** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes**											**Programme Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO 1	3(WK 1. 2, 3, 4, 8)	3										2(WK 5,6)	1	
CO 2	3	3(WK 1, 2, 4, 5)										2(WK5, 7)	2(WK5, 7)	
CO 3	3(WK 1, 3, 6)	3(WK 1. 2, 3, 4, 8)	3	3(W K 1. 2, 3, 4, 8)								2(WK5, 7)	2(WK2, 3,7)	
CO 4	3(WK 1, 3, 6)			2(W K1, 2, 4, 5)								2(WK5, 7)	1(WK)	

Course Code		:	BCVA602C	Irrigation Engineering	Semester	:	06
L:T:P		:	2:0:0		Course Type	:	PCC
Hours/Sem.	Teaching	:	32 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	32 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	70 Hrs		Credits	:	02

UNIT-I	6 Hrs.

Irrigation Engineering - Introduction: Necessity, benefits and ill effects of irrigation, and its history of development, Water Resources of India and its Demand in Various Sectors Types of Irrigation, Techniques of water distribution in the farm, quality of irrigation water.

UNIT–II	8 Hrs.

Water requirement of Crops: Definition of gross command area, cultural command area, intensity of irrigation, time factor, crop factor. Soil water system, consumptive use, duty, delta and base period, and problems, factors affecting and methods to improve duty, Crop seasons in India, irrigation efficiencies, and numerical.

UNIT–III	8 Hrs.

Canals: Classifications, Regime theory, Design of canals cross sections by Lacey's method, Cross section of irrigation canals, Balanced depth, fixing L-section and design considerations and design.

Cross Drainage works: Definition and Types, Design considerations of Aqueduct, ,Fluming of canal by Mitra's formulae. Design problems of aqueduct

UNIT–IV	8 Hrs.

Dams and Reservoirs

Investigation for reservoir site, storage zones, determination of storage capacity using mass curve , economical height of dam by Area elevation curve method.

Gravity Dam- Forces acting on Gravity dam, Profile of the dam , Design considerations and fixing the section, Principals stresses, Stability analysis by gravity method and problems.

Earthen Dams (Theory only, No problems on earthen dam): Types, Construction, Causes of failure of earthen dams ,Seepage control measures,

Reference Books*

1. IrrigationEngineeringandHydraulicStructures"bySantoshKumarGarg,KhannaPublishers,2015(7thedition),ISBN:978-8174092456.
2. "Irrigation Engineering" by N.N. Basak, Prentice-Hall of India Pvt. Ltd., 2012 (2nd edition),ISBN:978-8120345309.
3. "PrinciplesofIrrigationEngineering"byV.T.Chowdhury,Prentice-HallofIndiaPvt.Ltd.,2004(1stedition),ISBN:978-8120323185.
4. "IrrigationWaterManagement"byA.M.Michael,NewAgeInternationalPublishers,2012(1stedi

tion),ISBN:978-8122434679.
5. "IrrigationandWaterResourcesEngineering"byG.L.Asawa,NewAgeInternationalPublishers,2010(4thedition),ISBN:978-8122414602.
6. " Lesson-47-Project Planning and Financial analysis of Irrigation Project", board proceedings of Indian Agricultural Statistical Research Institute , (Under ICAR), by Shashikala Sukhatme (2002)
7. "Project Planning and Financial analysis of Irrigation Project", article by Pandurang Sukhatme, Journal of Statistical Planning and Inference, -102, 3-24, (2002)

Course Outcomes	Programme Outcomes(POs)												Program Specific Outcomes(PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	-	2	2	-	-	-	-	-	-			
CO2	3	2	3	-	2	1	-	-	-	-	-	-			
CO3	3	2	3	-	3	-	-	-	1	-	-	-			
CO4	2	1	1	-	2	1	-	-	1	-	-	1			

CourseOutcomes (Studentswillbeableto**

1. Able to classify and design the canals longitudinal sections and cross drainage works.
2. To comprehend various aspects of gravity dam analysis and design
3. Tobeabletounderstandconceptsofconstructionandfailureinearthendamsanddesignofmajorspill ways.
4. To know concepts canal falls and regulator works and apply the knowledge in their design

Course Code		**:**	**BCVA603C**	**Estimating and Costing**	**Semester**	**:**	**07**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Apply standard methods of estimation, rate analysis, and cost estimation to prepare accurate estimates and tender documents for Civil Engineering projects.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Understand and apply various estimation methods (centre line, long & short wall) to prepare detailed and abstract estimates for civil engineering structures including buildings, masonry and RCC components.

CO2: Develop detailed specifications and perform estimation for structures like steel trusses, slab culverts, septic tanks and manholes, adhering to standard practices.

CO3: Carry out rate analysis for common construction works and compute earthwork quantities for roads using appropriate formulas for various terrains.

CO4: Demonstrate knowledge of tendering and contract procedures, departmental processes, billing, and valuation including legal and technical aspects related to civil engineering projects.

UNIT–I	**10 Hrs.**

Estimate: Different types of estimates, study of various drawing attached with estimates. Important terms, units of measurement, abstract, approximate methods of estimating building, cost from materials and labour equations recommended by CBRI examples.

Estimation: Methods of taking out quantities and cost centre line method, long and short wall method. Preparation of detailed and abstract estimates for the following Civil Engineering works Buildings Masonry structures and framed structures with flat, sloped RCC roofs. Building components (Beams, Columns and Column Footings, RCC Roof Slabs).

UNIT–II	**11 Hrs.**

Estimates: Steel truss (Fink and Howe truss), RCC Slab culverts, manhole and septic tanks.

Specifications: Definition of specifications, objective of writing specifications, essentials in specifications, general and details specifications of items.

UNIT-III	11 Hrs.
Rate analysis: Definition and purpose. Working out quantities and rates for the following standard items of works earth work in different types of soils, cement concrete of different mixes, bricks and stone masonry, flooring, plastering, RCC works, centring and form work for different RCC items, wood and steel works for doors, windows and ventilators. **Measurement of earthwork for roads:** Methods for computation of earthwork cross sections mid-section formula, trapezoidal or average end area or mean sectional are formula, Prismoidal formula for different terrains.	
UNIT-IV	**10 Hrs.**
Contract Management: Types of contracts, essentials of contract agreement, legal aspects, penal provisions on breach of contract. Types of tenders, two-bid system (technical bid + financial bid), e-tendering. Invitation to tender, Prequalification, administrative approval & Technical sanction. Contract Formulation: Letter of intent, Award of contract, letter of acceptance and notice to proceed. **Tender Process and Procedures:** Features of standard Tender document. Law of Contract as per Indian Contract act 1872, Types of Contract, Joint venture. Contract Forms: FIDIC contract Forms, CPWD, NHAI, NTPC, NHEPC. Notice Inviting Tender (NIT): essential contents, eligibility criteria, scope of work, time schedule, earnest money deposit (EMD), tender fee	
Text Books:	
1. Dutta, B. N., Estimating and costing in civil engineering, UBS Publishers, New Delhi. 2. Chakraborty, M., Estimating, costing, specification, and valuation in Civil Engineering, Chakraborty Publishing House. 3. S. C. Rangawala "Estimating, Costing and Valuation" 17th revised Charotar Publishing House ANAND, 2017 4. R. Ramanathan “Contract Management” KONARK PUBLISHERS PVT LTD New Delhi, 2002	
Reference Books:	
1. B. S. Patil “Civil Engineering Contracts and Estimates” Orient Longman, Mumbai, Ed.2010 ISBN: 9788173715594, 2. Estimating construction cost (fifth edition), Peurifoy, RobertL. Oberlender, Garold, McGraw Hill Education, New Delhi 3. Kohli, D. D. and Kohli, R. C., A textbook of estimating and costing including accounts and building bye-laws., S. Chand and company, New Delhi	

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO 9**	**PO1 0**	**PO11**	**PSO 1**	**PSO 2**	**3**
CO1	**3** (WK2, WK3, WK4)	**2** (WK2, WK3)	**1** (WK5)	–	**1** (WK6)	–	–	–	–	**1**	–	**3**	**2**	
CO2	**3** (WK3, WK4)	**2** (WK3)	**2** (WK5)	–	**2** (WK5, WK6)	–	**1** (WK7)	–	–	**1**	–	**3**	**2**	
CO3	**2** (WK2, WK3)	**3** (WK2, WK3, WK5)	**2** (WK5)	**1** (WK6)	**2** (WK6)	**1** (WK6)	**1** (WK7)	–	–	**1**	**1** (WK6)	**3**	**2**	
CO4	**2** (WK3)	**2** (WK6)	**2** (WK6)	–	**1** (WK6)	**2** (WK6, WK7)	**2** (WK7)	–	–	**2**	**2** (WK6, WK8)	**2**	**3**	

Course Code		**:**	**BCVA604C**	**Wastewater Engineering**	**Semester**	**:**	**06**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Plan, design, operate, and evaluate wastewater collection, treatment, and disposal systems using engineering principles and environmental standards to protect public health and the environment

Course Outcomes:

After completion of the course student will be able to

CO1: To estimate sewage and drainage quantity, for the design of sewers and drainage sections.

CO2: To demonstrate the characterization of sewage and sewer appurtenances.

CO3: To identify the impact of sewage disposal on water and land and minimum treatment necessary for sewage.

CO4: To design biological treatment units for sewage and knowledge of sludge disposal.

UNIT–I	**11 Hrs.**

Introduction: Necessity for sanitation, methods of sewage disposal, types of sewerage systems, dry weather flow, wet weather flow, factors effecting dry and wet weather flow on design of sewerage system, estimation of storm water flow, time of concentration flow, numericals.

Design of Sewers: Self cleansing and non-scouring velocities - Numerical problems. Design of hydraulic elements for circular sewers for full flow and half flow conditions, Laying of sewers, joints and testing of sewers, ventilation and cleaning of sewers.

UNIT–II	**10 Hrs.**

Sewer Appurtenances: Catch basin, manholes, flushing tanks, oil and grease traps.

Sewage Characteristics: Sewage Sampling. Physical, Chemical and Biological characteristics, with emphasis on BOD & COD, BIS and CPCB standards, BOD Numerical problems, Reaction kinetics (zero order, 1st order and 2nd order).

Drainage traps, Basic principles of house drainage, Typical layout plan showing house drainage connections, maintenance of house drainage.

UNIT–III	**11 Hrs.**

Sewage Treatment - Primary Treatments: Flow diagram of municipal wastewater treatment plant. Primary treatment Screening, grit chambers, skimming tanks, primary sedimentation tanks- Theory and Design.

Secondary Treatments: Fixed film bioprocess-Trickling filter theory and design, Suspended growth system-Activated sludge process-Theory and design**.**

UNIT–IV	**10 Hrs.**

Sludge Treatment Methods: Sludge digestion tanks, Sludge drying beds. Low cost wastewater treatment - Septic tanks.

Sewage Disposal: Dilution method - self-purification phenomenon. Streeter-Phelp's equation, Oxygen sag curve, Zones of purification and numerical. Oxidation Pond and Oxidation ditches, Land disposal: Sewage farming, sewage sickness.

Reference Books *

1. Environmental Engineering, Peavy H. S., Rowe D. R. and George Tchobanoglous, McGraw-Hill International.
2. Garg, S.K., "Environmental Engineering", Vol. 1 & II Khanna Publishers, New Delhi, 2005.
3. Water Supply and Sewerage, McGhee T. J., McGraw-Hill Inc.,
4. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, McGraw Hill Education, 2017, 4th Edition.
5. APHA, Standard Methods Examination of Water and Wastewater, American Public Health Association, Washington DC, 1995.
6. CPCB, Guide Manual: Water and Wastewater Analysis.
7. CPHEEO manual on sewage treatment, Ministry of Urban Development, Government of India, New Delhi,1999.
8. Mark.J Hammer, "Water & Waste Water Technology" John Wiley & Sons Inc., New York, 2008
9. Benefield R.D., and Randal C.W, "Biological Process Design for Wastewater Treatment", Prentice Hall, Englewood Chiffs, New Jersey 2012
10. Metcalf and Eddy Inc, "Wastewater Engineering - Treatment and Reuse", Publishing Co. Ltd., New Delhi, 4th Edition, 2009.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**3** (WK1, WK2, WK3, WK4)	**3** (WK1, WK2, WK3, WK4)	**2** (WK5)	–	–	–	**1** (WK7)	–	–	–	–	**3**	**2**
CO2	**3** (WK1, WK2, WK3)	**2** (WK1, WK2, WK3, WK4)	–	**2** (WK8)	**2** (WK6)	**1** (WK1, WK5, WK7)	**2** (WK7)	–	–	**1**	–	**3**	**2**
CO3	**2** (WK1, WK2)	**3** (WK1, WK2, WK3)	**2** (WK5)	**2** (WK8)	–	**3** (WK 1, WK5, WK7)	3 (WK7)	**1**	–	**1**	–	**2**	**3**
CO4	**3** (WK1, WK2, WK3, WK4)	**3** (WK1 , WK2, WK3)	**3** (WK 5)	**2** (WK 8)	**2** (WK 6)	**2** (WK1, WK5, WK7)	3 (WK7)	**1**	**1**	**1**	**1**	**3**	**3**

Note:

If there is no mapping between a CO and a PO, indicate "–".

The WKs (Knowledge Profile elements) shown are indicative and should align with the relevant Program Outcomes addressed by each Course Outcome.

Course Code		:	BCVA607L	SOFTWARE APPLICATION LAB	semester	:	06
L:T:P		:	0 : 0: 2		Course Type	:	PCCL
Hours/Sem.	Teaching	:	26		CIE Marks	:	50
	Learning (TW+SL)	:	--		SEE Marks	:	50
	Exam	:	04		Total Marks	:	100
	Total Hrs	:	30		Credits	:	01

MICROSOFT EXCEL: Analysis and design of singly beam, doubly beam, one way slab and two way slabs.

ANALYSIS AND DESIGN SOFTWARES: Analysis and Design of structural Engineering components using commercially available Software's: Cantilevers, Simply supported beams, Propped Cantilevers, Fixed and Continuous Beams. 2D Portal frames - Single and two storied.

AUTOCAD: Drawing and detailing of: singly Beam, doubly beam, one way slab, two way slab Doglegged stair case and isolated footing with column.

Reference Books *

1. Unnikrishnan and Devadas Menon, Design of reinforced concrete structures, PHI, New Delhi.2013.
2. Karve S.R. and Shah V.L, Limit state theory and design of reinforced concrete, VidyarthiPrakashan, Pune. 2017.
3. A.K. Jain, Limit state method of design, Nemchand and Bros, Roorikee, Jan 2012.
4. Park and Paulay, Reinforced concrete, John Wiley & Sons. 1975.
5. Kong and Evans, Reinforced and prestressed concrete, ELBS, London
6. H.J. Shah, Reinforced concrete Vol. I, Charotor Publishing House, Anand. Jan 2016.7. IS: 456-2000, SP-24, SP-16.

