

www.sjcit.ac.in

||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

AICTE Approved, Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME & CV), NIRF(151-300) in 2023,Gold Rated by QS I-Gauge

P.B. No.20, B.B Road, Chikkaballapur - 562 101, Karnataka

Estd : 1986

I & II Semester
Scheme & Syllabus of M.Tech Programme
Structural Engineering
(2024 Scheme)

Core Values

Spiritual, **J**udicious, **C**ommitment, **I**ntegrity, **T**rustworthy



NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

A+ NAAC

QS I-GAUGE GOLD

INSTITUTION'S INNOVATION COUNCIL (Ministry of HRD Initiative) 4-Star Rating



Estd : 1986

||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

AICTE Approved, Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME, CV & AE), Gold Rated by QS I-Gauge

P.B. No.20, B.B Road, Chikkballapur - 562 101, Karnataka

www.sjcit.ac.in

Scheme of Teaching and Examinations

Department of Civil Engineering

Specialization-Ist Sem M.Tech in Structural Engineering

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

I SEMESTER (Core Courses related to Main Engineering Stream)											
Sl. No	**Course Type**	**Course Code**	**Course Title**	**Teaching Hours per Week**			**Examination**				**Credits**
				Theory	**Practical\ Seminar**	**Tutorial/ SDA**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
				L	P	T/SDA					
1	IPCC	MCV101	Numerical methods and Optimization Techniques	3	2	0	03	50	50	100	4
2	PCC	MCV102	Artificial Intelligence and Applications in Civil Engineering	2	0	2	03	50	50	100	3
3	PCC	MCV103	Advanced Design of RCC Structures	2	0	2	03	50	50	100	3
4	PCC	MCV114x	Professional Elective I	2	0	2	03	50	50	100	3
5	PCC	MCV115x	Professional Elective II	2	0	2	03	50	50	100	3
6	PCCL	MCVL106	Computational Lab-1	1	2	0	03	50	50	100	2
7	NCMC	MRMC107	Research Methodology and IPR (Online)	Classes and Evaluation Procedures are as per the policy of the online course providers (online.vtu.ac.in OR nptel.ac.in)							PP
		OR									
		MCVC107	BoS Recommended online course								
Total				**12**	**4**	**8**	**18**	**300**	**300**	**600**	**18**

Professional Elective I		**Professional Elective II**	
MCV114A	Ground Improvement Technique	MCV115A	Environmental Geotechnology
MCV114B	Material Characterization	MCV115B	DPR Preparation
MCV114C	Non-Destructive Testing for Civil Engineering	MCV115C	Advanced Surveying & Location
MCV114D	Remote Sensing & GIS	MCV115D	Composite Materials
MCV114E	Special Concrete	MCV115E	Road Safety for Engineers

Note: BSC-Basic Science Courses, **PCC**: Professional core. **IPCC**-Integrated Professional Core Courses, **PCC(PB):** Professional Core Courses (Project Based), **PCCL**- Professional Core Course lab**, NCMC**- None Credit Mandatory Course, **L-**Lecture**, P-**Practical**, T/SDA-**Tutorial **/** Skill Development Activities (Hours are for Interaction between faculty and students) **MRMC107**- Research Methodology and IPR (**Online**) for the students who have **not studied** this course in the Undergraduate level. This course is not counted for vertical -progression, Students have to qualify for the award of the master's degree. **MCVC107** - BoS Recommended online course for the students who have studied Research Methodology and IPR in Undergraduate level.

BSC: Basic Science Courses: Courses like Mathematics/ Science are the prerequisite courses that the concerned engineering stream board of Studies will decide. **PCC: Professional Core Course:** Courses related to the stream of engineering, which will have both CIE and SEE components, students have to qualify in the course for the award of the degree. **Integrated Professional Core Course (IPCC)**: Refers to a Professional Theory Core Course Integrated with practical of the same course. The IPCC's theory part shall be evaluated by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. **Project Based Learning Course (PB):** Project Based Learning course is a professional core Course only Students have to complete a project out of learning from the course and SEE will be viva voce on project work. **PCCL: Professional Core Course Laboratory:** Practical courses whose

CIE will be evaluated by the class teacher and SEE will be evaluated by the two examiners.

Skill development activities: Under Skill development activities in a concerning course, the students Should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in the modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s are to be involved either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities that will enhance their skills. The prepared report shall be evaluated for CIE marks.

MRMC107-Research Methodology and IPR- None Credit Mandatory Course (NCMC) if students have not studied this course in their undergraduate program then he /she has to take this course at **http://online.vtu.ac.in or http://nptel.ac.in** and to qualify for this course is compulsory before completion of the minimum duration of the program (Two years), however, this course will not be considered for vertical progression.

Semester: I						
NUMERICAL METHODS AND OPTIMIZATION TECHNIQUES						
Course Code	**:**	MCV101		**Credits**	**:**	4
Hours/Week (L: T: P)	**:**	3:2:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40L+12P		**SEE**	**:**	50 Marks
Course Type	**:**	IPCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Calculus and Statistics
Knowledge on Fundamental Concepts	Linear algebra, Differentiation and Integration
Knowledge on Connected Tools (If any)	MATLAB, MS Excel

Course Learning Objectives: This course will enable the students to	
CLO1	Formulate Linear programming for obtaining solution for real world problems
CLO2	Interpret Non-linear, geometric and dynamic programming techniques for civil engineering problems.
CLO3	Analyze the civil engineering data and characterize with regression equations and test its efficacy.
CLO4	Apply the techniques of numerical methods for solving differential equations.
CLO5	Analyze project management technique to use in real civil engineering projects.

Module – 1	**08 Hrs**
Linear Programming Introduction to optimization techniques, engineering applications of optimization, nature and characteristics of operation research, Introduction to Linear programming, formulation of linear programming problems, graphical solution, solution by simplex and revised simplex technique, Primal-Dual relations. **Text Book 1:** Ch 1: 1.1-1.4, Ch2: 2.1-2.5, 2.8.1 **Text Book 2:** Ch1:1.1-1.3, Ch3:3.1-3.8, Ch4:4.3 **Text Book 3:** UNIT 2: LPP.1-LPP.45	
Module – 2	**08 Hrs**
Non-Linear Programming one dimensional minimization methods, elimination methods, Golden Section Method, Fibonacci method; Dynamic programming- Introduction, Approaches, Application and case studies; Geometric programming methods- Introduction, Approaches, conversion of NLP as a sequence of LP. Numerical Problems. **Text Book 2:** Ch5: 5.1-5.8 **Text Book 3:** UNIT 5: OPT-TECH.1-OPT.TECH.21	
Module – 3	**08 Hrs**
Statistical inferences Methods of least square and regression, multiple regressions. Concept of probability, Random Variables, Binomial, Poisson and Normal distribution – applications, Chi- squared test and Analysis of Variance. **Text Book 4:** Ch8:8.1-8.5, Ch9:9.1-9.4, Ch10:10.1-10.3 **Text Book 5:** Ch12:12.1-12.30	
Module – 4	**08 Hrs**

Numerical Solutions	
Solution of ordinary differential equations: Euler's method, and Ranga Kutta 3rd and 4th order method, Taylor's series method Solutions for Integral Equations: Trapezoidal rule, Simpson's 1/3rd and 3/8th rule, and Weddle's Rule. **Text Book 5:** Ch22:22.1-22.10, Ch23:23.9-23.13	
Module – 5	**08 Hrs**
Project Management Introduction to Project management, PERT (Program Evaluation and Review Technique): Network construction and analysis, Time estimation and probability calculations. CPM (Critical Path Method): Resource allocation and levelling, Resource-constrained project scheduling, Resource levelling techniques (heuristics and optimization methods), Differences and similarities of CPM with PERT. **Text Book 1:** Ch3: 3.7	
PRACTICAL COMPONENT	**12 Hrs**
(Using any computer software app/tool) - Linear programming by graphical solution - Statistical inferences- Methods of least square and multiple regression. - Concept of probability, Random Variables, Binomial, Poisson and Normal distribution - Applications, Chi- squared test and Analysis of Variance. -Solution of Ordinary differential equations - Solutions for Integral Equations	

Course Outcomes: After completing the course, the students will be able to	
CO1	Formulate Linear programming problem to obtain solution for real world problems.
CO2	Solve Non-linear problems of civil engineering and differential equations using numerical methods.
CO3	Analyze the data and characterize with regression equations and test its efficacy.
CO4	Apply the project management concepts to solve civil engineering field problems.
CO5	Explore software/tool to optimize civil engineering problems.

Text Books	
1	Michael W. Carter, Camille C. Price, Ghaith Rabadi, "Operation Research A Practical Introduction", Second edition, Taylor Francis group-2019, ISBN:13:978-1-4987-8010-0
2	Singiresu S. Rao, "Engineering Optimization", Third Enlarged Edition, New age international (P) Ltd, Reprint 2012, ISBN:81-224-1149-5-20
3	Operations Research, S.D. Sharma, Kedaranath Ramnath& Co. Meerut. 17th Revised Edition 2009
4	Ken Black, "Business Statistics for contemporary Decision Making", 10th Edition, John Willey &Sons 2020, EPUB ISBN13:978-1-119-59135-1
5	H K Das, "Introduction to Engineering Mechanics", Volume-III, 4th Revised Edition, S.Chand & Company Ltd 2013, ISBN:978-93-5283-403-7

Reference Books	
1	Johnson R and G Bhattacharya, "Statistics – Principles and methods", John Wiley & sons, New york,1985
2	M K Jain, S.R.K Iyengar, R K. Jain, " Numerical methods for Scientific and Engineering Computation",New Age International, 2003, ISBN:81-224-1461-3-12

3	Chitkara, K.K, "Construction Project Management: Planning, Scheduling and Control", Tata McGraw-Hill Publishing Company, New Delhi, 1998, ISBN:9780074620625, 0074620622

Web links and Video Lectures (e–Resources)	
1	https://nptel.ac.in/courses/111105039
2	https://www.google.co.in/books/edition/Optimization_Techniques_in_Operation_Res/JL5EFfKVoBcC?hl=en&gbpv=1&dq=optimization+techniques+india&printsec=frontcover
3	https://www.youtube.com/watch?v=84HOL_EiJ4M&list=PLLtQL9wSL16ioUvHckGCko Wq_CIvyUI 0p
4	https://www.slideshare.net/slideshow/optimization-techniquespdf-9d44/265458944
5	https://www.youtube.com/watch?v=fuBvQJP0ecw&list=PLp6ek2hDcoNCp9o8aLQrbY1 5a-o0weoTd&index=2
6	https://www.youtube.com/watch?v=3yGx-_qcdMM
7	https://www.youtube.com/watch?v=WrAf6zdteXI
8	https://www.youtube.com/watch?v=-TDh-5n90vk

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**1**	**2**	**3**	**2**	**2**
CO2	**3**	**1**	**2**	**3**	**2**	**2**
CO3	**2**	**2**	**2**			**1**
CO4	**2**	**2**	**2**			**1**
CO5	**2**	**2**	**2**			**3**

Semester: I						
ARTIFICIAL INTELLIGENCE AND APPLICATIONS IN CIVIL ENGINEERING						
Course Code	**:**	MCV102		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	2:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	20L + 20SDA		**SEE**	**:**	50 Marks
Course Type	**:**	PCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Basics of Mathematics and Programming.
Knowledge on Fundamental Concepts	Basic understanding of Artificial Intelligence and its applications. Awareness of core Civil Engineering principles.
Knowledge on Connected Tools (If any)	Basic computer usage skills. Familiarity with Python or MATLAB (at a beginner level).

Course Learning Objectives: This course will enable the students to	
CLO1	Apply the fundamentals of Artificial Intelligence (AI) and its various branches.
CLO2	Equip with the knowledge of Machine Learning (ML) concepts and their application in civil engineering projects.
CLO3	Explore the structure and function of Artificial Neural Networks (ANNs).
CLO4	Introduce the concepts of fuzzy logic and its utility in civil engineering systems.
CLO5	Apply computer vision and its techniques in civil engineering.

Module – 1	**08 Hrs**
Introduction to AI: Introduction to AI, definition of AI, Historical evolution of AI, AI types, brief introduction to the branches of AI, Machine learning, Natural Language processing, computer vision, robotics, expert systems, Artificial neural networks and deep learning, evolutionary computation, cognitive computing, and swarm intelligence. Applications in civil engineering in each branch of AI. **Text Book 1:** Ch1: 1.1-1.3, Ch2: 2.1-2.3, Ch20: 20.1, Ch21: 21.2, Ch23: 23.1	
Module – 2	**08 Hrs**
Machine Learning: Introduction to ML, Machine learning process model, Concept learning, general-to- specific ordering, version spaces, inductive bias, general to specific ordering, introduction to different kinds of machine learning, supervised, unsupervised, semi supervised, reinforcement, transfer learning and federated learning. The related algorithms under each type of ML, Applications of different ML techniques in Civil Engineering. Well posed learning problem, designing a learning system, examples. **Text Book 2:** Ch1: 1.1-1.3, Ch3: 3.1, Ch4: 4.1, Ch10: 10.1-10.2	
Module – 3	**08 Hrs**
Artificial neural networks (ANN): Introduction, biological motivation, appropriate problems in ANN learning, perceptron's, the representational power of perceptions, multilayer networks, back propagation. Introduction to recurrent neural networks, and deep learning. Illustrative real-world examples on applications of neural networks in highway/ infrastructure construction management and other civil engineering domains. **Text Book 3:** Ch6: 6.1-6.2, Ch7: 7.1-7.2, Ch10: 10.1-10.2	
Module – 4	**08 Hrs**
Learning under uncertainty and ambiguity: Fuzzy logic, linguistic variables, fuzzy sets, membership functions, fuzzy set operations, fuzzy expert systems, fuzzification, defuzzification, fuzzy rules, fuzzy inferences. Fuzzy inference system, Illustrative examples of engineering applications of fuzzy logic with specific reference to civil engineering.	

Text Book 4: Ch1: 1.1-1.2, Ch2: 2.1-2.2, Ch5: 5.1-5.2	
Module – 5	**08 Hrs**
Introduction to Computer Vision: Definition and scope, history and evolution, Image acquisition, image representation (grey scale and colour), basic operations like filtering, thresholding. Primitives of image processing, geometric primitives, 2d Transforms, 3D transforms, photometric image formation, lighting, reflectance and shading, the digital camera, sampling and aliasing. Applications of computer vision in Civil engineering.	
Text Book 5: Ch1: 1.1-1.2, Ch2: 2.1-2.2, Ch3: 3.1, Ch4: 4.1, Ch23: 23.1	

Course Outcomes: After completing the course, the students will be able to	
CO1	Comprehend ANN techniques to model and solve real-world civil engineering problems.
CO2	Apply AI in modern civil engineering practices and enhance decision-making.
CO3	Develop and evaluate ML models for solving complex civil engineering problems.
CO4	Apply the principles of Fuzzy Logic and imprecision in Civil engineering problems.
CO5	Implement computer vision and image processing techniques in assessment of civil infrastructure.