(Note: Use of IS: 456-2000 is permitted and SP-16 to be used in design of columns only).

Course Outcomes**

After completion of the course student will be able to

1. Analyze and design simply supported doubly reinforced beams and slabs using MS Excel.
2. Apply commercial structural software to design cantilevers, fixed beams, portal frames.
3. Draft and details beams of beams, slabs, staircase and footing using AutoCAD

Course Articulation Matrix:

Course Outcomes	Programme Outcomes											Programme Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO 1	3(WK1, 2, 3, 4,7)	3(WK 1, 2, 3, 5)										2(WK4, 5, 6, 7)	1(WK1,2, 3, 4, 5,6, 7)	
CO 2	3(WK1 ,2, 3, 4, 5, 6, 7)	3(WK 1,2, 3, 4, 5, 6, 7)										2(WK4, 5, 6, 7)	2(WK4, 5, 6, 7)	
CO 3	3(WK1 ,2, 3,	3(WK 1,2, 3,	3(WK 1,2,	3(W K1,2,								2(WK4, 5, 6, 7)	2(WK4, 5, 6, 7)	

	4, 5, 6, 7)	4, 5, 6, 7)	3, 4, 5, 6, 7)	3, 4, 5, 6, 7)										

Course Code		**:**	**BCVA608L**	**Environmental Engineering Lab**	**Semester**	**:**	**05**
L:T:P		**:**	**0:0:2**		**Course Type**	**:**	**PCCL**
Hours/Sem.	**Teaching**	**:**	**26 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**26 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**04 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**30 Hrs**		**Credits**	**:**	**01**

Professional Competency:

Plan, design, operate, and evaluate wastewater collection, treatment, and disposal systems using engineering principles and environmental standards to protect public health and the environment

Course Outcomes:

After completion of the course student will be able to

CO1: Able to determine the physical, chemical and biological parameters for drinking purpose as per BIS standards.

CO2: Analyse the test results and recommend the water for its potability.

CO3: Identify and characterize wastewater using standard methods.

CO4: Analyse the test results and recommend wastewater for its disposal.

List of Experiments OR Programs List

I. Tests on Water Quality

i. Physical Parameters

1) Colour

2) Turbidity

3) Conductivity

4) Temperature

ii. Chemical Parameters

1) Solids-Total, dissolved and suspended

2) pH

3) Acidity

4) Alkalinity

5) Chlorides

6) Hardness- Carbonate and Non carbonate

7) Sulphate

8) Fluoride

9) Iron

10)Chlorine demand & Residual chlorine

11) Nitrate

12) Dissolved Oxygen

iii. Bacteriological Parameters

1) MPN

2) Membrane Filter Technique

II. Tests on Sewage

1) Solids-Total, dissolved, suspended, volatile and fixed

2) Biochemical oxygen Demand

3) Chemical oxygen Demand

III. Other Tests

1) Optimum Alum dose (Jar Test)

2) Percentage of chlorine in Bleaching Powder

3) Break Point Chlorination and Residual Chlorine

Open Ended Experiment(s) OR Open Ended Program(s)

1. Determine the most suitable treatment process for a given raw water sample based on its quality characteristics.
2. Design a sewage treatment scheme for a town based on wastewater characteristics.

Reference Books *

1. Manual of Water and Wastewater Analysis- NEERI Publication 1988.
2. Standard methods for Examination of Water and Wastewater Analysis APHA, AWWA. 2011.
3. Central Pollution Control Board (CPCB), Guidelines for Sewage Treatment Plants, Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India.
4. Bureau of Indian Standards (BIS), IS 10500: Drinking Water — Specification (latest revision), BIS, New Delhi.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**3** (WK1, WK2, WK3, WK4)	**2** (WK1, WK2, WK3)	–	**3** (WK8)	**3** (WK6)	**2** (WK1, WK5, WK7)	**2** (WK7)	–	**1**	**1**	–	**3**	**2**
CO2:	**2** (WK1, WK2)	**3** (WK1, WK2, WK3, WK4)	**1** (WK5)	**3** (WK8)	**2** (WK6)	**3** (WK1, WK5, WK7)	**3** (WK7)	–	**1**	**1**	–	**3**	**3**
CO3	**3** (WK1, WK2, WK3, WK4)	**2** (WK1, WK2, WK3)	–	**3** (WK8)	**3** (WK6)	**2** (WK1, WK5, WK7)	**2** (WK7)	–	**1**	**1**	–	**3**	**2**
CO4	**2** (WK1, WK2)	**3** (WK1, WK2, WK3, WK4)	**1** (WK5)	**3** (WK8)	**2** (WK6)	**3** (WK1, WK5, WK7)	**3** (WK7)	–	**1**	**1**	–	**3**	**3**

Note:

If there is no mapping between a CO and a PO, indicate "–".

The WKs (Knowledge Profile elements) shown are indicative and should align with the relevant Program Outcomes addressed by each Course Outcome.

CourseCode		**:**	BCVA605E	**Traffic Engineering**	**Semester**	**:**	IV
L:T:P*		**:**	**3 :0: 0**		**CourseType**	**:**	**PCC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs.**		**CIEMarks**	**:**	50
	Learning (TW+SL)	**:**	**42 Hrs.**		**SEEMarks**	**:**	50
	Exam	**:**	**06 Hrs.**		**Total Marks**	**:**	100
	TotalHrs.	**:**	**90 Hrs.**		**Credits**	**:**	03

Professional Competency:

The course develops professional competency to in **Traffic Engineering** focuses on ensuring the safe, efficient, and environmentally sustainable movement of people and goods. It requires mastering traffic data analysis, capacity evaluation, geometric intersection design, and the application of Intelligent Transportation Systems (ITS).

Course Outcomes:

After completion of the course, student will be able to:

CO1: Able to analyze the vehicles behavior and reaction time of driver.

CO2: Able to interpretate the traffic data in analyzing different vehicular speeds.
Able to provide different parking facilities and analyze the accidents and giving the remedial measures.

CO3: Evaluate the traffic flow behavior able to design rotary and channelization

CO4: Design the signals by different methods and understands ITS

Unit-I	**11 Hrs.**

Introduction: Definition-Objective Scope of Traffic Engineering. Road User and Vehicle Characteristics Static and Dynamic characteristics- Power performance of vehicles- Resistances to the motion of vehicles- Reaction time of driver- Problems of above

Unit-II	**11 Hrs.**

Traffic Parameter Studies and Analysis: Various types of traffic engineering studies, data collection, Objectives and Method of study. Definition of study area- Sample size- Data Collection and Analysis-Interpretation of following Traffic Studies- Volume, Spot Speed study, presentation of spot speed data problems on spot speed, Speed and Delay study Origin and Destination. Parking-on Street and off Street Parking, Accidents-Causes, Analysis (collision with parked vehicle only) Measures to reduce Accident.

Unit-III	**10 Hrs.**

Traffic Flow Theories: Traffic flow theory Green shield theory Goodness of fit correlation and regression analysis (linear only)- Queuing theory Car following theory relevant Problems on above. Traffic Regulation- Driver, Vehicle and Road controls- Traffic Regulations- One Way-

Traffic Signs- Traffic Markings-Canalization, Classified traffic volume at intersections, PCU, Traffic Rotary elements, analysis of capacity of rotary	
Unit-IV	**10 Hrs.**
Traffic Control: Traffic operation Traffic Signals-Vehicle actuated and synchronized signals Signal Coordination – Intelligent Transport system- Webster's method of signal Design, IRC Method, Street lighting Road Side Furniture.	
Text Books:	
1. Khanna, S.K., and Justo, C.E.G., "Highway Engineering", Nem Chand & Bros, Roorkee, 10th Edition, 2017. 2. Kadiyali, L.R., "Principles and Practice of Highway Engineering", Khanna Publishers, New Delhi, 6th Edition, 2018. 3. Matson, Smith and Hurd.," Traffic Engineering ", McGraw Hill and Co 4. H Traffic Flow theory "Drew McGraw Hill Co.	
Reference Books:	
1. Garber, N.J., and Hoel, L.A., "Traffic and Highway Engineering", Cengage Learning, Boston, 5th Edition, 2014. 2. Pignataro.," Traffic Engineering"., Prentice Hall 3. Highway capacity Manual-2000 4. An Introduction to Transportation Engineering, Jotin Khistey and Kent Lall, PHI. 5. Traffic Engineering-Mc Shane and Roess, PHI	

Table5: Matrix to describe the mapping of Cos with Pos (considering WKs) and PSOs

Course Outcomes (COs)	**Program Outcomes and (WKs)**											**Program Specific Outcomes (PSOs)**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO1	**2** (WK1, WK4)	-	-	-	-	**1** (WK7)	**2** (WK7)	-	**1**	**1**	-	**1**	-
CO2	**1** (WK1)	**2** (WK1, WK2,	**2** (WK5)	-	**2** (WK2	-	**1** (WK7)	-	-	-	**1** (WK5)	**1**	**2**

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
		WK3,)			WK6)								
CO3	**1** (WK1,)	**2** (WK1, WK4)	**1** (WK5)	**1** (WK8)	**1** (WK6)	**-**	**-**	**-**	**1**	**-**	**-**	**2**	**3**
CO4	**2** (WK1, WK3,)	**2** (WK1, and WK4)	**-**	**1** (WK8)	**-**	**1** (WK7)	**2** (WK7)	**-**	**-**	**-**	**2** (WK5)	**2**	**2**

Course Code		**:**	**BCVB605E**	**MATRIX METHODS OF STRUCTURAL ANALYSIS**	**Semester**	**:**	**06**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PEC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Develop the competency to formulate and solve civil engineering problems using appropriate numerical methods for engineering analysis and design.

Course Outcomes:

After completion of the course, student will be able to:

CO1: *Explain* the definitions, basic concepts, and differences between classical and matrix methods, including force and displacement methods, as well as system and element approaches. *Analyze* and *evaluate* member forces for continuous beams and plane frames using the force transformation method.

CO2: *Apply* the flexibility matrix method to determine member forces in trusses. *Explain* the fundamental concepts related to the stiffness matrix method. *Evaluate* member forces for continuous beams using the displacement transformation method.

CO3: *Apply* the displacement transformation method to *analyze* and *evaluate* member forces in plane frames and trusses.

CO4: *Illustrate* the core concepts of the direct stiffness method. *Apply* the method to *evaluate* member forces in plane trusses and continuous beams.

UNIT–I	**10 Hrs.**

Definitions and Concepts: Comparison of classical, matrix and approximate methods of structural analysis, System approach versus Element approach, degrees of freedom, coordinate systems, stiffness and flexibility coefficients, Flexibility and stiffness methods.

Flexibility Method: Introduction, element flexibility matrix, Principle of contragradience, construction of member and structure flexibility matrix, determination of member forces. Procedure for analysis of indeterminate structures: analysis of continuous beams and plane frames.

UNIT–II	**11 Hrs.**

Flexibility Method Continued: Analysis of indeterminate structures: analysis of plane trusses.

Stiffness Method: Introduction, element stiffness matrix, Principle of contragradience, construction of member and structure stiffness matrix, determination of member displacements. Procedure for analysis of indeterminate structures: continuous beams.

UNIT-III	11 Hrs.
Stiffness Method continued: Analysis of indeterminate structures: plane frames and Plane trusses.	
UNIT-IV	**10 Hrs.**
Direct Stiffness Method: Introduction, transformation of variables, transformation of stiffness matrix for member of truss and continuous beams. Global stiffness matrix, Boundary conditions, computation of internal forces, analysis of plane trusses and continuous beams.	

Text Books:

1. S. Rajasekaran and G. Sankarasubramanian - Computational Structural Mechanics, PHI Learning, 2023.
2. R. C. Hibbeler, Structural Analysis, Pearson Prentice Hall, 9th edition 2015

Reference Books:

1. Kassimali Aslam – Matrix Analysis of Structures, Cengage Learning Custom Publishing, Boston USA, 2011.
2. G Pandit and 1 more. Authors. G Pandit. Author · S. Gupta. Author. STRUCTURAL ANALYSIS : A MATRIX APPROACH, 2ND EDN. 2nd Edition. 2nd Edition - 10 April 2008.
3. William Weaver Jr. and James M. Gere– Matrix Analysis of Framed Structures, CBS Publishers and distributors, New Delhi, 2018.
4. Neville A M and Ghali A- Structural Analysis: A Unified Classical and Matrix Approach, CRC Press, 2009.

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	**Program Outcomes and (WKs)**											**(PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**3**
CO1:	3 (WK2, WK3, WK4)	3 (WK3, WK4)	1 (WK5)	1 (WK5)	2 (WK6)	–	–	–	–	1	–	2	2	
CO2:	3 (WK2, WK3, WK4)	3 (WK3, WK4, WK5)	2 (WK5)	1 (WK5)	3 (WK6)	–	–	–	–	1	–	2	2	
CO3:	2 (WK3, WK4)	3 (WK3, WK5)	3 (WK5)	2 (WK5, WK6)	3 (WK6)	–	1 (WK7)	–	1	1	1 (WK6)	2	2	
CO4:	2 (WK3, WK4)	3 (WK5)	3 (WK5)	2 (WK5, WK6)	3 (WK6)	–	1 (WK7)	–	1	2	2 (WK6)	2		

Course Code		:	BCVC605E	GEOMORPHOLOGY	Semester	:	03
L:T:P		:	3:0:0		Course Type	:	PEC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Ability to apply principles of geomorphology to engineering projects to ensure they are safe, sustainable, and economically viable.

Course Outcomes:

After completion of the course, student will be able to:

CO1 : Define the field of Geomorphology, its basic principles and interior of earth.

CO2 : To outline the mechanism and theories of dynamic nature of the Earth.

CO3 : To illustrate the geomorphic processes, agents and their effects on the earth.

CO4 : To explain the conceptual and dynamic aspects of landform development**.**

UNIT–I	10 Hrs.

Introduction: Introduction to Geomorphology- Definition meaning, nature, development and scope; Basic concepts; Geological Time Scale; Distribution of continents and oceans; Internal structure of the earth.

UNIT–II	12 Hrs.

Earth Movements: Epierogenic and Orogenic earth movements; Theories of continental drift , plate tectonics, sea floor spreading, Isostasy ,Earthquakes, volcanoes and their distribution.

UNIT-III	10 Hrs.

Geomorphic Processes and Agents: Constructive and destructive processes: exogenetic and endogenetic processes and agents. Agents of Denudation: River; Drainage patterns, Groundwater, Sea Waves, Wind and Glaciers. Weathering, erosion and mass wasting.