Text Books	
1	Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, II Edition, 2003, ISBN-13: 978-0137903955, ISBN-10: 0137903952
2	Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, I Edition, 2006, ISBN-13: 978-0387310732, ISBN-10: 0387310738
3	Yoshua Bengio, Aaron Courville, "Deep Learning", Ian Goodfellow, MIT Press, I Edition, 2016, ISBN-13: 978-0262035613, ISBN-10: 0262035618
4	Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley Publishers, IV Edition, 2016, ISBN-13: 978-1119235866, ISBN-10: 1119235865
5	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, I Edition, 2010, ISBN-13: 978-1848829343, ISBN-10: 1848829345

Reference Books	
1	Margaret A Boden, "Artificial Intelligence", II Edition, 1996, Academic Press London, ISBN-13: 978-0121619640, ISBN-10: 0121619646
2	Tom.M. Mitchel, "Machine Learning", 2017, Indian Edition, McGraw Hill, ISBN-13: 978-1259096952, ISBN-10: 1259096955
3	Kothari Dwarkadas Pralhaddas, Samui Pijush, "Artificial Intelligence in Civil Engineering", 2012, Lambert Academic Publishing, ISBN-13: 978-3659162276, ISBN-10:3659162274
4	Paul Harrison, "Artificial Intelligence Applications in Material Science and Engineering",2023, Kindle Edition, ISBN-13: 978-0323950595, ISBN-10: 0323950593

Web links and Video Lectures (e–Resources)	
1	https://www.researchgate.net/publication/383094533_Artificial_Intelligence and_Applications_in_Civil_Engineering_Module_1
2	https://www.researchgate.net/publication/383669419_AI_and_Applications _in_Civil_E ngineering_Module_2_Machine_Learning

3	https://www.researchgate.net/publication/383951466_AI_for_Civil_Engineers_Module_3_ANNs
4	https://www.researchgate.net/publication/384246445_AI_for_Civil_Engineers_Module_ 4_Dealing_with_Uncertainty
5	https://www.researchgate.net/publication/384429783_AI_and_Applications_in_Civil_Engineering_Module_5_Computer_Vision
6	http://digimat.in/nptel/courses/video/106106213/L01.html
7	http://digimat.in/nptel/courses/video/106106198/L01.html
8	https://www.youtube.com/watch?v=Op80iPN8mCM&t=516s
9	https://www.youtube.com/watch?v=C4so06zT85k
10	https://www.youtube.com/watch?v=esC381aaRM0

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**1**	**3**	**2**		
CO2	**2**		**3**	**2**	**1**	
CO3	**3**	**2**	**3**	**3**	**2**	
CO4	**2**		**2**	**3**		**1**
CO5	**2**		**2**	**3**	**3**	**1**

Semester: I						
ADVANCED DESIGN OF RCC STRUCTURES						
Course Code	**:**	MCV103		**Credits**	**:**	4
Hours/Week (L: T: P)	**:**	2:2:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40T+12L		**SEE**	**:**	50 Marks
Course Type	**:**	IPCC		**SEE Duration**	**:**	3 Hours

Prerequisites: An undergraduate course on reinforced concrete.	
Courses	Design of RCC structural elements
Knowledge on Fundamental Concepts	Analysis of structures, Design of RCC structural elements, Special concrete, IS 456:2000, SP (16)
Knowledge on Connected Tools (If any)	STADD.PRO, ETABS, Excel

Course Learning Objectives: This course will enable the students	
CLO1	To develop advanced knowledge in the design of reinforced concrete structures.
CLO2	To comprehend in sustainable design solutions for reinforced concrete structures that address modern challenges in the construction industry.
CLO3	To delve into the principles of reinforcement design and detailing for complex structural components.
CLO4	To evaluate performance of the structures.
CLO5	To gain knowledge in design of RC structures using design tool.

Module – 1	**08 Hrs**
Design of R C slabs by yield line method: Yield line theory for analysis of slabs: Equilibrium and virtual work methods of analysis, rectangular slabs and triangular slabs with various edge conditions – yield line patterns, Circular slabs. **Continuous beam:** Design of continuous beams with redistribution of Moments **Text Book 2:** Ch 3: 3.1 – 3.6 **Text Book 4:** Ch 1: 1.1 – 1.6, Ch 2: 2.1 – 2.5	
Module – 2	**08 Hrs**
Design of Grid floors and Flat slabs: General features, Rigorous and approximate methods of analysis, Design and detailing of grid floors. Design and detailing of flat slabs including unbalanced column moments. **Text Book 1:** Ch 7: 7.1 – 17.17, Ch 10: 10.1 – 10.8 **Text Book 2:** Ch 16: 16.1 – 16.3	
Module – 3	**08 Hrs**
Design of R C Chimneys: General Aspects, Structural parts of a chimney, Design of reinforced concrete chimney, Analysis and design examples **Design of deep beams:** Introduction, simply supported deep beams, continuous deep beams, design according to IS–456, British Practice and ACI procedure, design examples. **Text Book 2:** Ch 5: 5.1 – 5.11, Ch 20: 20.1 – 20.7 **Text Book 3:** Ch 13: 13.7.1 – 13.7.5	
Module – 4	**08 Hrs**
Design of R C bunkers and silos: Introduction, differences between bunkers and silos, design of square, rectangular and circular bunkers, design of silos. **Text Book 2:** Ch 4: 4.1 – 4.11 **Text Book 3:** Ch 13: 13.7.1 – 13.7.5	

Module – 5	08 Hrs
Formwork: Introduction, Requirements of good formwork, Materials for forms, Choice of formwork, loads on formwork, Permissible stresses for timber, Design of formwork, shuttering for columns, Shuttering for slabs and beams, Erection of Formwork, Action prior to and during concreting, Striking of forms. Recent developments in form work. **Reference book 3:** Ch 1, 3, 6,7, 13, 17	
LABORATORY EXPERIMENTS	**12 Hrs**
1. Design of continuous beam using excel spreadsheet. 2.Design of continuous beam with redistribution of moment using excel spreadsheet. 3. Design of flat slab using excel spreadsheet. 4. Design of grid floor using excel spreadsheet. 5. Design of RC chimney using excel spreadsheets. 6. Design of RC simply supported deep beam using excel spreadsheets. 7. Design of square bunkers using excel spreadsheets. 8. Design of silos using excel spreadsheets. 9. Concrete mix design using excel spreadsheet.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze and design advanced reinforced concrete elements and systems using current design codes and standards.
CO2	Verify that designs meet all legal and safety standards while considering the ethical implications of engineering decisions.
CO3	Develop sustainable design solutions for reinforced concrete structures that address modern challenges in the construction industry
CO4	Adopt advanced construction techniques and technologies for reinforced concrete structures.
CO5	Proficiency in using computational tools and software for the analysis and design of RC structures.

Text Books	
1	Varghese. P. C., "Advanced Reinforced Concrete Design", Prentice-Hallof India, New Delhi, 2000, ISBN: 1978-81-203-2787-0
2	Krishna Raju. N., "Advanced Reinforced Concrete Design", CBS Publishers & Distributors, ISBN: 9788123912257
3	R Park and T Paulay, "Reinforced Concrete Structures", 2nd Edition, 2013. John Wiley & Sons, USA, ISBN:9780471659174.
4	S.S Bhavikatti., "Advanced RCC Design", New age publication, Second edition, ISBN: 9788122440522

Reference Books	
1	Purushothaman. P., "Reinforced Concrete Structural Elements: Behaviour Analysis and Design", Tata Mc Graw Hill, 1986, ISBN: 978-0074518359
2	Punmia B.C, Ashok Kumar Jain and Arun Kumar Jain, "Comprehensive RCC Design", Laxmi Publications, New Delhi, ISBN: 978-8131809426
3	Dr. Kumar Neeraj Jha, "Formwork for Concrete Structures", Tata McGraw Hill Education Private Limited, ISBN: 9781259007330
4	IS Code Books: IS 456: 2000, IS 4995-1, IS 4998:2015.

Web links and Video Lectures (e – Resources)

1	https://www.youtube.com/watch?v=undsd92MM8w&list=PLbQO4xhI7wEDIYv90NoF7veaJIohpuf0Q
2	https://www.bing.com/videos/riverview/relatedvideo?&q=design+of+bunkers+and+silos+nptel&&mid=A071F8325420685B6D2FA071F8325420685B6D2F&&FORM=VRDGAR
3	https://www.bing.com/videos/riverview/relatedvideo?q=concrete+form+work+failures+lecture+videos&&view=riverview&mmscn=mtsc&mid=6C8E08E35B6EE05802576C8E0 8E35B6EE0580257&&aps=283&FORM=VMSOVR

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**1**	**1**	**2**	**2**	**1**
CO2	**2**	**2**	**2**	**2**	**2**	**1**
CO3	**2**	**2**	**1**	**2**	**2**	**1**
CO4	**2**	**1**	**2**	**2**	**2**	**1**
CO5	**1**	**2**	**2**	**2**	**1**	**1**

Semester: I						
GROUND IMPROVEMENET TECHNIQUES						
Course Code	**:**	MCV114A		**Credits**	**:**	4
Hours/Week (L: T:P)	**:**	2:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	PCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Soil Mechanics, Engineering Geology, Construction Materials
Knowledge on Fundamental Concepts	Soil Behaviour and Mechanics, Soil Stabilization Techniques, Environmental Engineering Basics
Knowledge on Connected Tools (If any)	Laboratory Testing Methods, Surveying Tools

Course Learning Objectives: This course will enable the students to	
CLO1	To select suitable ground improvement techniques for problematic soil, mechanical, chemical and hydraulic modifications.
CLO2	To gain a deep understanding of advanced ground improvement methods, including preloading, sand drains, stone columns, MSE walls, and landfill design.
CLO3	To develop skills in designing and analyzing ground improvement solutions for complex geotechnical problems.
CLO4	To engage in research-oriented learning, critically evaluating recent advancements and innovations in ground improvement techniques.
CLO5	To Adopt the ground improvement techniques in Geo-environment and Sustainable Engineering Practices and applications.

Module – 1	**08 Hrs**
Introduction to Advanced Ground Improvement – Need of Ground Improvement, Different methods of Ground improvement, General Principal of Compaction: Mechanics, field procedure, quality control in field. Overview of traditional and modern ground improvement methods. Selection criteria for different techniques in various geotechnical projects. **Advanced Mechanical and Chemical Stabilization-** High-energy impact and deep compaction methods. Dynamic compaction, Vibro-flotation, Blasting, Compaction piles and its applications. Introduction to chemical stabilization: Cement stabilization: Mechanism, amount, age and curing. Fly-ash, Lime Stabilization, Soil Bitumen Stabilization. Applications of biochemicals in soil stabilization. Use of fly ash, slag, and other industrial by-products in soil stabilization. **Text Book 1:** Ch1: 1.1-1.3 **Text Book 2:** Ch1: 1.1-1.4, Ch2: 2.1-2.4	
Module – 2	**08 Hrs**
Ground Improvement by Grouting and Soil Reinforcement: Grouting in soil, types of grouts, desirable characteristics, grouting pressure, grouting methods. Soil Reinforcement: Mechanism, Types of reinforcing elements, reinforcement-soil interaction. Reinforcement of soil beneath the roads, foundation. **Preloading and Drainage Techniques Purification –** Preloading: Concepts, design principles, and applications. Sand drains: Design, installation, and case studies. Prefabricated vertical drains (PVDs): Design and application. Field monitoring and performance assessment of preloading with drains construction techniques. **Text Book 2:** Ch4: 4.1-4.4, Ch5: 5.1-5.4	

Text Book 3: Ch6: 6.1-6.3, Ch7: 7.1-7.3	
Module – 3	**08 Hrs**
Geosynthetic Materials in Ground Improvement- Introduction to geosynthetics: Types of geosynthetics and their application. Material properties: Tensile strength, durability, creep, and chemical resistance. Applications in ground improvement. Reinforcement, filtration, drainage, and containment. Design considerations for geosynthetics in soil reinforcement, erosion control, and environmental protection. Case studies of geosynthetic applications in complex geotechnical projects. **Stone Columns and Ground Reinforcement Techniques** – Stone Column: Function, Design principles, installation load carrying capacity, construction techniques, settlement of stone column foundation and applications in soft soils. Introduction to geosynthetic encased stone columns (GESC). Advances in coupling GESC with electro-kinetic method. Effect of GESC on consolidation. **Text Book 1:** Ch2: 2.1-2.3, Ch3: 3.1-3.3 **Text Book 2:** Ch8: 8.1-8.3	
Module – 4	**08 Hrs**
Design of Mechanically Stabilized Earth (MSE) Walls- Design of geotextile walls Design principles of MSE walls: Reinforcement types and configurations. Applications of geosynthetics (Geogrids, geotextiles, geonets, and geocells) in MSE Walls Analysis of MSE wall against external and internal stability. Design problems of MSE walls as per IRC – 102. Considering modular blocks, vertical panels. **Text Book 1:** Ch5: 5.1-5.4 **Text Book 3:** Ch9: 9.1-9.3	
Module – 5	**08 Hrs**
Scope of ground improvement techniques in Geo-environmental engineering – Landfill site selection and geotechnical considerations. Design of landfill liners and covers. Introduction to CCL and GCL. Applications of HDPEs in ponds, reservoirs and canals. **Sustainable Geoenvironmental engineering practices** - Overview, unsustainable actions and events, renewable geoenvironmental engineering practice. Impact of ground improvement on soil and groundwater quality. Renewable Geoenvironmental natural resources. Water and soil quality indicators. Sustainability practice examples (rehabilitation of airport land, sustainable mining conservation, agriculture sustainability study, petroleum oil well development). **Text Book 2:** Ch10: 10.1-10.3, Ch11: 11.1-11.3 **Text Book 3:** Ch8: 8.1-8.3	

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply knowledge of ground improvement techniques, including their principles, methods, and applications.
CO2	Apply grouting methods and evaluate the field performance of preloading techniques in construction
CO3	Analyze and design solutions for geosynthetics, stone columns and ground reinforcement techniques in geotechnical projects.
CO4	Identify and resolve design challenges in geotextile walls and Mechanically Stabilized Earth (MSE) walls for stability and sustainability.
CO5	Evaluate landfill site selection, environmental impacts, and safety considerations in ground improvement for sustainable geoenvironmental practices.

Text Books	
1	R. M. Korner, "Design with Geosynthetics", 3rd Edition, 2002, Prentice Hall, New Jersy, ISBN: 978-0130895283
2	P. Purushothama Raj, "Ground Improvement Techniques", 1995, Tata Mc Graw Hill, New Delhi, ISBN: 978-0074638360

3	Dr. B.C. Chattopadhyay and J. Maity, "Ground Control and Improvement Techniques", 2011, PEEDOT, Howrah.
4	G. V. Rao and G. V. S. Rao, "Text Book On Engineering withGeotextiles", 1st Edition, 2000, Tata McGraw Hill, ISBN: 978-0074622819
5	T. S. Ingold and K. S. Miller, "Geotextile Hand Book", 1995. Thomas Telfrod, London
6	N. V. Nayak, "Foundation Design Manual", 2003, Dhanpat Rai and Sons, Delhi.
7	M.P. Moasley, "Ground Improvement Techniques", 1999, Thomas Telford Publishing, ISBN: 978-0727727225

Reference Books	
1	Koerner, R.M. "Designing with Geosynthetics",2012, Vols. 1&2, 6th Edition, Xlibris Corporation, USA.
2	Hausmann, M.R, "Engineering principles of ground modification", 1976, McGraw-Hill Publishing Co., New York, N.Y. USA.
3	Jewell, R.A. "Soil reinforcement with geotextiles", 1996, CIRIA & Thomas Telford, London, U.K.

Web links and Video Lectures (e–Resources)	
1	https://archive.nptel.ac.in/courses/105/108/105108075/
2	http://kcl.digimat.in/nptel/courses/video/105101143/L01.html
3	http://kcl.digimat.in/nptel/courses/video/105106052/L01.html
4	https://www.youtube.com/watch?v=6pLzhO8DHuk
5	https://www.youtube.com/watch?v=I3oYNQ5psNU
6	http://acl.digimat.in/nptel/courses/video/105102160/L01.html
7	http://acl.digimat.in/nptel/courses/video/105101200/L08.html
8	http://sdnbvc.digimat.in/nptel/courses/video/105101143/L01.html
9	https://www.youtube.com/watch?v=tAogDgJSknI
10	https://www.youtube.com/watch?v=kH0ed84JWjg
11	http://kcl.digimat.in/nptel/courses/video/105108075/L17.html

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**2**	**3**	**3**		
CO2	**3**	**2**	**2**	**3**		**2**
CO3	**2**		**3**	**3**	**3**	
CO4	**3**	**3**	**3**	**3**	**3**	
CO5	**3**	**3**	**2**	**3**	**3**	**3**

Semester: I						
Materials characterization						
Course Code	**:**	MCV114B		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	2:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	20L + 20SDA		**SEE**	**:**	50 Marks
Course Type	**:**	PCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Basic knowledge of physics and chemistry, Familiarity with mathematical concepts, Understanding of basic materials science principles
Knowledge on Fundamental Concepts	Material Properties, Characterization Techniques
Knowledge on Connected Tools (If any)	Environment, Transportation etc.