UNIT-IV	10 Hrs.

Evolution Of Landforms: Meaning, types and factors controlling landforms development. Slope development; concept and types, Concept of Cycle of Erosion–W.M. Davis and W. Penck. Erosional and depositional landforms made by wind, rivers, glaciers and underground water. Application of geomorphology.

Text Books:

1. Parbin Singh-A **Text book of Engineering & General Geology**; S.K. Kataria & Sons, 8th Revised Edn. New Delhi.2008
2. Santoshkumar Garg – **Physical and Engineering Geology;** Khanna Publishers, 3rdrevised and enlarged Edn New Delhi. 1999.
3. P. K. Mukerjee-A **Textbook of Geology;** The World Press,11th reviser Edn Pvt Ltd Calcutta.1990.
4. K. M. Bangar**- Principals of Engineering Geology;** Standard Publishers and Distributors, New Delhi.2004.
5. D. Venkat Reddy-**Engineering Geology for Civil Engineers;** Oxford & IBH Publishers, New Delhi.1997.
6. N. Chennakesavalu - Text Book of Engineering Geology; Macmillan Publishers2nd Edn India Ltd. New Delhi. 2009.
7. Vasudev Kanithi – Engineering Geology; Universities Press (India) Pvt. Ltd. Hyderabad. 2018.
8. Subinoy Gangopadhyay- Engineering Geology; Oxford Universities Press New Delhi. 2013.
9. F. G. H. Blyth, M.H.de Freitas –Geology for Engineers; Elsevier publications 7th Edn 1988.
10. KVGK Gokhale - Principles of Engineering Geology; B S Publications, Hyderabad.

Reference Books:

1. Ahmed E. (1985) Geomorphology, Kalyani Publishers, New Delhi.
2. Strahler A.N. (1968) The Earth Sciences, Harper & Row Intl. Edn, New York
3. Thornberry W.D. (1969) Principles of Geomorphology 2nd Edition, Wiley International Edn. & Wiley Eastern Reprints 1984.
4. Verstappen H. (1983) Applied Geomorphology, Geomorphological Surveys for Environmental Development, Elsevier, Amsterdam
5. Woodridge S.W and R.S. Morgan (1991) An Outline of Geomorphology, The Physical Basis of Geography, Orient Longman, Kolkata.
6. Dayal P. (1995) A Text Book of Geomorphology 2nd Edition. Sukla Book/Dept. Patna.
7. Homes A. (1965) Principles of Physical Geology, 3rd Edition, ELBSS Edn.
8. Goudie Anrew et.al. (1981) Geomorphological Techniques, George Allen & Unwin,London.
9. Bloom A.L. (1978) Geomorphology: A Systematic Analysis of Late Cenozoic Landforms Prentice Hall of India, New Delhi.
10. Brunsden D. (1985) Geomorphology in the Service of Man: The Future of Geography, Methnen, U.K.
11. Worcester P.G. (1965), A Text Book of Geomorphology, Can North and 2nd Edition, East West Edn. New Delhi.
12. William D. Thornbury(2004). Principles of Gomorphology, 2nd Edition, CBS Publisher and Distributor Pvt. Ltd, New Delhi
13. Vishwas S. Kale, Avijit Gupta (2018), Introduction to Geomorphology, Universities Press.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	-	-	-	-	-	-	2 (WK1, WK3, WK4, WK5, WK6)	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-	1 (WK1, WK3, WK4, WK5, WK6)	-
CO2	-	-	-	-	-	-	2 (WK1, WK3, WK4, WK5, WK6)	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-	2 (WK1, WK3, WK4, WK5, WK6)	-
CO3	-	-	-	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-	1 (WK1, WK3, WK4, WK5, WK6)	-
CO4	-	-	-	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-	2 (WK1, WK3, WK4, WK5, WK6)	-

CourseCode		:	BCVD605E	Advanced Concrete Technology	Semester	:	06
L:T:P		:	3:0:0		Course Type	:	PEC
Hours/Sem	Teaching	:	42Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42Hrs		SEE Marks	:	50
	Exam	:	06Hrs		Total Marks	:	100
	Total Hrs.	:	90Hrs		Credits	:	03

Professional Competency:

Advanced Concrete Technology trains students to master advanced mix designs, assess material durability, and apply innovative concrete solutions to real-world infrastructure challenges.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Apply basic knowledge to understand compound composition of cement, hydration and products of hydration, phases in concrete and factor affecting strength and modulus of concrete.

Apply basic knowledge to understand role of chemical and mineral admixtures and their effect on the strength and properties of concrete.

CO2: Design the process of mix proportioning for different grades of concrete as per IS: 10262-2009. Analyse the factors affecting durability by knowing the concepts of producing durable concrete structures.

CO3: Understand and assess new techniques in concrete production, leading to special concretes like RMC, FRC including materials used and properties.

CO4: Understand and assess new techniques in concrete production, leading to special concretes like High Density Concrete and High performance concrete, materials, properties and applications. Analyse Effect of end condition of specimen, capping, H/D ratio, rate of loading, moisture condition, compression tension and flexure tests. NDT tests concepts- Rebound hammer.

UNIT–I	11 Hrs.

Importance of Bogue's compounds, Structure of Hydrated cement paste, Volume of hydrated Product, transition zone, Factors affecting strength, Elastic modulus.

Chemical admixtures: Mechanism of chemical admixtures, Plasticizers and superplasticizers, effect on concrete properties, dosage of super plasticizers.

Mineral admixtures: Flyash, Silica fame, GBS and their effect on concrete properties.

UNIT–II	10 Hrs.

Mix Design: Factors affecting mix design, design of concrete mix by IS 10262:2009 and correct American and British methods.

Durability of concrete: Introduction, permeability of concrete, chemical attack, efflorescence, Alkali aggregate reaction. IS 456-2000 requirements.

UNIT-III	10 Hrs.

RMC Concrete- manufacture, concreting, placing, precautions, High volume fly ash concrete, self-compacting concrete concept, materials, properties and applications.

Fiber reinforced concrete- Fiber types and properties, Behaviors of FRC in compression, tension including pre-cracking stage and post cracking stages. Light weight concrete-materials, properties and types.

UNIT-IV	11 Hrs.

High Density concrete and High performance concrete, materials, properties and applications, typical mix.

Test on hardened concrete- Effect of end condition of specimen, capping, H/D ratio, rate of loading, moisture condition, compression tension and flexure tests. NDT tests concepts-Rebound hammer.

TextBooks:

1. M.S.Shetty Concrete Technology Theory and Practice, S.Chand and Co, New Delhi 2002
2. Concrete Technology A.R.SanthaKumar
3. Power T.C. ESFN, Properties of Fresh concrete, London 1969.
4. Code Book, IS: 10262:2009

ReferenceBooks:

1. P.K.Metha & PTM Monteiro Concrete- Microstructures properties and Materials (Special student edition by ICI Chennai) - PH

Table: Matrix to describe the mapping of Cos with Pos (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3, and WK4)	-	-	-	-	-	1	-	-	1	-	2
CO2	-	2 (WK1, WK2, WK3, and WK4)	3 (WK5)	-	3 (WK6)	1 (WK1, WK5 and WK7)	1 (WK9)	1	1	-	1 (WK8)	-	2
CO3	-	2 (WK1, WK2, WK3, and WK4)	3 (WK5)	-	3 (WK6)	1 (WK1, WK5 and WK7)	-	1	1	-	1 (WK8)	-	2
CO4	-	2 (WK1, WK2, WK3, and WK4)	2 (WK5)	-	-	1 (WK1, WK5 and WK7)	-	1	1	-	1 (WK8)	-	2

Course Code		:	**BCVE605E**	**GROUND IMPROVEMENT TECHNIQUES**	**Semester**	:	**06**
L:T:P		:	**3:0:0**		**Course Type**	:	**PEC**
Hours/Sem.	**Teaching**	:	**42 Hrs**		**CIE Marks**	:	**50**
	Learning (TW+SL)	:	**42 Hrs**		**SEE Marks**	:	**50**
	Exam	:	**06 Hrs**		**Total Marks**	:	**100**
	Total Hrs.	:	**90 Hrs**		**Credits**	:	**02**

Professional Competency:

Demonstrate the ability to investigate weak ground conditions, recommend suitable ground improvement techniques, and assess their effectiveness in enhancing the engineering properties of soil for infrastructure development.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Explain the need for ground improvement and select appropriate ground modification techniques based on soil conditions, site characteristics, and engineering requirements and apply mechanical ground improvement methods for improving soil performance.

CO2: Analyze and apply hydraulic ground improvement methods, including dewatering, preloading, and vertical drains, for improving soil performance.

CO3: Evaluate and design physical and chemical ground improvement measures, including soil stabilization and grouting techniques, for different geotechnical engineering applications.

CO4: Design reinforced earth systems, ground anchors, and soil nailing solutions by selecting suitable reinforcement materials and construction techniques for earth-retaining and foundation applications.

UNIT–I	**11Hrs.**

Need and objectives of Ground Improvement, Classification of Ground Modification Techniques – suitability and feasibility, Emerging Trends in ground improvement.
Mechanical Modification: Methods of compaction, Shallow compaction, Deep compaction techniques – Vibro-floatation, Blasting, Dynamic compaction, preloading and Precompression, sand compaction piles, Lab and Field compaction control.

UNIT–II	**10Hrs.**

Hydraulic Modification : Methods of dewatering – open sumps and ditches, Well-point system, Electro- osmosis, Vacuum dewatering wells;
pre-loading without and with sand drains, strip drains and rope drains, Design of prefabricated vertical drains.

UNIT-III	10 Hrs.
Physical And Chemical Modification: Stabilisation with admixtures like cement, lime, calcium chloride, fly ash, and bitumen; Grouting: Categories of grouting, Compaction and Consolidation Grouting, Art of grouting, Grout materials, Grouting techniques, and control.	
UNIT-IV	**11 Hrs.**
Reinforced Earth Technology: Concept of soil reinforcement, reinforcing materials, and Backfill criteria, Art of reinforced earth technology, Design and construction of reinforced earth structures. Ground Anchors and Soil Nailing: Types of ground anchors and their suitability, Uplift capacity of anchors; Soil nailing and Applications	

Textbooks:

1. Purushothama Raj., Ground Improvement Techniques, Laxmi Publications Pvt Ltd, 2nd edition, 2016.
2. M. R. Haussmann, Engineering principles of ground modification, McGraw Hill Education, new Delhi, India. 2013.
3. J. Han , Principles and Practice of Ground Improvement, Wiley Publishing, New Delhi, India 2018.
4. G. L.S. Babu , An Introduction to Soil Reinforcement and Geosynthetics",Universities Press Pvt. Ltd., New Delhi, India, 1st Ed .,2005.

Reference Books:

1. F. G., Bell, Engineering Treatment of Soils, CRC Press, UK, 1st Ed., 2019.
2. Peter G. Nicholson, Soil Improvement and Ground Modification Methods, Butterworth-Heinemann Publishing, UK, 1st Ed., 2014.

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3(WK3, WK4)	2(WK3, WK4)	1	-	-	1(WK7)	-	-	1	-	1(WK8)	-	3	-
CO2	3(WK3, WK4)	3(WK3, WK4)	2	2(WK8)	1	1(WK7)	-	-	1	-	1(WK8)	-	3	-
CO3	3(WK3, WK4)	3(WK3, WK4)	3	2(WK8)	1	2(WK7)	-	-	-	-	1(WK8)	-	3	-
CO4	3(WK3, WK4)	3(WK3, WK4)	3	2(WK8)	-1	2(WK7)	-	-	1	1	1(WK8)	-	3	-

Course Code		:	BCVB606N	DISASTER MANAGEMENT AND MITIGATION	Semester	:	03
L:T:P		:	3:0:0		Course Type	:	OEC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Ability to identify, assess, mitigate disaster and design effective disaster management plans and strategies at individual, instructional and community levels, aligning with national and global frameworks.

Course Outcomes:

After completion of the course, student will be able to:

CO1 : Explain the concepts of disaster management and disaster profile of India.

CO2 : Categorize the disasters and their causes.

CO3 : Predict the various impacts of disasters and their mitigation measures.

CO4 : Evaluate the significance of disaster management cycle along with role of various government and non-government organizations in disaster risk reduction.

UNIT–I	10 Hrs.

Introduction: Concepts and definitions: disaster, hazard, vulnerability, resilience, risks severity, frequency, capacity, impact, prevention, mitigation. India's natural disaster proneness and disaster prone zones.

UNIT–II	12 Hrs.

Disasters classification: Natural disasters (floods, draughts, cyclones, volcanoes, earthquakes, tsunamis. Landslides etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, transportation accidents, terrorist strikes, etc.).

UNIT-III	10 Hrs.

Disaster Impacts and Mitigation measures: Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters; mitigation measures and case studies of common disasters .

UNIT-IV	10 Hrs.

Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Importance of disaster education and community awareness and preparedness in disaster management. Roles and responsibilities of citizens, technology, media, community, government and non-government organizations in disaster management; Policies and legislation for disaster risk reduction; Disaster management system in India.

Reference Books:

1. R. Subramanian, 2021, Disaster Management, Vikas publishing house Pvt. Ltd., Noida, India.
2. A. K. Srivastava, 2021, Textbook of Disaster Management, Scientific publishers, India.
3. Tushar Bhattacharya, 2012, Disaster science and Management, Tata McGraw Hill publications, New Delhi, India.
4. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
5. Singh B.K., 2008, Handbook of Disaster Management: Techniques and Guidelines, Rajat Publication.
6. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation.
7. Jagbir Singh, 2007, Disaster Management, I.K International Publishing House, New Delhi.
8. Vinod K. Sharma, 2013,Disaster Management, second Edn., Scientific International Pvt. Ltd., New Delhi, India.
9. Carter. W. Nick, 1991, Disaster Management: A Disaster Manager's Handbook, Asia Development Bank, Manila.
10. Government of India website on Disaster Management: www.ndmindia.nic.in.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	-	-	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	1 (WK1, WK3, WK4, WK5, WK6)	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-	2 (WK1, WK3, WK4, WK5, WK6)	-
CO2	-	-	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	1 (WK1, WK3, WK4, WK5, WK6)	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-	2 (WK1, WK3, WK4, WK5, WK6)	-
CO3	-	-	-	-	-	2 (WK1, WK3, WK4, WK5, WK6)	2 (WK1, WK3, WK4, WK5, WK6)	-	-	-	-	-	2 (WK1, WK3, WK4, WK5, WK6)	-
CO4	-	-	-	-	-	-	1 (WK1, WK3, WK4, WK5, WK6)	-	1 (WK1, WK3, WK4, WK5, WK6)	1 (WK1, WK3, WK4, WK5, WK6)	-	-	2 (WK1, WK3, WK4, WK5, WK6)	-

Course Code		:	BCVC606N	PUBLIC HEALTH ENGINEERING	Semester	:	05
L:T:P		:	3:0:0		Course Type	:	OEC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Develop the knowledge and skills to plan, design, and manage water supply, wastewater, drainage in accordance with engineering standards and public health requirements. Apply sustainable engineering principles to protect public health, conserve environmental resources, and improve the quality of life in urban and rural communities.