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the morphology and composition at Micro and Nano level Material
CLO2	Study Pavement Materials – Soil sub grade, Base layers material characterization. Characterization of bituminous binders: different types, properties and uses
CLO3	Study the Non-renewable sources of energy and Environmental aspects.
CLO4	Understand the sustainable materials used in construction.
CLO5	Understand the various aspects of Geotechnical components, and Geological structures.

Module – 1	**08 Hrs**
Introduction to Materials Characterization: Basics of tools in understanding the morphology and composition at Micro and Nano level– SEM, XRD, EDAX; sample preparation, interpretation of results for specific applications In-situ testing of materials/components – Basics of Non- destructive testing – ultra-sonic pulse velocity tests, rebound hammer test, carbonation test, corrosion test using half-cell potentiometer test, core-sample extraction and preparation for lab test. Interpretation of results for specific performance parameters. **Text Book 1:** Ch1:1.2, Ch3:3.1-3.2 **Text Book 2:** Ch5	
Module – 2	**08 Hrs**
Pavement Materials: Soil sub grade, Base layers material characterization. Characterization of bituminous binders: different types, properties and uses, physical tests on bitumen, Rheological and pavement performance related properties, Modified binders, criteria for selection of different binders, Bituminous mixes, types, requirements, properties, tests, Marshall Method of mix design Criteria and super pave mix design, Additives & Modifiers to binders. **Portland cement and cement concrete for use in road works:** requirements, OPC as per IS 269: 2015, design of mix for CC pavement as per BIS standards, use of additives / admixtures, joint filler and sealer materials and their characterization. **Alternate and New materials:** Reclaimed Asphalt Pavement, Fly Ash, Slag, GGBS and other marginal materials & waste materials, Characteristics and application in road construction. Pavement stabilization using innovative and sustainable materials. Concept of Value Engineering in Infrastructure engineering. **Text Book 2:** Ch10:10.1-10.3 **Text Book 3:** Ch6: 6.3 **Text Book 4:** Ch7: 7.5	
Module – 3	**08 Hrs**

Carbon cycle and role of construction material such as concrete and steel, etc. CO2 contribution from cement and other construction materials. Control of energy use in building, ECBC code, codes in neighboring tropical countries, features of LEED and TERI Griha ratings, Performance ratings of green buildings

Non-renewable sources of energy and Environmental aspects – energy norm, coal, oil, natural gas, Nuclear energy, Global temperature, Greenhouse effects, global warming. Acid rain - Causes, effects and control methods. Regional impacts of temperature change

Text Book 3: Ch2: 2.4-2.5
Text Book 4: Ch3: 3.2
Text Book 5: Ch7: 7.1

Module – 4	**08 Hrs**

Factors influencing nature and formation of soils. Soils as a multiphase material, Complexity of soil nature, Typical soil deposits with special reference to Indian soils. Basic engineering properties of different soils and their uses.

Study of rocks: Formation, basic types of rocks, igneous, sedimentary, metamorphic rocks and their classification.

Geological structures: Folds, faults and joints, their classification, criteria for the identification of faults and other discontinuities.

Text Book 6: Ch2: 2.3-2.**5**
Text Book 5: Ch3: 3.1

Module – 5	**08 Hrs**

Sustainability index parameters: Understanding the Embodied energy, carbon dioxide emission, global warming potential of materials, Re-use and recycle potential of common building materials.

Text Book 3: Ch4: 4.1-4.2

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply knowledge to manage and utilize micro and nano-level materials effectively in construction
CO2	Analyze the characteristics of soil subgrade and base layers to synchronize them with construction activities.
CO3	Design sustainable construction solutions by selecting appropriate materials based on necessity and budget constraints.
CO4	Evaluate and select suitable non-renewable energy sources while considering environmental impacts.
CO5	Apply advanced geotechnical software tools for problem-solving and decision-making in engineering projects.

Text Books	
1	Sam Zhang and Lin Li, "Materials Characterization Techniques", CRC Press Inc; 1st edition (22 December 2008), ISBN-10: 1420042947, ISBN-13 : 978-1420042948.
2	A. T. Papagiannakis, E. A. Masad "Pavement Design and Materials", 2nd Edition May 2024, ISBN: 978-1-394-15018-2, May 2024,656 pages.
3	William D. Callister Jr. and David G. Rethwisch, "Introduction to Materials Science and Engineering"10th edition. Hoboken, NJ: Wiley, [2018] ISBN-13: 9781119321590
4	Michael F Ashby, "Materials and the environment Eco-informed material choice", Elsevier Inc., 2009, 400 pp ISBN 978-1-85617-608-8
5	GRIHA Version 2019 Manual (VOLUME I), GRIHA Council and The Energy and Resources Institute, ISBN: 9788179936870, 81-7993-687-2, Edition: 1, 2021Pages:979.

6	Soil Behavior and Critical State Soil Mechanics Wood, D.M (1991)-Cambridge university press3.OnlineISBN:9781139878272 DOI: https://doi.org/10.1017/CBO9781139878272
7	Soil Mechanics SI version- Lambe, T. W. and Whitman, R. V, John Wiley &Sons, Publication date1979; ISBN 10 0471022616; ISBN 13 9780471022619

Reference Books	
1	National Building Code of India - 2005, Bureau of Indian Standards, BIS, New Delhi, © BUREAU OF INDIAN STANDARDS ICS 0.120; 91.040.01 ISBN 81-7061-026-5
2	Donold P Coduto, "Geotechnical Engineering, Phi Learning Private Limited, New Delhi, 1st Edition - 14 July 1998. ISBN-13: 978-0135763803 ISBN-10: 0135763800

Web links and Video Lectures (e–Resources)	
1	https://youtu.be/EJoUQP-5g7g?si=QaQ2MDuIpYKiUU9t
2	https://youtu.be/sQ63_AvwGFY?si=CHOTyOmNYM5tw0f2
3	https://youtu.be/WoAN9YAhs3g?si=_IjUDzU_SSoeviMa
4	https://youtu.be/OEhKwuNolbM?si=H2QBEcarbYRntNFr
5	https://youtu.be/9qqV8hF7B88?si=DbpHT4r8SwRhAsYl
6	https://youtu.be/mh51mAUexK4?si=lSBO9szSGQtLyObw
7	https://youtu.be/DB1dbhzR6kY?si=-oy7L-uvmEoz_Ozs
8	https://youtu.be/XWdYLfhrC2A?si=Iwetm-uCOohw1tPJ
9	https://youtu.be/L9SkmXsEyvo?si=aReLxwwxgQLWwrcd

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**		**3**			
CO2	**3**	**2**	**3**	**3**		
CO3			**3**	**3**	**3**	**3**
CO4			**3**		**3**	**2**
CO5	**3**	**3**				**3**

Semester: I						
Non-Destructive Testing for Civil Engineering						
Course Code	**:**	MCV114C		**Credits**	**:**	3
Hours/Week (L:T:P)	**:**	2:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	20 L + 20 SDA		**SEE**	**:**	50 Marks
Course Type	**:**	PCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Analysis of Structures, Concrete technology
Knowledge on Fundamental Concepts	Construction Techniques, Materials properties
Knowledge on Connected Tools (If any)	NDT Equipment

Course Learning Objectives: This course will enable the students to	
CLO1	Impart knowledge on various Non-destructive testing techniques and their applications in civil engineering processes and structures.
CLO2	Teach principles of various NDT methods
CLO3	Demonstrate NDT equipment and procedures
CLO4	Explore applications in civil engineering processes and structures

Module – 1	**08 Hrs**
Introduction and Management of NDT activities: Role of NDT in material science, Nature, Definition, Purpose and Importance Advantages and limitations of NDT, Various NDT Methods-Principles and applications and limitations of Management of NDT Processes. **Text Book 1:** Ch1: 1.1, 1.2, 1.3, 1.4	
Module – 2	**08 Hrs**
Surface NDT methods **Visual Testing:** Requirements, Equipment, for lab in situ and Remote Visual Testing, Visual inspection of welds, and visual acceptance standards **Penetrant Testing**: types, procedures, test equipment, sensitivity indicators, flaw evaluation, ASME Acceptance standards, Advantages and limitation. Studying the working principles of Rebound Hammer. **Magnetic Testing:** Types, procedures test equipment ASME Acceptance Standards. Advantages and limitations of applications **Eddy current Testing**: Principles Types equipment advantages and limitations. **Text Book 1:** Ch. 4: 4.1, 4.2, 4.3, 4.4, Ch. 5: 5.1-5.9, Ch. 6: 6.1-6.4	
Module – 3	**08 Hrs**
NDT Methods for Internal Inspection: Radiography Testing Principles Techniques Sensitivity analysis, Equipment Radiation sources- X rays Gamma rays and neutrons, Detectors X ray films Imaging plates, Image processing Interpretation and defect evaluation Computed Tomography its advantages and disadvantages. **Ultrasonic Testing:** Principles its advantages and disadvantages. Equipment Techniques Probes, A B & C Scan method, Phased array Ultrasonic Testing Advantages and Limitations. Studying the working principles of Ultrasonic Pulse Velocity Meter, Profometer. **Thermography:** Principles equipment applications advantages, limitations and applications **Acoustic Emission:** Principles, Types equipment Advantages limitations and applications **Text Book 1:** Ch. 2: 2.1-2.6, Ch.3: 3.5 - 3.9, Ch.7: 7.1, 7.2	
Module – 4	**08 Hrs**

NDT of Bridges and Dams: Types of Bridges and their main issues& failure causes and preventive measures. Different NDT methods and applications concerning the Inspection of important bridge elements. Types of Dams and their main issues& failure causes and preventive measures. Different NDT methods and applications concerning the Inspection of important dam elements. **Text Book 2:** Ch.1: 1.1 -1.4, Ch.2: 2.1 - 2.12 **Text Book 3:** Ch.1: 6.1 - 6.13
Module – 5 | **08 Hrs**
NDT of Concrete Structures: Important Case studies like Case study of Dhruva Reactor building. Residual life assessment methods in civil engineering. Study of NDT of Concrete Structures in India. Studying the working principles of Scanning Electron Microscopy (SEM) and XRD testing methods. **Case studies and NPTEL videos**

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the Knowledge on various Non-destructive testingtechniques and their applications in Civil engineering processes and structures.
CO2	Interpret test results and apply industry standards to evaluate the significance of findings.
CO3	Analyze and interpret the principles, techniques, and equipment used in various Non- Destructive Testing (NDT) methods for internal inspection
CO4	Assess the significance of different failure mechanisms and the role of preventive measures in extending the service life and safety of these critical infrastructures.
CO5	Critically analyze case studies, applying NDT findings to real-world situations and offering informed judgments regarding the structure's integrity and potential failure causes.

Text Books	
1	J Prasad, CG Krishnadas Nair and T Rangachari "Nondestructive Testing of materials" Tata McGraw-Hill Publishing Company Limited NEW DELHI ISBN (13): 978-0-07- 070703-0, ISBN (10): 0-07-070703-0
2	A.K. Gupta, "NON DISTRUCTIVE TESTING OF BRIDGES" Second Edition, (Revised & Reprinted October 2014) Indian Railway Institute of Civil Engineering Pune 411001
3	Dr. R. K. Gupta, "Manual for Assessing Structural Safety of Existing Dams" Dam Safety Rehabilitation Directorate 3rd Floor, CWC New Library Building R. K. Puram New Delhi - 110066

Text Books	
1	Nondestructive Testing handbook Vol 10 Nondestructive Testing Overview American society for nondestructive testing
2	DhrvaRai, Sateesh and Dr Verde "Non-Destructive Evaluation of Concrete structures" Case study BARC 5. Methods for Predicting Remaining Life of Concrete in Structures NISTIR4954 J Clifton and Pommersheim, Building and Fire Research Laboratory, Gaithersburg, Maryland 20899
3	Neethu Urs, Manthesh B S,Harish Jayaram, Dr. M N Hegde "Residual Life Assessment of Concrete Structures-A Review"

Reference Books	
1	Non-Destructive Evaluation and Quality Control, Metal Handbook, Vol.17, 9th Edition, ASM, 1989
2	Baldev Raj, Jayakumar T, Thavasimuthu M, "Practical Non-Destructive testing", 3rd. Edition, Narosa, 2019
3	Srivastava KC," Handbook of Magnetic Particle Testing", Oscar Publications, 1998

4	Hull B, "Non-Destructive Testing", Springer, 2012

Web links and Video Lectures (e–Resources)	
1	https://archive.nptel.ac.in/courses/113/106/113106070/
2	https://www.youtube.com/watch?v=lmyi-LpwhtQ
3	https://www.youtube.com/watch?v=lPEPLjNrF0I
4	https://www.youtube.com/watch?v=Fk9PdqhqVRc
	Skill Development Activities Suggested 1) Identifying material properties like compressive strength, corrosion, and microstructural defects using NDT methods. 2) Documentation of the findings from NDT techniques in detailed reports, including data analysis and recommendations for further actions. 3) Data Interpretation and Diagnosis: Develop skills in interpreting NDT results, such as reading ultrasonic wave 18 signals, analyzing thermal images, and detecting voids or cracks

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**1**	**2**	**3**	**3**	**2**
CO2	**3**	**3**				**2**
CO3	**1**	**1**	**3**	**3**		**2**
CO4	**1**	**1**	**3**			**2**
CO5	**3**	**3**	**2**			**2**

Semester: I						
REMOTE SENSING & GEOGRAPHICAL INFORMATION SYSTEM						
Course Code	**:**	MCV114D		**Credits**	**:**	3
Hours/Week (L:T:P)	**:**	2:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	20L + 20 SDA		**SEE**	**:**	50 Marks
Course Type	**:**	PCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Advanced Surveying, Map Reading Skills
Knowledge on Fundamental Concepts	Geographical terms such as latitude, longitude, topography, and spatial data.
Knowledge on Connected Tools (If any)	Basic Computer Skills

Course Learning Objectives: This course will enable the students to	
CLO1	Inculcate the Core Concepts and Methodologies of Remote Sensing and GIS
CLO2	Apply Image Processing Techniques for Data Interpretation
CLO3	Design and Develop Spatial Databases for Real-World Applications
CLO4	Conduct Advanced Spatial Analysis for Resource Management
CLO5	Integrate Remote Sensing and GIS for Decision-Making

Module – 1	**08 Hrs**
Remote Sensing Basic Principles: Basic concept of Remote Sensing, Data and Information, Remote Sensing data collection, Remote sensing advantages & limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and earth surface features (soil, water, and vegetation), Resolution (spatial, spectral, Radiometric and temporal), Image registration and False color composite, Elements of visual interpretation techniques. **Remote Sensing Platforms and Sensors:** Satellite System Parameters, Sensor Parameter: Spatial Resolution, Spectral Resolution, Radiometric Resolution; Imaging Sensor Systems: Multispectral Imaging Sensor System, Thermal Sensing System, Microwave Imaging Systems; Earth Resources Satellites: Landsat Satellite Programme, SPOT Satellite, Indian Remote Sensing Satellite (IRS); Meteorological Satellites: NOAA Satellite, GOES Satellite. **Text Book 1:** Ch 1: 1.1 – 1.8, Ch 5: 5.1- 5.17	
Module – 2	**08 Hrs**
Visual Image Interpretation: Introduction, Elements of Image Interpretation, Image Interpretation Strategies, Image Interpretation Keys, Color Perception and Color Mixing, Basic Equipment for Visual Interpretation, Relationship between Visual Image Interpretation and Computer Image Processing. **Digital Image Processing:** Introduction, Basic character of Digital Image, Pre-processing: Geometric Correction Methods, Radiometric Geometric Correction, Atmospheric Geometric Correction, Image Enhancement Techniques: Contrast Enhancement, Spatial Filtering Techniques: Low Pass Filters, High Pass Filters. Filtering for Edge Enhancement: Image Transformations NDVI Transformation, PCA Transformation. Image Classification: Supervised Classification, Training Dataset, Unsupervised Classification. **Text Book 1:** Ch 1: 1.12, Ch 7: 7.1- 7.17	
Module – 3	**08Hrs**
Geographic Information System: Introduction to GIS, Components of a GIS, Geographically Referenced Data, Spatial Data-Attribute data- Joining Spatial and attribute data. GIS Operations: Spatial Data Input – Attribute data Management, Geographic coordinate System, Datum, Map Projections: Types of Map Projections, Projected coordinate Systems. UTM Zones. **Text Book 2:** Ch 7: 7.1- 7.12	
Module – 4	**08 Hrs**