Course Outcomes:

Course outcomes:

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

CO1 Estimate average and peak water demand for a community.

CO2 Evaluate water quality and environmental significance of various parameters and plan suitable treatment system.

CO3 Design the different units of water treatment plant

CO4 Understand and design the various units of wastewater treatment plant

UNIT-I	10 Hrs.

Introduction: Water: Need for protected water supply, Demand of Water: Types of water demands – domestic demand, industrial, institutional and commercial demand, public use and fire demand estimation, factors affecting per capita demand, Variations in demand of water, Peak factor. Numericals

Design period and factors governing design period. Methods of population forecasting and numerical problems. Physico-chemical characteristics of water ,Numerical

UNIT–II	10 Hrs.

Water Treatment: Objectives, Unit flow diagrams – significance of each unit, Aeration process Limitations and types, Sedimentation – Theory, settling tanks, types and design with numericals, Coagulation and flocculation, types of coagulants, Filtration: mechanism, theory of filtration, types of filters: slow sand, rapid sand and pressure filters. Operation and cleaning. Design of slow and rapid sand filter without under drainage system Numericals

UNIT–III	10Hrs.

Disinfection: Methods of disinfection with merits and demerits. Breakpoint of chlorination Softening: Lime soda and Zeolite process. Wastewater: Introduction: Need for sanitation, methods of sewage disposal, types

of sewerage systems, Treatment of municipal wastewater: Wastewater characteristics sampling, significance and techniques, physical, chemical and biological characteristics, Numericals on BOD
UNIT–IV **10 Hrs.**
Treatment Process: flow diagram for municipal wastewater treatment unit operations and process Screens: types, disposal. Grit chamber, oil and grease removal. primary and secondary settling tanks (no numerical), Suspended growth system – conventional activated sludge process and its modifications
Reference Books *
1. Howard S. Peavy, Donald R. Rowe, George T, "Environmental Engineering" - Tata McGraw Hill, New York, Indian Edition, 2013 2. S. K. Garg, Environmental Engineering vol-I, Water supply Engineering – M/s Khanna Publishers, New Delhi2010 3. B.C. Punmia and Ashok Jain, Environmental Engineering I-Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi2010. 4. B C Punmia, "Environmental Engineering vol-II", Laxmi Publications 2nd, 2016 5. Karia G.L., and Christian R.A, "Wastewater Treatment Concepts and Design Approach" , Prentice Hall of India Pvt. Ltd., New Delhi. 3rd, Edition, 2017 6. S.K.Garg, "Environmental Engineering vol-II, Water supply Engineering", Khanna Publishers, – New Delhi, 28th edition and 2017

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK2, WK3, and WK4)	2 (WK1, WK2, WK3, and WK4)	-	-	-	-	-	1	-	-	1	-		2
CO2	-	2 (WK1, WK2, WK3, and WK4)	3 (WK5)	-	3 (WK6)	1 (WK1, WK5 and WK7)	1 (WK9)	1	1	-	1 (WK8)	-		2
CO3	-	2	3	-	3	1	-	1	1	-	1	-		2

		(WK1, WK2, WK3, and WK4)	(WK5)		(WK6)	(WK1, WK5 and WK7)					(WK8)			
CO4	-	2 (WK1, WK2, WK3, and WK4)	2 (WK5)	-	-	1 (WK1, WK5 and WK7)	-	1	1	-	1 (WK8)	-		2

Course Code		:	BCVD606N	Occupational Health and Safety	Semester	:	06
L:T:P		:	3:0:0		Course Type	:	OEC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Identify workplace hazards, assess occupational risks, and implement health and safety practices in compliance with relevant standards and regulations.

Course Outcomes:

After completion of the course student will be able to

CO1: Ensure workplace safety by understanding occupational hazards, safety principles, OSHA regulations, accident causation, and investigation methods.

CO2: Apply ergonomic principles, fire safety measures, and electrical safety standards to prevent hazards.

CO3: Prevent disease transmission, utilize PPE, mitigate exposure effects, and develop environmental management plans for workplace safety.

CO4: Understand occupational health and safety in water treatment, construction material manufacturing, and construction sites, along with roles and responsibilities.

UNIT-I	10 Hrs.

Occupational Hazard and Control Principles: Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety.

Administration: Laws governing OSHA and right to know. Accident – causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation.

UNIT–II	11 Hrs.

Ergonomics at Workplace: Ergonomics Task analysis, Preventing Ergonomic Hazards, Workspace, Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. Hazard cognition and Analysis, Human Error Analysis, Fault Tree**.**

Analysis – Emergency Response - Decision for action – purpose and considerations, Fire Prevention and Protection, Electrical Safety, Product Safety.

UNIT–III	11 Hrs.

Health Considerations at Workplace: Types of diseases and their spread, Health Emergency. Personal Protective Equipment (PPE) – types and advantages, effects of exposure and treatment for engineering industries, Municipal solid waste.

Environment management plans (EMP) for safety and sustainability.

UNIT–IV	10 Hrs.

Occupational Health and Safety Considerations: Water and wastewater treatment plants,Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing, Policies, Roles and responsibilities of workers, managers, and supervisors.

Reference Books *

1. Goetsch D.L., (1999), “Occupational Safety and Heal th for Technologists, Engineers and Managers”, Pren tice Hall.
2. Heinrich H.W., (2007), “Industrial Accident Prevent ion - A Scientific Approach”,McGraw-Hill Book Company
3. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), “IndustrialSafety and Pollution Control Handbook
4. Colling D.A., (1990), “Industrial Safety Management and Technology”, Prentice Hall,New

Delhi.
5. Della D.E., and Giustina, (1996), “Safety and Environmental Management”, Van Nostr and Reinhold International Thomson Publishing Inc.

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1:	**3** (WK1, WK2, WK3)	**2** (WK1, WK2, WK3, WK4)	–	**2** (WK8)	–	**3** (WK1, WK5, WK7)	**2** (WK7)	**2**	–	**1**	–	**2**	**2**
CO2:	**2** (WK1, WK2)	**3** (WK1, WK2, WK3)	**2** (WK5)	**2** (WK8)	**2** (WK6)	**3** (WK1, WK5, WK7)	**2** (WK7)	**2**	**1**	**1**	–	**2**	**3**
CO3:	**2** (WK1, WK2)	**2** (WK1, WK2, WK3)	**2** (WK5)	**1** (WK8)	**1** (WK6)	**3** (WK1, WK5, WK7)	**3** (WK7)	**2**	**1**	**1**	**1**	**2**	**3**
CO4:	**2** (WK1, WK2)	**2** (WK1, WK2, WK3)	**1** (WK5)	–	–	**3** (WK1, WK5, WK7)	**3** (WK7)	**2**	**2**	**2**	**1**	**3**	**3**

Note:

If there is no mapping between a CO and a PO, indicate "–".

The WKs (Knowledge Profile elements) shown are indicative and should align with the relevant Program Outcomes addressed by each Course Outcome.

BASAVESHWAR ENGINEERING COLLEGE,BAGALKOTE

B.E. in Civil Engineering

Scheme of Teaching and Examinations 2022

Scheme of Teaching and Examinations2022 (2023-24 admitted Batch) 2026-27 Academic Year

VII SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical /	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	22UCV711C	Design of Steel Structures	TD: CV PSB: CV	3	0	0		03	50	50	100	3
2	HSSM	22UCV712C	Estimation and Contract Management	TD: CV PSB: CV	3	0	0		03	50	50	100	3
3	PEC	22UCV72XE	Professional Elective Course-3	TD: CV PSB: CV	3	0	0		03	50	50	100	3
4	PEC	22UCV73XE	Professional Elective Course-4	TD: CV PSB: CV	3	0	0		03	50	50	100	3
6	PROJ	22UCV714P	Major Project Phase-II	TD: CV PSB: CV	0	0	12		03	50	50	100	12
					12		12			250	250	500	24

Professional Elective Course -3

22UCV721E	Intelligent Transportation Systems	22UCV724E	**Deep Foundations**
22UCV722E	Earthquake Resistant Structures	22UCV725E	Advanced Design of RC Structures
22UCV723E	**Design of Prestressed Concrete Structures**	22UCV726E	**Pavement Design**

Professional Elective Course -4

22UCV731E	**Railway and Airport Engineering**	22UCV734E	**Numerical Techniques in Civil Engineering**
22UCV732E	Application of AI in Civil Engineering	22UCV735E	Precast Members – Systems & Construction
22UCV733E	Energy and Environment	22UCV736E	**Solid Waste Management**

BASAVESHWAR ENGINEERING COLLEGE,BAGALKOTE

B.E. in Civil Engineering

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Scheme of Teaching and Examinations2022 (2023-24 admitted Batch) 2026-27 Academic Year

VIII SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	AEC	22UCV81XE	Professional Elective (Online Courses)	TD: CV PSB: CV	3	0	0		03	50	50	100	**3**
2	OEC	22UCV8XXN	Open Elective (Online Courses)	TD: CV PSB: CV	3	0	0		03	50	50	100	**3**
3	INT	22UCV802I	Internship (Industry/Research) (14 - 15 Weeks)	TD: CV PSB: CV	0	0	10		03	50	50	100	**10**
					06	00	10			150	150	300	**16**

Professional Elective Course (Online courses)

22UCV811E	Deep Excavation and Tunnels	22UCV813E	Project management and finance
22UCV812E	Advanced Design of RCC Structures	22UCV814E	Metro and Seaports Engineering

Open Elective Courses (Online Courses)

22UCV8XXN	Energy Conservation in Buildings	22UCV8XXN	Green Buildings
22UCV8XXN	Occupational Health and Safety	22UCV8XXN	Integrated Building Services

Course Code		**:**	**22UCV711C**	**Design of Steel Structures**	**Semester**	**:**	**07**
L:T:P		**:**	**3:0:0**		**CourseType**	**:**	PCC
Hours/Sem.	**Teaching**	**:**	**42Hrs**		**CIEMarks**	**:**	**50**
	Learning (TW+SL)	**:**	**42Hrs**		**SEEMarks**	**:**	**50**
	Exam	**:**	**03Hrs**		**Total Marks**	**:**	**100**
	TotalHrs.	**:**	**90Hrs**		**Credits**	**:**	**03**

Professional Competency:

Apply the principles of limit state design to analyze and design steel structural members and connections in accordance with relevant design standards. Develop the ability to produce safe, economical, and efficient steel structural systems for practical engineering applications.

CourseOutcomes:

After completion of the course student will be able to

1. Knowledge of Limit state method. Different types of load and their combinations acting on steel structures. Exposure to various steel sections with different types of bolts available in the market highlighting the connections details
2. Knowledge of different types of welds and their connections. An approach to plastic analysis will lead in designing the steel sections with limit state approach.
3. Knowledge to design the tension member, lug angle, compression member, lacing and battens.
4. Knowledge to design different types of column bases including pedestal and also design the beam for given configuration.

UNIT–I	**10Hrs.**

Introduction: Advantages & Disadvantages of steel structures, Loads & Load combinations, Design considerations, Limit State method of design, Failure criteria for steel, codes, specifications and section classification.

Bolted Connections: Introduction, Behavior of bolted joints, design strength of ordinary black bolts, design of HSFG bolts, simple connections, moment resistant connections, beam to beam Connections.

UNIT–II	**10Hrs.**

Welded Connections: Introduction, welding process, advantages of welding, types and properties of welds, types of joints, weld symbols, weld specifications, effective area of welds, and design of welds, simple joints, moment resistant connections, and continuous beam to beam connections.

Plastic behavior of structural steel: Introduction, Plastic theory, plastic hinge concept, plastic collapse load, condition of plastic analysis, theorem of plastic collapse, methods of plastic analysis, plastic analysis of continuous beam.

UNIT-III	**12Hrs.**

Design of Tension members: Introduction, Types of tension members, Behavior of tension member, factors affecting the strength of tension member, design of tension member, Axially loaded tension members and their connections, Design of Lug angles, Design of truss ties and joints.

Design of Compression members: Introduction, failure modes, Behavior of compression member, sections used for compression members, effective length, design of compression members, Columns including built up sections Laced and Battened systems, Column splicing.

UNIT-IV	10Hrs.

Design of Column Bases: Design of slab base and gusted base.
Design of Beams: Introduction, beam types, factors affecting lateral stability of beams, behavior of simple and built up beams in bending(without vertical stiffeners), design strength of laterally Supported beams in bending, maximum deflection, design of beams and purlins.

TextBooks:

1. N. Subramanian , Design of Steel Structures, Oxford Publications, 2008
2. Ramachandra, Design of Steel Structures, Standard Book House, NewDelhi, 2016.
3. Duggal, S. K, Design of Steel Structure, Tata McGraw Hill Publications, 2017.

ReferenceBooks:

1. Punmia, B. C, Comprehensive Design of Steel Structures, Laxmi Publications, 2015.
2. Karve, Design of Steel Structures (Limit State Method), Structures Publications, Pune.
3. Bhavikatti S.S, Design of Steel Structures (Limit State Method), I K International
4. Publishing house Pvt. Ltd, 2012
5. IS-800-2007, Steel tables

Matrix to describe the mapping of Cos with Pos (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1	2	2						2	2	2	2
CO2	2	2	2	1	2	2						2	2	2	2
CO3	2	2	2	1	3	2						2	2	2	2
CO4	2	2	2	1	3	2						2	2	2	2

Course Code		:	22UCV712C	Estimating and Contract Management	Semester	:	07
L:T:P		:	3:0:0		Course Type	:	HSSM
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Apply standard methods of estimation, rate analysis, and cost estimation to prepare accurate estimates and tender documents for Civil Engineering projects.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Understand and apply various estimation methods (centre line, long & short wall) to prepare detailed and abstract estimates for civil engineering structures including buildings, masonry and RCC components.

CO2: Develop detailed specifications and perform estimation for structures like steel trusses, slab culverts, septic tanks and manholes, adhering to standard practices.

CO3: Carry out rate analysis for common construction works and compute earthwork quantities for roads using appropriate formulas for various terrains.

CO4: Demonstrate knowledge of tendering and contract procedures, departmental processes, billing, and valuation including legal and technical aspects related to civil engineering projects.

UNIT–I	10 Hrs.