Spatial Database Management Systems: Introduction, Data Storage, Database Structure Models, Database Management system, Entity Relationship Model, Normalization. **Data Models and Data Structures:** Introduction, GIS Data Model, Vector Data Structure, Raster Data structure, Geodatabase and Metadata. Modelling Surfaces: DTM Generation, Triangulated Irregular Network (TIN), DTM Manipulation, DTM Interpretation. DTM Applications. **Text Book 2:** Ch 9: 9.2, Ch 8: 8.1- 8.6, Ch 12: 12.8.1 – 12.8.7
Module – 5 **08 Hrs**
Spatial Analysis: Introduction to spatial analysis, Vector Operations and Analysis, Network Analysis, Raster Data Spatial Analysis. Interpolation: Introduction to Interpolation, Global Methods of Interpolation, Local Methods of Interpolation. **Web GIS:** Introduction, Web GIS, OGC & Web Services. **Text Book 2:** Ch 12: 12.2 – 12.7

Course Outcomes: After completing the course, the students will be able to	
CO1	Identify the key components of remote sensing systems, including sensors, platforms, and data acquisition methods.
CO2	Apply Image Processing Techniques for Data Interpretation
CO3	Design and Develop Spatial Databases for Real-World Applications
CO4	Conduct Advanced Spatial Analysis for Resource Management
CO5	Integrate Remote Sensing and GIS for Decision-Making

Text Books	
1	Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, Remote Sensing and Image Interpretation, 7th edition, WILEY, ISBN 978-1-118-34328-9
2	M Anji Reddy, Remote Sensing and Geospatial Information Systems, 3rd. Edition, B S Publications, ISBN: 978-81-7800-135-7
3	Kali Charan Sahu, Textbook of Remote Sensing And Geographical Information Systems, First Edition, Atlantic Publishers and Distributors ISBN:10 -8126909102

Reference Books	
1	Longley, P. A, Goodchild, M. F, Maguire, D.J, and Rhind, D. W, "Geographic Information Systems and Science", 2nd Edition, John Wiley and Sons. ISBN: 0-470-87000-1
2	Burrough, P. A, and McDonnell, R.A, "Principles of Geographical Information Systems", 2nd Edition. Oxford University Press, ISBN: 978-0-19-874284-5
3	Demers, M. N, "Fundamentals of Geographic Information Systems", 3rd Edition. John Wiley & Sons, ISBN:9788126516865

Web links and Video Lectures (e–Resources)	
1	https://archive.nptel.ac.in/courses/105/101/105101206/
2	https://www.youtube.com/watch?v=b9fmR8dAEo8
3	https://www.youtube.com/watch?v=1pJInslFkPA
4	https://archive.nptel.ac.in/courses/117/105/117105135
5	https://archive.nptel.ac.in/courses/105/107/105107206
6	https://www.youtube.com/watch?v=NFUfC5Qpa8s
7	https://ocw.mit.edu/courses/res-str-001-geographic-information-system-gis-tutorial- january-iap-2022/pages/gis-level-2/
8	https://www.youtube.com/watch?v=5qAKnY_RMZA

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	1	1	1
CO2	3	2	3	2	1	1
CO3	3	2	3	2	2	3
CO4	3	2	3	3	2	1
CO5	3	2	3	3	2	2

Semester: I						
SPECIAL CONCRETE						
Course Code	:	MCV114E		**Credits**	:	3
Hours/Week(L:T:P)	:	2:0:2		**CIE**	:	50Marks
Total Hours	:	20L +20SDA		**SEE**	:	50Marks
Course Type	:	PCC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Building materials and Concrete Technology
Knowledge on Fundamental Concepts	Material properties, Mix design
Knowledge on Connected Tools (If any)	NDT equipment's

Course Learning Objectives:	
CLO1	To introduce students to various types of special concrete such as high-strength concrete, high-performance concrete, fiber-reinforced concrete, self-compacting concrete, light-weight concrete, and others.
CLO2	To make students Apply the knowledge of design methods to achieve desired properties of special concretes.
CLO3	To develop students' ability to conduct laboratory experiments to test the properties of special concrete, including compressive strength, durability, and shrinkage tests.
CLO4	To explore the practical uses of special concrete in various industries like construction, transportation, infrastructure, and even in high-tech applications such as aerospace, underwater, or nuclear environments.
CLO5	To expose students to the latest innovations in special concrete, including nanotechnology, smart concrete, and advances in materials and manufacturing techniques.

Module – 1	**08Hrs**
Constituent materials: Role of constituents, Components of modern concrete, Rheology, Mineral and Chemical admixtures and their effect on properties of concrete. Special cements: Need, Classifications, Blended cements, modified hydraulic cements, calcium aluminate cements, calcium sulphate-based binders, calcium sulfo-aluminate cements, shrinkage compensating (or) expansive cements, macro defect-free cements, phosphate cements, fast setting cements, their Performance and prescriptive specifications, Methods of mix proportioning: IS method, ACI method and BS method **Text Book 1:** Ch.2, Appendix II & III	
Module – 2	**08Hrs**
Light Weight concrete: Introduction, classification, strength and elastic properties, durability, mix proportioning. **High density concrete:** Radiation shielding ability of concrete, materials for high density concrete, mix proportioning, properties in fresh and hardened state, placement methods. **Self-compactingConcrete (SCC):** General characteristics, Properties, microstructure. Robustness and methods of mix proportioning and applications. **Text Book 2:** Ch.12: 12.1, 12.2, 12.3, 12.9	
Module – 3	**08 Hrs**
Fibre reinforced concrete: Fibre materials, mix proportioning, distribution and orientation, interfacial bond, properties in fresh state, Toughness and impact resistance, Elastic modulus, creep, and drying shrinkage, strength and behavior in tension, compression and flexure, crack arrest and toughening mechanism, durability and applications.	

Ferro cement: Materials, mechanical properties, cracking of ferrocement, Types and methods of construction, strength and behavior in tension, compression and flexure, Design of ferrocement in tension, durability, and applications. **Text Book 2:** Ch.12: 12.6 **Text Book 4:** Ch.12.19
Module – 4 **08 Hrs**
High strength concretes: Materials and mix proportion, Microstructure, stress-strain relation, fracture, drying shrinkage, and creep. **Mass concrete and Roller compacted concrete:** Constituents, mix proportioning, properties in fresh and hardened states, applications and limitations. **Different NDT techniques for performance evaluation of structures:** Rebound hammer, Ultrasonic pulse velocity meter, Profometer, Ground Penetrating Radar (GPR), Core test, Carbonation and Corrosion assessment. **Text Book 2:** Ch.12: 12.2, 12.11, 12.12, **Text Book 3:** Ch. 2: 2.1 to 2.6, Ch.3: 3.5 to 3.9, Ch.7: 7.1, 7.2
Module – 5 **08 Hrs**
Other concretes for special properties: High-volume fly ash concretes, geo-polymer concrete, pervious concrete, aerated concrete, ultrahigh performance concretes, Reactive powder concrete, Bacterial concrete, Heat resistant and refractory concrete. Their significance, materials, general consideration strength and durability aspects. Mixture proportioning and parameters in the development of Special concreting operations: Guniting and shot creting, pre- placed aggregate, anti-washout concretes, concrete pumping, Tremie placement for underwater applications. **Text Book 4:** Ch.12.1 ,12.22, 12.24, 12.6, 12.21, 12.15, 7.14, 7.13

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the fundamental principles behind the mix design of special concrete and how additives, fibers, and curing methods affect its performance.
CO2	Apply the knowledge of special concrete to design a mix for a specific application, ensuring it meets the required mechanical and durability standards.
CO3	Demonstrate the ability to conduct practical laboratory experiments to test the properties of special concrete and interpret the results for real-world applications.
CO4	Analyze the performance of different special concretes based on their mechanical properties, durability, and workability in specific conditions
CO5	Assess the quality control measures and troubleshooting techniques used during the production, transportation, and placement of special concrete, ensuring they comply with industry standards and specifications.