Estimate: Different types of estimates, study of various drawing attached with estimates. Important terms, units of measurement, abstract, approximate methods of estimating building, cost from materials and labour equations recommended by CBRI examples.

Estimation: Methods of taking out quantities and cost centre line method, long and short wall method. Preparation of detailed and abstract estimates for the following Civil Engineering works Buildings Masonry structures and framed structures with flat, sloped RCC roofs. Building components (Beams, Columns and Column Footings, RCC Roof Slabs).

UNIT–II	11 Hrs.

Estimates: Steel truss (Fink and Howe truss), RCC Slab culverts, manhole and septic tanks.

Specifications: Definition of specifications, objective of writing specifications, essentials in specifications, general and details specifications of items.

UNIT-III	11 Hrs.
Rate analysis: Definition and purpose. Working out quantities and rates for the following standard items of works earth work in different types of soils, cement concrete of different mixes, bricks and stone masonry, flooring, plastering, RCC works, centring and form work for different RCC items, wood and steel works for doors, windows and ventilators. **Measurement of earthwork for roads:** Methods for computation of earthwork cross sections mid-section formula, trapezoidal or average end area or mean sectional are formula, Prismoidal formula for different terrains.	
UNIT-IV	**10 Hrs.**
Contract Management: Types of contracts, essentials of contract agreement, legal aspects, penal provisions on breach of contract. Types of tenders, two-bid system (technical bid + financial bid), e-tendering. Invitation to tender, Prequalification, administrative approval & Technical sanction. Contract Formulation: Letter of intent, Award of contract, letter of acceptance and notice to proceed. **Tender Process and Procedures:** Features of standard Tender document. Law of Contract as per Indian Contract act 1872, Types of Contract, Joint venture. Contract Forms: FIDIC contract Forms, CPWD, NHAI, NTPC, NHEPC. Notice Inviting Tender (NIT): essential contents, eligibility criteria, scope of work, time schedule, earnest money deposit (EMD), tender fee	
Text Books:	
1. Dutta, B. N., Estimating and costing in civil engineering, UBS Publishers, New Delhi. 2. Chakraborty, M., Estimating, costing, specification, and valuation in civil engineering, Chakraborty Publishing House. 3. S. C. Rangawala "Estimating, Costing and Valuation" 17th revised charotar publishing house ANAND, 2017 4. R. Ramanathan “Contract Management” KONARK PUBLISHERS PVT LTD New Delhi, 2002	
Reference Books:	
1) B. S. Patil “Civil Engineering Contracts and Estimates” Orient Longman, Mumbai, Ed.2010 ISBN: 9788173715594, 2) Estimating construction cost (fifth edition), Peurifoy, RobertL. Oberlender, Garold, McGraw Hill Education, New Delhi 3) Kohli, D. D. and Kohli, R. C., A textbook of estimating and costing including accounts and building bye-laws., S. Chand and company, New Delhi.	

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO 8**	**PO 9**	**PO1 0**	**PO11**	**PSO 1**	**PSO 2**	**3**
CO1	**3** (WK2, WK3, WK4)	**2** (WK2, WK3)	**1** (WK5)	–	**1** (WK6)	–	–	–	–	–	–	**3**	**2**	
CO2	**3** (WK3, WK4)	**2** (WK3)	**2** (WK5)	–	**2** (WK5, WK6)	–	**1** (WK7)	–	–	–	–	**3**	**2**	
CO3	**2** (WK2, WK3)	**3** (WK2, WK3, WK5)	**2** (WK5)	**1** (WK6)	**2** (WK6)	**1** (WK6)	**1** (WK7)	–	–	–	**1** (WK6)	**3**	**2**	
CO4	**2** (WK3)	**2** (WK6)	**2** (WK6)	–	**1** (WK6)	**2** (WK6, WK7)	**2** (WK7)	–	–	–	**2** (WK6, WK8)	**2**	**3**	

22UCV714P	Major Project Work	Credits: 12
L:T:P		CIEMarks:50
Total Hours/Week:		SEEMarks:50

Project Work

1) CIE- 50 Marks

CIE Marks to be awarded by Project Coordinator/ Faculty In-charge Departmental Committee (DC) will conduct the CIE examination.

2) SEE – 50 Marks

SEE Marks to be awarded by PEC members Project Evaluation Committee (PEC) will conduct the SEE examination.

3) Consolidated marks will be signed by Projector Coordinator and HOD

DC MEMBERS:

1. HOD or his Nominee
2. Guide
3. Project Coordinator

PEC MEMBERS:

1. Internal Examiner
2. External Examiner
3. HOD/ Nominee

Course Code		**:**	**22UCV721E**	**Intelligent Transportation Systems**	**Semester**	**:**	V
L:T:P*		**:**	**3 : 0 : 0**		**Course Type**	**:**	**PEC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs.**		**CIE Marks**	**:**	50
	Learning (TW+SL)	**:**	**42 Hrs.**		**SEE Marks**	**:**	50
	Exam	**:**	**06 Hrs.**		**Total Marks**	**:**	100
	Total Hrs.	**:**	**90 Hrs.**		**Credits**	**:**	03

Professional Competency:

Apply Intelligent Transportation Systems (ITS) technologies, data collection and analysis methods, traffic management strategies, public transport and vehicle safety applications, and automated enforcement systems to plan and develop safe, efficient, sustainable, and smart urban transportation systems.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Examine the various Technologies and methods of data collection for implementation of ITS.
CO2: Analyse and adopt a suitable type of traffic management system in urban area.
CO3: Justify the various applications of ITS in Public Transport System and vehicle safety systems.
CO4: Plan the application of ITS in law enforcement on traffic rules violation and apply the knowledge of ITS in developing Smart Cities.

Unit-I	**11 Hrs.**

Introduction to ITS: Urbanization, Transportation Issues, Need for Intelligent Transportation System (ITS), Challenges and opportunities in ITS, ITS-benefits and application areas, ITS Architecture, Data acquisition, Communication tools, Data analysis.

Detection and Sensing technologies: Building blocks of communication technologies, Telecommunication Technologies, Data and information processing technologies, Intrusive and Non-Intrusive detectors, Sensors, Bluetooth, RFID, Real time traffic monitoring, Smart Cards.

Unit-II	**11 Hrs.**

Traffic Management System Components: Objectives of Traffic management, ITS for traffic management, TMC, ATMS, ATIS, AVCS, APTS and CVO, Emergency management, Incident management, Urban road safety, ITS for intermodal freight transport.

Transport Demand Management: Applications of ITS for-Transport demand management

Unit-III	**10 Hrs.**

ITS for Public Transport: Use of GPS, APC, AVL, AVI, TSP, GIS, RTPI, Surveillance/CCTV/Security systems, ITS operations for Public Transport, Transport integrated Management solutions.

Advance Vehicle Control and safety Services (AVCS): AVCS systems, Emergency management, Information management, communications and information management. Case studies on Regional Integrated Transportation Information system.

Unit-IV	**10 Hrs.**

ITS Technologies for Vulnerable Road Users (VRU): Introduction, Need for VRU's safety, ITS technologies for VRU's.

ITS for Law Enforcement: Technologies to Support the Enforcement of Traffic Rules and regulations, Detection of Violations

ITS for Smart Cities: Strategies and approaches to Smart city, Smart Cities Mission and Guidelines, ITS solutions for Smart Cities, ITS Technologies for Smart City, Examples of Smart City Initiatives in India.

Text Books:	
1. R Srinivasa Kumar, “Intelligent Transportation Systems”, Universities Press, 1st Edition, 2022. 2. Pradip Kumar Sarkar and Amit Kumar Jain, “Intelligent Transport Systems”, PHI Learning, 1st Edition, 2017.	
Reference Books:	
1. Mashrur A Chowdhury and Adel W. Sadek, “Fundamentals of Intelligent Transportation Systems Planning”, Artech House, 1st Edition, 2003. 2. Sumit Ghosh and Tony S. Lee, “Intelligent Transportation Systems: New Principles and Architectures”, CRC Press, 1st Edition, 2000. 3. Amit Kumar Tyagi and Niladhuri Sreenath, “Intelligent Transportation Systems: Theory and Practice”, Springer Nature, 1st Edition, 2023.	

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	**3** (WK1, WK3, WK4)	**3** (WK2, WK3, WK4)	–	**2** (WK2, WK4, WK8)	**3** (WK6)	–	–	–	–	–	–	**2**	**3**
CO2	**2** (WK1, WK3, WK4)	**3** (WK2, WK3, WK4)	**3** (WK5)	**2** (WK8)	**3** (WK6)	**2** (WK1, WK5, WK7)	**2** (WK5, WK7)	**1** (WK9)	**1**	–	**1** (WK8)	**2**	**3**
CO3	**2** (WK1, WK3, WK4)	**2** (WK2, WK3, WK4)	**2** (WK5)	–	**3** (WK6)	**3** (WK1, WK5, WK7)	**2** (WK5, WK7)	**2** (WK9)	**1**	–	**1** (WK8)	**2**	**3**
CO4	**2** (WK1, WK3, WK4)	**3** (WK2, WK3, WK4)	**3** (WK5)	**2** (WK8)	**3** (WK6)	**3** (WK1, WK5, WK7)	**3** (WK5, WK7)	**3** (WK9)	**2**	**1**	**2** (WK8)	**3**	**3**

Course Code		**:**	**22UCV722E**	**EARTHQUAKE RESISTANT STRUCTURES**	**Semester**	**:**	**03**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PEC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Develop ability to assess seismic hazard and design earthquake resistant structures.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Explain earthquake fundamentals including seismic waves, plate tectonics, magnitude scales, intensity scales, and Indian seismic zones per IS 1893:2016; understand ground motion characteristics and seismic hazard assessment methodologies.

CO2: Model and Evaluate the response of a structure subjected to dynamic loads. Apply equivalent static method and response spectrum method for seismic load determination; calculate design forces for buildings per IS 1893:2016 provisions.

CO3: Assess damages to the buildings based on irregularities in plan, mass and stiffness and configure the building for seismic forces.

CO4: Design and detail the RC and masonry building for seismic forces as per the IS code provisions.

UNIT–I	**10 Hrs.**

Seismology and Ground Motion: Earth's internal structure, Plate Tectonics, lithospheric plates, plate boundaries (convergent, divergent, transform), earthquake; causes, types and terminologies. Seismic Waves: Body waves (P-waves and S-waves), surface waves (Rayleigh and Love waves). Earthquake Magnitude and intensity, structural damage correlation. Indian Seismic Zones: Seismic zones per IS 1893:2016, characterisation and terminologies.

UNIT–II	**12 Hrs.**

Structural Dynamics: Mathematical modelling; mass, stiffness and damping, degrees of freedom, SDOF and MDOF systems. Free, forced, damped and un-damped vibrations in a structural system. Equivalent spring, under damped, overdamped and critically damped systems. Evaluation of response of SDOF and MDOF (up to 3 degree only) systems subjected to free vibration, time period and mode shapes, concept of response spectrum. Calculate design seismic loads as per provisions of IS 1893. Numerical Problems.

UNIT-III	10 Hrs.
Seismic Performance of Buildings and Over View of IS-1893 (Part-1): Types of damages to building observed during past earthquakes; Plan irregularities; mass irregularity; stiffness irregularity; Concept of soft and weak storey; Torsional irregularity and its consequences; configuration problems; continuous load path; Architectural aspects of earthquake resistant buildings; Lateral load resistant systems. Seismic design philosophy; Structural modeling; Code based seismic design methods.	
UNIT-IV	**10 Hrs.**
Earthquake Resistant Analysis and Design of RC Buildings: Typical failures of RC frame structures, Ductility in Reinforced Concrete, Design of Ductile Reinforced Concrete Beams, Seismic Design of Ductile Reinforced Concrete column, Concept of weak beam-strong column, Detailing of Beam-Column Joints to enhance ductility, Detailing as per IS-13920. Retrofitting of RC buildings **Earthquake Resistant Design of Masonry Buildings:** Performance of Unreinforced, Reinforced, Infill Masonry Walls, Box Action, Lintel and sill Bands, elastic properties of structural masonry, lateral load analysis, Recommendations for Improving performance of Masonry Buildings during earthquakes; Retrofitting of Masonry buildings.	
Text Books:	
1. Pankaj Agarwal and Manish Shrikande, “Earthquake resistant design of structures”, PHI India. 2. S.K. Duggal, “Earthquake Resistant Design of Structures”, Oxford University Press 3. Anil K. Chopra, “Dynamics of Structures: Theory and Applications to Earthquake Engineering”, Pearson Education, Inc. 4. Earthquake-Resistant Design of Building Structures, by Dr. Vinod Hosur, Wiley India Pvt. Ltd. 5. T. K. Datta, “Seismic Analysis of Structures”, John Wiley & Sons (Asia) Ltd.	
Reference Books:	
1. Structural Dynamics: Theory and Computation by Mario Paz , William Leigh, Springer New York, NY. 2. Clough, R. W., & Penzien, J. (2003). Dynamics of Structures (3rd ed.). Computers & Structures. 3. Mechanical Vibrations Fifth Edition Singiresu S. Rao University of Miami, Prentice Hall. 4. C. V. R. Murty, Rupen Goswami, A. R. Vijayanarayanan & Vipul V. Mehta, “Some Concepts in Earthquake Behaviour of Buildings”, Published by Gujarat State Disaster Management Authority, Government of Gujarat. 5. IS-13920 – 2016, Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, BIS, New Delhi. 6. IS-1893 – 2016, Indian Standard Criteria for Earthquake Resistant Design of Structures, Part-1, BIS, New Delhi.	

7. IS- 4326 – 2013, Earthquake Resistant Design and Construction of Buildings, BIS, New Delhi.
8. IS-13828 – 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings, BIS, New Delhi.
9. IS-3935 – 1993, Repair and Seismic Strengthening of Buildings-Guidelines, BIS, New Delhi.

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3 (WK1, WK3, WK4, WK6)	2 (WK1, WK3, WK4, WK6	- (WK1, WK3, WK4, WK6	2 (WK1, WK3, WK4, WK6	- -	- -	- -	- -	- -	- -	- -	1 (WK1, WK3, WK4, WK6)	2 (WK1, WK3, WK4, WK6)	- -
CO2	2 (WK1, WK2, WK3, WK4, WK6)	2 (WK1, WK2, WK3, WK4, WK6)	2 (WK1, WK2, WK3, WK4, WK6)	2 (WK1, WK2, WK3, WK4, WK6)	3 (WK1, WK2, WK3, WK4, WK6)	- -	1 (WK1, WK2 WK3, WK4, WK6)	-	- -	-	- -	2 (WK1, WK2, WK3, WK4, WK6)	2 (WK1, WK2, WK3, WK4, WK6)	- -
CO3	2 (WK1, WK3, WK4, WK6)	3 (WK1, WK3, WK4, WK6)	2 (WK1, WK3, WK4, WK6)	3 (WK1, WK3, WK4, WK6)	2 -	1 -	2 -	-	- -	- -	- -	2 (WK1, WK3, WK4, WK6)	2 (WK1, WK3, WK4, WK6)	- -
CO4	3 (WK1, WK2, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4, WK5, WK6)	3 (WK1, WK3, WK4, WK6)	- -	- -	- -	- -	- -	- -	- -	2 (WK1, WK3, WK4, WK6)	2 (WK1, WK3, WK4, WK6)	- -

Course Code		:	22UCV723E	DESIGN OF PRE-STRESSED CONCRETE STRUCTURES	semester	:	07
L:T:P		:	3 : 0: 0		Course Type	:	PEC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs	:	90 Hrs		Credits	:	03

UNIT-I — **12 Hrs**

Materials: High strength concrete and steel, stress-strain characteristics and properties.

Basic Principles of Prestressing : Fundamentals, Load balancing concept, stress concept, centre of thrust, pre-tensioning and post-tensioning systems, tensioning methods and end anchorages.

UNIT–II — **10 Hrs.**

Analysis of sections for flexure: Stresses in concrete due to prestress and loads, stresses in steel due to loads, cable profile.

Losses of prestress: Various losses encountered in pretensioning and post tensioning methods, determination of jacking force.

UNIT–III — **10 Hrs.**

Deflections: Prediction of short term and long term deflections of un-cracked members.

Limit State of collapse and serviceability: I.S. code recommendations-ultimate flexural and shear resistance of sections, shear reinforcement, Limit state of serviceability-control of deflections and cracking.

UNIT–IV — **10 Hrs.**

Design of End blocks: Transmission of Prestressing pre-tensioned members, transmission length, and anchorage stress in post-tensioned members, bearing stress and bearing tensile stress in end block, Methods, I.S. code provision for the design of end block reinforcement.

Design of Beams: Design of pretensioned and post-tensioned symmetrical sections, permissible stress, design of Prestressing force and eccentricity.

Reference Books *

1. N.KrishnaRaju,Prestressed Concrete Design, McGrawHill Publications, 6th edition, 2018.
2. P.Dayaratnam, Prestressed Concrete Design, Medtech publishers, 7th edition,2017.
3. N. Rajgopalan, Prestressed Concrete Design, Narosa Publishers 2nd edition,2010.
4. E.G. Nawy, Prestressed Concrete Design,Pearson publication, 2nd edition, 1995.

Code Book.

IS 1343: 2012 (Code of Practice for Prestressed Concrete).

Course Outcomes**

After completion of the course student will be able to

1. Remember and recall materials used in PSC, their characteristics and basic principles of prestressing including pretensioning and posttensioning constructions.
2. Apply basic engineering principles to evaluate stresses due to loads in concrete and steel under flexure and shear.
3. Understand concepts and analyze the different losses and evaluate losses of prestress and deflections.
4. Understand the concepts and apply them to evaluate / estimate the ultimate resistance capacity of PSC members in flexure and shear.

COURSE ARTICULATION MATRIX

Course Outcomes	**Programme Outcomes**											**Programme Specific Outcomes**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	3 (WK 1,2 3, 4, 6	2(WK 1. 2, 3, 4, 8	1(WK 3, 4, 6)	-								3(WK 1, 3, 6)	1(WK 2, 3, 4,6)	2(WK 1. 2, 3, 4, 8)
CO2	3(WK1, 2, 6, 7,)	3(WK 1, 2, 6, 7,)	2(WK 1. 2, 3, 4, 8)	1(WK 2, 3, 4,6)								3(WK 1, 3, 6)	1(WK 2, 3, 4,6)	2(WK 1. 2, 3, 4, 8)
CO3	3(WK 1, 3, 6)	3(WK 1, 3, 6	3(WK 1, 3, 6	2(WK 1. 2, 3, 4, 8)								3(WK 1, 3, 6)	1(WK 2, 3, 4,6)	2(WK 1. 2, 3, 4, 8)
CO4	3(WK 1, 3, 6	3(WK 1, 3, 6)	3(WK 1, 3, 6)	2(WK 1. 2, 3, 4, 8)	1(WK 2, 3, 4,6)							3(WK 1, 3, 6)	3(WK 1, 3, 6)	2(WK 1. 2, 3, 4, 8)
Average														

Course Code		**:**	**22UCV724E**	**Deep Foundations**	**Semester**	**:**	**07**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PEC**
Hours/Sem.	**Teaching**	**:**	**42Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90Hrs**		**Credits**	**:**	**03**

Professional Competency:

Apply geotechnical engineering principles to analyze, design, and evaluate deep foundation systems, including pile foundations, well foundations, caissons, and foundations on expansive soils, ensuring safe, stable, and economical foundation solutions for civil engineering structures.

Course Outcomes:

CO1: Understand the necessity and Classify pile foundations and evaluate the axial load-carrying capacity of single piles using static equations, dynamic formulas, pile load tests, and negative skin friction analysis.

CO2: Analyze pile group efficiency, determine load distribution on vertical and inclined piles, and evaluate the lateral resistance, deflection, and construction of under-reamed piles.

CO3: Analyze the components, design criteria, and forces acting on well foundations and caissons, and evaluate construction methods, advantages, and remedies for tilts and shifts.

CO4: Understand expansive soil behavior and machine foundation types, design criteria, treatments, and Dynamic considerations.

UNIT–I	**11 Hrs.**

Introduction to Foundation Engineering: Necessity, classification, Shallow Vs Deep foundation.

Pile Foundation: Pile classification based on their friction, composition and Method of installation. Axial load carrying capacity of single pile by different methods: By use of Static bearing capacity equations and dynamic formulae. Pile load tests and Negative skin friction.

UNIT–II	**10 Hrs.**

Pile group: Group efficiency, Problems related to load on each pile: Pile group with vertical and inclined piles (Culman's graphical method- no problems). Laterally loaded vertical piles: Pile resistance and deflection under lateral loads, elastic method and Under-reamed piles: construction stages.

UNIT–III	**11 Hrs.**

Well Foundations & Caissons: Introduction, Different shapes and characteristics of wells. Components of well foundation. Forces acting on well foundation. Sinking of wells. Causes and remedies of tilts and shifts. Drilled Piers & Caissons: Introduction, construction, advantages and disadvantages of drilled piers. Design of open, pneumatic and floating caissons. Advantages and disadvantages of floating caissons.

UNIT–IV	**10 Hrs.**

Foundations on expansive soils: Introduction, Definition, Identification, Mineral Structure, Index properties of expansive soils, Swell potential and swell pressure, Free swell, CNS layer, foundation treatment for structures in expansive soil.

Machine Foundations: Introduction, Types of Machine foundations, basic definitions, degree of freedom of a block foundation, general criteria for design of machine foundation.

Text Books:

1. Dr. Satyendra Mittal, "Pile Foundation Design and Construction", CBS Publishers Pvt. Ltd., (5^{th} Edition) 2025.
2. B. C. Punmia, Ashok K. Jain and Arun K. Jain, "Soil Mechanics and Foundation Engineering", Laxmi Publications Co., New Delhi, (17^{th} Edition) 2017.
3. G. Ranjan and A.S.R Rao. "Basic and Applied Soil Mechanics" New Age International (P) Ltd., New Delhi, (5^{th} Edition) 2022.
4. Davis and Poulus, "Pile Foundation Analysis and Design", Johniley & Sons Inc, 1980.
5. P. Purushotham Raj, "Soil Mechanics and Foundation Engineering", Dorling kidersley, pvt, Ltd. (2^{nd}Edition) 2013

Reference Books:

1. Dr. C. Venkataramaiah, "Geotechnical Engineering" (4^{th} Edition), New age Publications 2010.
2. Dr. P. C. Varghese, "Foundation Engineering", Prentice Hall of India 2005.
3. Braja M. Das, "Principles of Foundation Engineering", (8^{th} Edition) Cengage India Pvt. Ltd. 2017.
4. V.N.S. Murthy "Soil Mechanics and Foundation Engineering" UBS Publishers and Distributors, New Delhi, 4^{th} Ed., 2018.

Table5: Matrix to describe the mapping of Cos with Pos (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**
CO1	**3** (WK3, WK4)	**3** (WK3, WK4)	**2** (WK5)	**2** (WK2, WK5)	**2** (WK6)	**-**	**-**	**-**	**-**	**-**	**1** (WK8)	**3**	**2**
CO2	**2** (WK3)	**3** (WK3, WK4)	**3** (WK5)	**2** (WK5)	**3** (WK6)	**1** (WK5 WK7)	**1** (WK9)	**-**	1	**-**	**1** (WK8)	**3**	**2**
CO3	**2** (WK3)	**3** (WK3, WK4)	**3** (WK5)	**2** (WK5)	**3** (WK6)	**2** (WK5, WK7)	**1** (WK9)	**-**	**1**	**-**	**1** (WK8)	**3**	**2**
CO4	**3** (WK3, WK4)	**3** (WK3, WK4)	**2** (WK5)	**2** (WK2, WK5)	**3** (WK6)	**1** (WK5, WK7)	**1** (WK9)	**-**	**-**	**-**	**1** (WK8)	**3**	**2**

Course Code		:	22UCV725E	Advanced Design of RC Structures	Semester	:	07
L:T:P		:	3:0:0		CourseType	:	PEC
Hours/Sem.	Teaching	:	42Hrs		CIEMarks	:	50
	Learning (TW+SL)	:	42Hrs		SEEMarks	:	50
	Exam	:	03Hrs		Total Marks	:	100
	TotalHrs.	:	90Hrs		Credits	:	03

Professional Competency:

Apply advanced reinforced concrete design principles to analyze and design complex RC structural elements in accordance with relevant design codes. Develop the ability to produce safe, durable, and economical reinforced concrete structures for practical engineering applications.

CourseOutcomes:

After completion of the course student will be able to

1. Students will analyze and design the combined footing.
2. Student will understand the design and solving technique of retaining walls.
3. Students will analyze and design the portal frames.
4. Students will design water tanks.

UNIT–I	10Hrs.

Design of combined footing:
a) Slab and Beam type - Equal loading.
b) Slab and Beam type - Unequal loading.

UNIT–II	10Hrs.

Design of Retaining Wall(RW):
a) Cantilever Retaining Wall.
b) Counter fort Retaining Wall

UNIT-III	12Hrs.

Portal Frames:(Single Bay and Single Storey)
a) Fixed Base.
b) Hinge Base

UNIT-IV	10Hrs.

Design of Water Tanks:(Resting on Ground):
a) Circular tanks (Flexible Base).
b) Rectangular tanks.

TextBooks:

1. Unnikrishnan and Devadas Menon, Design of reinforced concrete structures, PHI, New Delhi. 2013.
2. Karve S.R. and Shah V.L, Limit state theory and design of reinforced concrete, Vidyarthi prakashan, Pune. 2017.
3. A.K.Jain,Limit state method of design, Nemchand and Bros,Roorisee. Jan2012.

4. Parkand Paulay, Reinforced Concrete, John Wiley & Sons. 1975.

ReferenceBooks:

1. Kongand Evans. Reinforced and prestressed concrete, ELBS, London
2. H. J. Shah, Reinforced concrete Vol. I, Charotor Publishing House, Anand. Jan2016.
3. IS: 456-2000, SP-24, SP-16. IS: 3370 Part I, II, III and IV.
   (Note: Use of IS:456-2000 is permitted and SP-16 to be used in design of columns only)

Matrix to describe the mapping of Cos with Pos (considering WKs) and PSOs

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1								2	2	2	
CO2	3	2	2	1								2	2	2	
CO3	3	2	2	1								2	2	2	
CO4	3	3	3	1								2	2	2	

22UCV726E	Pavement Design	Credits: 3
L:T:P - 3 : 0: 0		CIEMarks:50
Total Hours/Week: 3		SEEMarks:50

UNIT-I	11 Hrs.
Introduction: Desirable characteristics of pavement, Types and components, Difference between Highway pavement and Air field pavement, Design strategies of variables, Functions of sub grade, sub base, Base course, surface course, comparison between Rigid and flexible pavement Fundamentals of Design of Pavements: Stresses and deflections, Principle, Assumptions and Limitations of Boussinesq's theory, Burmister theory and problems on above.	
UNIT–II	**10 Hrs.**
Design Factors: Design wheel load, contact pressure, Design life, Traffic factors, climatic factors, Road geometry, Subgrade strength and drainage, ESWL concept Determination of ESWL by equivalent deflection criteria, Stress criteria, EWL concept, and problems on above. Flexible pavement Design: Assumptions, Mcleod Method, Kansas method, CBR method, IRC Method (old), CSA method using IRC-37-2001, 2012 problems on above.	
UNIT–III	**10 Hrs.**
Flexible Pavement Failures, Maintenance and Evaluation: Types of failures, Causes, Remedial/Maintenance measures in flexible pavements, Functional Evaluation by Visual inspection and unevenness measurements, Structural evaluation by Benkelman beam deflection method, Falling weight deflectometer, GPR method. Design factors for runway pavements, Design methods for Airfield pavement and problems on above.	
UNIT–IV	**11 Hrs.**
Stresses in Rigid Pavement: Types of stress, Analysis of Stresses, Westergaard's Analysis, Modified Westergaard equations, Critical stresses, Wheel load stresses, Warping stress, Frictional stress, combined stresses (using chart / equations), problems on above. **Design of Rigid Pavement:** Design of CC pavement by IRC: 58-2002 for dual and Tandem axle load, Reinforcement in slabs, Design of Dowel bars, Design of Tie bars. **Rigid Pavement Failures, Maintenance and Evaluation:** Types of failures, causes, remedial/maintenance measures in rigid pavements.	

Reference Books *

1. S K Khanna, C E G Justo, and A Veeraragavan, "Highway Engineering", Nem Chand & Brothers
2. L.R Kadiyali and Dr.N.B. Lal, "Principles and Practices of Highway Engineering", Khanna publishers
3. Yang H. Huang, "Pavement Analysis and Design", University of Kentucky
4. Yoder & wit zorac, "Principles of pavement design", John Wiley & Sons.
5. Subbarao's, "Principles of Pavement Design" .
6. R Srinivasa Kumar, "Pavement Design", University Press.
7. Relevant recent IRC codes

Course Outcomes**

After completion of the course student will be able to

1. Systematically generate and compile required data for design of pavement (Highway & Airfield).

2. Analyze stress, strain and deflection by boussinesq's, bur mister's and westergaard's theory.

3. Design rigid pavement and flexible pavement conforming to IRC58-2002 and IRC37-2001.

4. Evaluate the performance of the pavement and also develops maintenance statement based on site specific requirements

***Books to be listed as per the format with decreasing level of coverage of syllabus**

****** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	**Programme Outcomes (POs)**											**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	2	3	2	-	2	2	-	-	-	-	-	**1**		
CO2	3	2	3	-	2	1	-	-	-	-	-		**1**	
CO3	3	2	3	-	3	-	-	-	1	-	-	**1**		
CO4	2	1	1	-	2	1	-	-	1	-	-			**1**

22UCV731E	ROAD SAFETY ENGINEERING	Credits: 3
L:T:P - 3 : 0: 0		CIEMarks:50
Total Hours/Week: 3		SEEMarks:50

UNIT-I	10 Hrs.
Accident Investigations And Risk Management: Collection Of Accident Data, Assessment Of Road Safety, Methods To Identify And Prioritize Hazardous Locations And Elements, Determine Possible Causes Of Crashes, Crash Reduction Capabilities And Countermeasures, Effectiveness Of Safety Design Features, Accident Reconstruction, Condition And Collision Diagram.	
UNIT–II	**10 Hrs.**
Traffic Engineering Studies: Regression Methods, Poisson Distribution, Chi-Squared Distribution, Statistical Comparisons-Traffic Management Measures And Their Influence On Accident Prevention.	
UNIT–III	**10 Hrs.**
Road Safety In Transport Planning And Geometric Design: Vehicle And Human Characteristics, Road Design And Safety Elements, Redesigning Junctions, Cross Section Improvements, TrafficControl, TrafficCalmingMeasures, Road SafetyFurniture	
UNIT–IV	**10 Hrs.**
Role Of Signs And Markings In Safety: Types Of Signs– Design Specifications– Guidelines For Installation– Role Of Signs In Safety; Types Of Road Markings–Design Specifications–Role Of Road Markings In Safety. **Traffic Management Systems For Safety:** Road Safety Audits And Tools For Safety Management Systems, RoadSafetyAudit Process, RoadSafety Improvement Strategies, ITS And Safety	

Reference Books *

1. Traffic Engineering And TransportationPlanning– L.R.Kadiyali,KhannaPublishers
2. FundamentalsOfTransportationEngineering-C.S.Papacostas,PrenticeHall India.
3. Transportation Engineering–An Introduction, C. JotinKhisty, B.Kent Lall
4. Fundamentals Of TrafficEngineering, RichardoGSigua
5. Handbook Of Road Safety Measures, Second Edition, Rune Elvik, Alena Hoye, Truls Vaa, Michael Sorenson Road SafetyByNCHRP

Course Outcomes**

After completion of the course student will be able to

1. Analyse road safety data, identify hazardous locations, and assess safety risks on roadways.
2. Evaluatetheeffectivenessofroadsafetyinterventionsandconductpost-implementationanalysis.
3. Utilizemodellingandsimulationtechniquestopredictandassesstheimpactofroadsafetymeasures.
4. Demonstrateknowledgeoftrafficcontroldevices,trafficmanagementstrategies,andtheirrole in enhancing road safety.
5. Comprehendthelegalandpolicyframeworkrelatedtoroadsafetyengineeringandcontributetopolicydevelopment.

Course Objectives

- To provide students with a comprehensive understanding of the principles, strategies, and techniques related to ensuring safety on roadways.

- To equip students with the knowledge and skills necessary to analyse road safety issues
- To design effective road safety measures, and contribute to the improvement of road safety practices.

***Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	1			**2**		2					**1**	**1**		
CO2		1											**1**	
CO3	1		1											**1**
CO4		1		**2**		2		**1**					**1**	

22UCV732E	Application of AI in Civil Engineering	Credits: 03
L:T:P-3: 0:0		CIE Marks:50
Total Hours/Week:3		SEE Marks:50

UNIT-I	10 Hrs.

Fundamentals of Artificial Intelligence in Civil Engineering : Introduction to Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL). AI applications in Civil Engineering. Data collection, preprocessing and visualization. Types of learning: Supervised, Unsupervised and Reinforcement Learning. Introduction to Neural Networks. AI ethics, responsible AI, data privacy and bias. Industry 4.0 and Digital Transformation in Construction

UNIT–II	10 Hrs.

AI Applications in Civil Engineering Design and Construction: AI in Structural Engineering: Load prediction, damage detection, optimization. AI in Geotechnical Engineering: Soil classification and foundation analysis. AI in Transportation Engineering: Traffic prediction and intelligent transportation systems. AI in Water Resources Engineering: Flood forecasting and water demand prediction. AI in Construction Management: Project scheduling, cost estimation, quality control and safety monitoring. Computer Vision and Drone-based inspection. Building Information Modelling (BIM) and Digital Twin.

UNIT–III	10 Hrs.

AI for Smart Infrastructure and Asset Management: Structural Health Monitoring using AI. Internet of Things (IoT) and Smart Sensors. Predictive Maintenance. Smart Cities and Intelligent Infrastructure. AI for Energy-efficient Buildings. Remote Sensing and GIS applications. Risk assessment and disaster management using AI. Case studies in civil infrastructure

UNIT–IV	10 Hrs.

AI Tools, Emerging Trends and Case Studies : AI tools for Civil Engineering: Python basics, Google Colab, TensorFlow overview, Scikit-learn overview. Generative AI for engineering documentation and report generation. Large Language Models (LLMs) in engineering workflows. AI-assisted design optimization. Explainable AI and ethical AI practices. Future trends: Autonomous construction, robotics, digital twins, generative design. Industrial case studies and real-world applications

Reference Books *

Textbooks

1. Stuart Russell & Peter Norvig, **Artificial Intelligence: A Modern Approach**, 4th Edition, Pearson.
2. Aurélien Géron, **Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow**, O'Reilly.
3. Ethem Alpaydin, **Introduction to Machine Learning**, MIT Press.
4. Ian Goodfellow, Yoshua Bengio & Aaron Courville, **Deep Learning**, MIT Press.
5. Pedro Domingos, **The Master Algorithm**, Basic Books.

Civil Engineering & AI References

6. The Institution of Civil Engineers (ICE), **Artificial Intelligence in Civil Engineering**.
7. **ASCE Manual of Practice** on Digital Engineering and Smart Infrastructure.
8. Bentley Systems – Digital Twin and Infrastructure AI Documentation.
9. Autodesk BIM and Construction Cloud AI Resources.
10. BuildingSMART International – BIM Standards.

Software & Learning Resources

11. Python (NumPy, Pandas, Matplotlib, Scikit-learn).

12. Google Colaboratory.
13. TensorFlow and Keras Documentation.
14. OpenCV for Computer Vision.
15. QGIS and Google Earth Engine (Introductory Applications).
16. Roboflow (Image Annotation and Vision AI).
17. Kaggle Datasets for Civil Engineering.
18. OpenStreetMap and government open-data portals.

Course Outcomes**

After completion of the course student will be able to

CO1: Explain the fundamentals of Artificial Intelligence, Machine Learning, and their relevance to Civil Engineering applications.

CO2: Apply AI techniques and modern digital technologies to solve problems in structural, geotechnical, transportation, water resources and construction engineering.

CO3: Analyze smart infrastructure systems using AI-based monitoring, predictive maintenance, IoT and data-driven decision-making techniques.

CO4: Evaluate AI tools and emerging technologies for engineering analysis, optimization and sustainable infrastructure development while considering ethical and societal aspects.

CO–PO Mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	–	2	–	1	2	–	–	–
CO2	2	3	3	2	3	2	2	1	2	1	2
CO3	2	3	2	3	3	2	2	2	2	1	2
CO4	2	3	3	3	3	2	2	3	1	2	2

CO–PSO Mapping

Course Outcomes	PSO1	PSO2	PSO3
CO1	2	3	2
CO2	3	3	2
CO3	2	3	3
CO4	2	3	3

*Books to be listed as per the format with decreasing level of coverage of syllabus
** Each CO to be written with proper action word and should be assessable and quantifiable

Course Outcomes	Programme Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															

Course Code		**:**	**22UCV733E**	**Energy and Environment**	**Semester**	**:**	**02**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PEC**
Hours/Sem	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Apply the principles of energy management and environmental sustainability to analyze, design, and recommend sustainable engineering solutions for civil infrastructure while addressing climate change challenges.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Explain the fundamentals of energy resources, environment, and sustainability.

CO2: Analyze conventional and renewable energy systems and their environmental impacts.

CO3: Assess pollution, climate change & resource management using sustainable engineering principles.

CO4: Recommend energy-efficient and sustainable solutions for buildings and infrastructure

UNIT–I	**11 Hrs.**

Fundamentals of Energy and Environment: Introduction to energy and environment, energy resources and classification, conventional and renewable energy resources, Earth's energy system, energy demand and consumption trends, energy security.

Sustainability and Environmental Protection: Environmental components, ecosystem and ecological balance, natural resource depletion, environmental degradation, sustainable development, Sustainable Development Goals (SDGs), role of civil engineers in energy conservation and environmental protection.

UNIT–II	**10 Hrs.**

Renewable Energy Systems: Solar energy systems, wind energy, hydropower, biomass energy, geothermal energy, hydrogen energy, energy storage systems.

Energy Efficiency and Green Buildings: Energy conservation principles, energy auditing, energy efficiency in buildings, energy-efficient construction materials, passive solar design, green building concepts, green building rating systems (GRIHA, LEED and IGBC), net-zero energy buildings, applications in civil engineering: Case studies.

UNIT-III	10 Hrs.

Pollution and Climate Change: Air pollution, water pollution, soil pollution and noise pollution, sources and effects of environmental pollution, greenhouse gases and greenhouse effect, global warming, climate change, ozone layer depletion.

Environmental Management Tools: Carbon footprint and carbon sequestration, Environmental Impact Assessment (EIA), Life Cycle Assessment (LCA), solid waste management, construction and demolition waste management, circular economy principles, mitigation and adaptation strategies, case studies.

UNIT-IV	11 Hrs.

Sustainable Infrastructure: Sustainable infrastructure concepts, climate-resilient infrastructure, sustainable urban planning, smart cities, water conservation and rainwater harvesting, energy-water nexus, Environmental Management Systems (ISO 14001), environmental laws and regulations.

Climate Change Mitigation and Professional Responsibility: Carbon credits and carbon trading, National Action Plan on Climate Change (NAPCC), Paris Agreement, role of the Intergovernmental Panel on Climate Change (IPCC), environmental ethics, sustainable engineering practices in civil engineering, case studies on sustainable infrastructure projects.

Text Books:

1. Richard Wolfson, **Energy, Environment and Climate**, W. W. Norton & Company, 2nd Edition, 2018.
2. Peter E. Hodgson, **Energy, the Environment and Climate Change**, Imperial College Press, 2010.
3. Ravindranath N.H. and Ostwald M., **Energy and Environment**, Oxford University Press, Latest Edition.
4. Boyle G., **Renewable Energy: Power for a Sustainable Future**, Oxford University Press, 4th Edition, 2021.

Reference Books:

1. Twidell J. and Weir T., **Renewable Energy Resources**, Routledge, 4th Edition, 2021.
2. Cengel Y. A. and Turner R. H., **Fundamentals of Thermal-Fluid Sciences**, McGraw Hill, Latest Edition.
3. Frank T. Princiotta, **Global Climate Change: The Technology Challenge**, Springer, Latest Edition.
4. Charles J. Kibert, **Sustainable Construction: Green Building Design and Delivery**, Wiley, 5th Edition, 2022.
5. IPCC, **Climate Change Assessment Reports**, Latest Edition.

Question paper pattern for SEE

1. Total of Eight Questions with two from each unit to be set uniformly covering the entire syllabus.
2. Each Question should not have more than four sub divisions.
3. Any FIVE Full questions are to be answered choosing at least one from each unit.

Web Links and e-Resources

1. IPCC – https://www.ipcc.ch
2. Ministry of New and Renewable Energy (MNRE) – https://mnre.gov.in
3. Bureau of Energy Efficiency (BEE) – https://beeindia.gov.in
4. Central Pollution Control Board (CPCB) – https://cpcb.nic.in
5. GRIHA Council – https://www.grihaindia.org
6. IGBC – https://igbc.in
7. NPTEL Courses

- Energy Resources and Technology
- Environmental Engineering
- Climate Change
- Sustainable Development

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											Program Specific Outcomes (PSOs)	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3 (WK1, WK3)	2 (WK2, WK3)	-	-	-	1 (WK1)	-	-	-	-	1	1	1
CO2	2 (WK3)	3 (WK3)	2 (WK5)	-	2 (WK6)	2 (WK5)		-	1	-	1	2	2
CO3	2 (WK3)	3 (WK5)	2 (WK5)	2 (WK6)	2 (WK6)	3 (WK5, WK7)	-	-	1	-	1	3	2
CO4	2 (WK3)	2 (WK5)	3 (WK5)	-	2 (WK6)	3(WK5, WK7)	-	-	1	-	1	3	3

Course Code		**:**	**22UCV734E**	**Numerical Techniques in Civil Engineering**	**Semester**	**:**	**07**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PEC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Develop the competency to formulate and solve civil engineering problems using appropriate numerical methods for engineering analysis and design.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Solve linear systems of equations related to civil engineering problems using Gauss elimination, Gauss-Seidel, Gauss-Jordan matrix inversion, and Cholesky decomposition methods. Evaluate air pollutant dispersion in the atmosphere and develop air quality models.

CO2: Determine the roots of nonlinear algebraic and transcendental equations in civil engineering applications using the bisection and Newton-Raphson methods.

CO3: Solve ordinary differential equations related to civil engineering problems using Euler's method and Runge-Kutta method.

CO4: Apply the finite central difference technique to solve differential equations for determinate and indeterminate beams, as well as for analyzing column buckling.

UNIT–I	10 Hrs.

Introduction: Historical development of numerical techniques, role in investigations, research and design in the field of Civil Engineering.

Application of Solution of Linear System of Equations to Civil Engineering Problems: Development of simultaneous equations from problems in construction planning, slope deflection method applied to beams and frames and analysis using Gaussian elimination method, Gauss-Jordan matrix inversion method, Gauss-Siedel matrix inversion method and Cholesky's decomposition method.

UNIT–II	11 Hrs.

Application of Root Finding to Civil Engineering Problems: Development of non-linear algebraic and transcendental equations from problems in hydraulics, irrigation engineering, structural engineering and environmental engineering using Bisection method and Newton- Raphson method. Application of Numerical Integration to Civil Engineering Problems: Computation of area of BMD drawn for statically determinate beams and hydraulics and environmental engineering by Trapezoidal rule and Simpson's one third rule.

UNIT-III	11 Hrs.
Application of Solution of Ordinary Differential Equations to Civil Engineering Problems: Development of ODE from problems in statically determinate beams, Environmental engineering, Hydraulics and Geotechnical engineering and solution by Euler's method and Runge-Kutta 4th order method.	
UNIT-IV	10 Hrs.
Application of Finite Difference Techniques to Civil Engineering Problems: Introduction, expression of derivatives by finite central differences. Development of differential equations for statically determinate beams, statically indeterminate beams and buckling of columns and solution by finite central difference technique.	
Text Books:	
N Krishna Raju and KU Muthu-Numerical Methods for Engineering Problems, 2nd ed. Laxmi Publications, New Delhi 2015 M.K Jain, SRK Iyengar and R.K. Jain-Numerical Methods for Scientific and Engineering computation, New Publications, New Delhi,2012. S S Sastry-Introductory Methods of Numerical Analysis,5thed. PHI, NewDelhi, 2012.	
Reference Books:	
E Balagurusamy - Numerical Methods, Tata McGraw Hill, 2017. H C Saxena-Examples in Finite Differences and Numerical Analysis, S Chand &Co. New Delhi, 1975 J B Scarborough-NumericalMathematicalAnalysis,6thed. Oxford and IBH New Delhi, 2005 Mario Salvadori-Numerical Methods in Engineering, PHI, 1961.	

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	Program Outcomes and (WKs)											(PSOs)	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1:	**3** (WK2, WK3)	**3** (WK2, WK3)	**1** (WK5)	–	**2** (WK6)	–	–	–	–	–	–	**3**	
CO2:	**3** (WK2, WK3)	**3** (WK2, WK3, WK5)	**2** (WK5)	**1** (WK5)	**3** (WK6)	–	–	–	–	**1**	–	**3**	
CO3:	**2** (WK3)	**3** (WK3, WK5)	**2** (WK5)	**2** (WK5, WK6)	**3** (WK6)	–	**1** (WK7)	–	–	**1**	**1** (WK6)	**3**	
CO4:	**2** (WK3)	**2** (WK5)	**2** (WK5)	**2** (WK6)	**2** (WK6)	**1** (WK7)	**1** (WK7)	**2** (WK8)		**2**	**2** (WK6, WK8)	**2**	

Course Code		:	22UCV735E	Precast Members–Systems & Construction	Semester	:	07
L:T:P		:	3:0:0		Course Type	:	PEC
Hours/Sem.	Teaching	:	42 Hrs		CIE Marks	:	50
	Learning (TW+SL)	:	42 Hrs		SEE Marks	:	50
	Exam	:	06 Hrs		Total Marks	:	100
	Total Hrs.	:	90 Hrs		Credits	:	03

Professional Competency:

Apply engineering principles to analyze, design, manufacture, and implement precast concrete systems by selecting appropriate members, connections, construction techniques, and erection procedures in accordance with relevant standards, safety requirements, and sustainable construction practices.

Course Outcomes:

After completion of the course, student will be able to:

CO1: Explain concepts, components and advantages of precast concrete systems.

CO2: Analyze and select suitable precast members and connection systems.

CO3: Plan manufacturing, transportation and erection of precast components.

CO4: Evaluate and apply precast systems considering safety, sustainability and codes.

UNIT–I	11 Hrs.

Fundamentals of Precast Construction:

Introduction; advantages and limitations; precast vs cast-in-situ; materials; production systems; plant layout; moulds; curing; tolerances; quality assurance; relevant standards.

UNIT–II	11 Hrs.

Precast Members and Connections

Beams, columns, slabs, wall panels, staircases, foundations; structural behaviour; dry and wet connections; mechanical connectors; grouting; diaphragm action; robustness and durability.

UNIT-III	10Hrs.

Precast Systems and Construction:

Framed, wall-bearing and modular systems; industrial, residential and commercial applications; transportation, lifting, erection, temporary stability; BIM and digital fabrication; safety.

UNIT-IV	10 Hrs.

Design Applications and Case Studies:

Design philosophy; serviceability and strength; seismic considerations; fire resistance; sustainability; life-cycle assessment; inspection and maintenance; case studies.

Text Books:
1. Kim S. Elliott, Precast Concrete Structures, 2nd Ed.
2. PCI Design Handbook.
3. fib Bulletin on Precast Concrete Structures.
Reference Books:
1. MNL-116 Manual for Quality Control for Plants and Production of Precast Concrete Products.
2. Relevant IS Codes and IRC provisions.

Table 5: Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes	**Program Outcomes and (WKs)**											**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PSO1**	**PSO2**	**PSO3**
CO1	3 (WK1, WK2, WK3, WK4)	2 (WK1, WK2, WK3)	-	-	-	-	-	1	-	-	1	2	3	1
CO2	3 (WK1, WK2, WK3, WK4)	2 (WK1, WK2, WK3, WK4)	3 (WK5)	-	3 (WK6)	2 (WK1, WK5, WK7)	-	1	1	-	1 (WK8)	3	3	-
CO3	2 (WK1, WK2)	2 (WK1, WK2, WK3)	3 (WK5)	-	3 (WK6)	2 (WK1, WK5, WK7)	1	2	1	-	1 (WK8)	2	3	1
CO4	2 (WK1, WK2)	2 (WK1, WK2, WK3)	2 (WK5)	-	2 (WK6)	2 (WK1, WK5, WK7)	2	3	1	-	2 (WK8)	2	3	2

Course Code		**:**	**22UCV736E**	**Solid Waste Management**	**Semester**	**:**	**07**
L:T:P		**:**	**3:0:0**		**Course Type**	**:**	**PEC**
Hours/Sem.	**Teaching**	**:**	**42 Hrs**		**CIE Marks**	**:**	**50**
	Learning (TW+SL)	**:**	**42 Hrs**		**SEE Marks**	**:**	**50**
	Exam	**:**	**06 Hrs**		**Total Marks**	**:**	**100**
	Total Hrs.	**:**	**90 Hrs**		**Credits**	**:**	**03**

Professional Competency:

Plan, design, and manage sustainable solid waste management systems.
Apply engineering principles and environmental standards for efficient waste handling, treatment, resource recovery, and safe disposal.

Course Outcomes:

After completion of the course student will be able to

CO1: Design Appropriate treatment component for municipal and certain industrial effluents

CO2: Evaluate the operational problems of treatment units and apply the solutions in water and wastewater treatment plant.

CO3: Construct appropriate treatment schemes to remove certain pollutants present in water or wastewater

CO4: Construct the alternative sludge processing techniques apply the knowledge in nutrient removal from the wastewater

UNIT–I	**11 Hrs.**

Solid Waste: Definition and scope, Necessity and importance, Sources, Classification, Integrated Solid Waste Management (ISWM), Hierarchy of waste management options, 4 R's - reduce, recover, recycle and reuse, Physical, Chemical and Biological characteristics of municipal solid waste (MSW), Generation rates and methods, Chemical composition, Numerical problems.

Functional elements: Flow chart, Waste generation, Storage, Collection, Transfer and transport, Processing and recovery, Disposal.

Collection, Transfer and Transport: Collection equipment, systems of collection - hauled container system, stationary container system, numerical problems; Transfer stations, Bailing and Compacting.

UNIT–II	**10 Hrs.**

Separation and Processing Technologies: Size reduction, Size separation, Density separation, Magnetic & Electric Field separation, Densification (Compaction), Design of Material Recovery Facilities (MRFs), Numerical problems.

Thermal Treatment Processes: Combustion Systems (Mass-Fired Combustion Systems, RDF-Fired Combustion Systems, Fluidized Combustion Systems, Heat recovery sytems, Water wall Combustion Systems, Waste heat boiler) Pyrolysis Systems, Gasification Systems, Environmental Control Systems, Energy Recovery Systems.

UNIT–III	11 Hrs.
Disposal methods: Types, Selection of suitable site, Ocean disposal, Feeding to hogs, Merits and demerits of various disposal methods. **Open dumping:** Environmental implications of open dumping, Construction debris - management & handling, Rag pickers and their role **Sanitary land filling:** Definition, methodology, Types - trench, area, ramp, pit methods, Basic steps involved, Site selection, Prevention of site pollution, Landfill remediation, Geo-technical considerations, Densification - earthen, Geo-membrane, Geo-synthetics and Geo-textiles	
UNIT–IV	**10 Hrs.**
Operational aspects of Landfills: Daily cover, Final cover, Leachate disposal, Ground water monitoring, Leachate and its treatment, Gas collection and re-circulation systems, Post-closure environmental monitoring. **Treatment of other wastes:** E-Waste Management, Hazardous waste management and Bio-medical waste.	
Reference Books *	
1. George Tchobanoglous, Hilary Theisen, Samuel A. Vigil, Integrated Solid Waste Management-Engineering Principles and Management Issues, McGraw-Hill, International Editions, 1993. 2. Ramachandra T.V., Management of Municipal Solid Waste, The Energy and Resources Institute, TERI, ISBN: 9788179931875, 9788179931875, 2006 3. Peavy and Tchobanoglous, Environmental Engineering, McGraw-Hill International Editions, 1985.	

Matrix to describe the mapping of COs with POs (considering WKs) and PSOs

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3 (WK1, WK2, WK3, WK4)	2 (WK1, WK2, WK3, WK4)	–	–	–	–	2 (WK7)	–	–	1	–	2	1
CO2	–	3 (WK1, WK2, WK3, WK4)	2 (WK5)	2 (WK8)	2 (WK6)	2 (WK1, WK5, WK7)	3 (WK7)	1	–	1	–	3	2
CO3	–	2 (WK1, WK2, WK3)	3 (WK5)	2 (WK8)	3 (WK6)	2 (WK1, WK5, WK7)	3 (WK7)	1	1	1	–	3	2
CO4	2 (WK1, WK2)	2 (WK1, WK2, WK3)	2 (WK5)	2 (WK8)	1 (WK6)	2 (WK1, WK5, WK7)	3 (WK7)	2	2	2	2	3	3

Note:

If there is no mapping between a CO and a PO, indicate "–".

The WKs (Knowledge Profile elements) shown are indicative and should align with the relevant Program Outcomes addressed by each Course Outcome.

22UCV714E	**Railway and Airport Engineering**	**Credits: 3**
L:T:P - 3 : 0: 0		CIEMarks:50
Total Hours/Week: 3		SEEMarks:50

UNIT-I	**10 Hrs.**
Railway Planning: Significance of Road, Rail, Air and Water transports – Coordination of all modes to achieve sustainability – Elements of permanent way, - Rails, Sleepers, Ballast, rail fixtures and fastenings, – Track Stress, coning of wheels, creep in rails, defects in rails Route alignment surveys, conventional and modern methods- – Soil suitability analysis – Geometric design of railways, gradient, super elevation, widening of gauge on curves- Points and Crossings (Explanation & Sketches of Right- and Left-hand turnouts only).	
UNIT–II	**10 Hrs.**
Railway Construction and Maintenance: Earthwork – Stabilization of track on poor soil, Calculation of Materials required for track laying – Construction and maintenance of tracks – Modern methods of construct ion & maintenance – Railway stations and yards and passenger amenities- Urban rail – Infrastructure for Metro, Mono and underground railways.	
UNIT–III	**10 Hrs.**
Airport Planning: Air transport characteristics, airport classification, airport planning: objectives, c o m p o n e n t s , layout characteristics, and socio-economic characteristics of the catchment area, criteria for airport site selection and ICAO stipulations, typical airport layouts, Parking and circulation area.	
UNIT–IV	**10 Hrs.**
Airport Design: Runway Design: Orientation, Wind Rose Diagram, Runway length, Problems on basic and Actual Length, Geometric design of runways, Configuration and Pavement Design Principles, Elements of Taxiway Design, Airport Zones, Passenger Facilities and Services, Runway and Taxiway Markings and lighting.	

Reference Books *

1. Y.H. Huang, Pavement Analysis and Design, Prentice Hall, New Jersey, 2003.
2. R. Horonjeff and F.X. Mckelvey, Planning andDesign of Airports, McGraw Hill, New York, 1994. **3**. S.C. Sexena and S.P. Arora, A Text Book of Railway Engineering, Dhanpat Rai & Sons, New Delhi, 1998.
4. W.W. Hay, Railroad Engineering, Wiley, New York, 1988.

Course Outcomes**

After completion of the course student will be able to

1 . Acquires capability of choosing alignment and also design geometric aspects of railway system, runway and taxiway.
2. Suggest and estimate the material quantity required for laying a railway track and also will be able to determine the hauling capacity of a locomotive.
3. Develop layout plan of airport, harbour, dock and will be able relate the gained knowledge to identify required type of visual and/or navigational aids for the same.
4. Apply the knowledge gained to conduct surveying, understand the tunnelling activities.

***Books to be listed as per the format with decreasing level of coverage of syllabus**

**** Each CO to be written with proper action word and should be assessable and quantifiable**

Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	1			**2**		2					**1**	**1**		
CO2		1											**1**	
CO3	1		1											**1**
CO4		1		**2**		2		**1**					**1**	

22UCV731E	**Railway and Airport Engineering**	**Credits: 3**
L:T:P - 3 : 0: 0		CIEMarks:50
Total Hours/Week: 3		SEEMarks:50

UNIT-I	**10 Hrs.**
Railway Planning: Significance of Road, Rail, Air and Water transports – Coordination of all modes to achieve sustainability – Elements of permanent way, - Rails, Sleepers, Ballast, rail fixtures and fastenings, – Track Stress, coning of wheels, creep in rails, defects in rails Route alignment surveys, conventional and modern methods- – Soil suitability analysis – Geometric design of railways, gradient, super elevation, widening of gauge on curves- Points and Crossings (Explanation & Sketches of Right- and Left-hand turnouts only).	
UNIT–II	**10 Hrs.**
Railway Construction and Maintenance: Earthwork – Stabilization of track on poor soil, Calculation of Materials required for track laying – Construction and maintenance of tracks – Modern methods of construct ion & maintenance – Railway stations and yards and passenger amenities- Urban rail – Infrastructure for Metro, Mono and underground railways.	
UNIT–III	**10 Hrs.**
Airport Planning: Air transport characteristics, airport classification, airport planning: objectives, c o m p o n e n t s , layout characteristics, and socio-economic characteristics of the catchment area, criteria for airport site selection and ICAO stipulations, typical airport layouts, Parking and circulation area.	
UNIT–IV	**10 Hrs.**
Airport Design: Runway Design: Orientation, Wind Rose Diagram, Runway length, Problems on basic and Actual Length, Geometric design of runways, Configuration and Pavement Design Principles, Elements of Taxiway Design, Airport Zones, Passenger Facilities and Services, Runway and Taxiway Markings and lighting.	

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Course Outcomes	Programme Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
CO1	1			**2**		2					**1**	**1**		
CO2		1											**1**	
CO3	1		1											**1**
CO4		1		**2**		2		**1**					**1**	