Text Books	
1	A.M. Neville, (2000) "Properties of Concrete", 4th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. ISBN: 978-81-7758-587-2
2	P. Kumar Mehta, Paul J.N. Monterio, "Concrete: Microstructure, Properties and Materials", Tata McGraw Hill
3	J Prasad, CG Krishnadas Nair and T Rangachari "Nondestructive Testing of materials "Tata McGraw-Hill Publishing Company Limited NEW DELHI ISBN (13): 978-0-07-070703-0 ISBN (10): 0-07-070703-0
4	M.S. Shetty, "Concrete Technology Theory and Practice 8ED (PB 2022), S Chand Publishing, ISBN-13 978-8121900034

Reference Books	
1	Short A and Kinniburgh, “Light Weight Concrete”- Asia Publishing House, 1963
2	Aitcin P.C. “High Performance Concrete”-E and FN, Spon London 1998
3	Rixom.R. and Mailvaganam.N., “Chemical admixtures in concrete”- E and FN, Spon London 1999

Web links and Video Lectures (e–Resources)	
1	https://www.sciencedirect.com/topics/engineering/special-concrete
2	https://www.youtube.com/watch?v=KHnFwnlCeZQ&pp=ygUWI3N1cGVyd29ya2FibGVj b25jcmV0ZQ%3D%3D
3	https://www.youtube.com/watch?v=RqnpEX-Sqg8
4	https://ecajmer.ac.in/facultylogin/announcements/upload/Unit-3(FRP%20&%20Ferrocement).pdf

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**1**	**2**	**3**	**3**	**2**
CO2	**3**	**3**				**2**
CO3	**2**	**2**	**3**	**3**		**2**
CO4	**2**	**2**	**3**			**2**
CO5	**2**	**2**	**2**			**2**

Semester: I						
ENVIRONMENTAL GEOTECHNOLOGY						
Course Code	:	MCV115A		**Credits**	:	3
Hours/Week (L: T: P)	:	2:0:2		**CIE**	:	50 Marks
Total Hours	:	20L + 20SDA		**SEE**	:	50 Marks
Course Type	:	PCC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Soil Mechanics, Waste management
Knowledge on Fundamental Concepts	Landfills, Soil Stability, Soil Pollution
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Explore the role of geotechnical engineering in addressing environmental issues such as waste management, soil remediation, and pollution control.
CLO2	Predict the behavior of contaminants and evaluate their impact on soil, groundwater and surrounding ecosystems.
CLO3	Investigate the mechanisms of contaminant transport in the subsurface, including advection, diffusion, and dispersion.
CLO4	Develop skills in designing geo-environmental systems, including landfills, waste containment systems, and contaminated site remediation strategies.
CLO5	Examine the role of geo-synthetics in environmental geo-technology, including their application in waste containment, groundwater protection, and erosion control.

Module – 1	**08 Hrs**
Soil Pollutant Interaction: Introduction to geo environmental engineering – environmental cycle – sources, production and classification of waste – causes of soil pollution – factors governing soil-pollutant interaction- Physicochemical behaviour and modelling -failures of foundations due to pollutants **Text Book 1:** Ch 1: 1.1-1.8, Ch 13: 13.7 – 13.12	
Module – 2	**08 Hrs**
Characterization, Stabilization and Disposal of waste: Safe disposal of waste – site selection for landfills –characterization of land fill sites – waste characterization –stability of landfills – current practice of waste disposal- passive contaminant system - Hazardous waste control and storage system – mechanism of stabilization - solidification of wastes – micro and macro encapsulation – absorption, adsorption, precipitation- detoxification — organic and inorganic stabilization **Text Book 1:** Ch 17: 17.1-17.11	
Module – 3	**08 Hrs**
Transport of Contaminants: Contaminant transport in sub surface – advection – diffusion – dispersion – governing equations– contaminant transformation – sorption – biodegradation – ion exchange – precipitation – hydrological consideration in land fill design – ground water pollution – bearing capacity of compacted fills – pollution of aquifers by mixing of liquid waste – protecting aquifers. **Text Book 1:** Ch 7: 17.1-17.10, Ch 12: 12.5	
Module – 4	**08 Hrs**
Detection and Testing Methods: Methodology-review of currents soil testing concepts–Proposed approach for characterization and Identification of contaminated ground soil for engineering purposes **Text Book 1:** Ch 3: 3.8-3.11, Ch 12: 12.5	
Module – 5	**08 Hrs**

Remediation of Contaminated Soils: Rational approach to evaluate and remediate contaminated sites – monitored natural attenuation– exsitu and insitu remediation – solidification, bio – remediation, incineration, soil washing, electro kinetics, soil heating, verification, bio venting – Ground water remediation – pump and treat, air sparging, reactive well- application of geo synthetics in solid waste management –rigid or flexible liners. **Text Book 2:** Ch 14: 14.1 -14.8

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply physicochemical modeling techniques to predict soil behavior under pollutant influence.
CO2	Design and select suitable landfill sites based on waste characterization and stability analysis.
CO3	Identify and apply various methods for detecting and testing soil contamination
CO4	Design and implement soil and groundwater remediation strategies for the effective restoration of contaminated sites.
CO5	Evaluate stabilization techniques such as solidification, encapsulation, and detoxification methods for waste and polluted soil

Text Books	
1	H. Y. Fang, "Introduction to Environmental Geotechnology". press New York, 1997. ISBN-10- 0849382882
2	John Wiley & Sons, "Geoenvironmental Engineering-Site Remediation, Waste Containment and Emerging Waste Management Technologies", ISBN-978- 0471215998
3	Deyi Hou (Butterworth-Heinemann), Sustainable Remediation of Contaminated Soil and Groundwater: Materials, Processes, 2019, ISBN-9780128179833

Reference Books	
1	Eduardo Pavan Korf, "Environmental Geotechnics: Waste and Geotechnical Stabilization", First Edition,2004, NOVA publishers, ISBN: 979-8-89113-651-9
2	T. F. Zimmie, "Environmental Geotechnics-Proceedings of Sessions of Geo-Denver 2000" Held in Denver, Colorado, First Edition, August 5-8, 2000 (Geotechnical Special Publication) ISBN: 978- 0784405192
3	Issa S. Oweis, Raj P. Khera, "Geotechnology of Waste Management", Butterworth- Heinemann Ltd (1 March 1990) ISBN:978-040800969

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**	**3**	**3**	**1**	**2**
CO2	**3**	**2**	**3**	**3**	**2**	
CO3	**3**	**3**	**3**	**3**	**3**	**2**
CO4	**3**	**2**	**2**	**3**	**3**	
CO5	**3**	**3**	**2**	**2**	**2**	

Semester: I						
DETAILED PROJECT REPORT PREPARATION						
Course Code	**:**	MCV115B		**Credits**	**:**	3
Hours/Week (L: T: P)	**:**	2:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	20L + 20SDA		**SEE**	**:**	50 Marks
Course Type	**:**	PCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Transportation Engineering.
Knowledge on Fundamental Concepts	Highway Components, Highway Geometric Design.
Knowledge on Connected Tools (If any)	-

Course Learning Objectives: This course will enable the students to	
CLO1	Acquire knowledge on how to conduct essential site investigations, including topographical surveys, soil investigations, material surveys, and traffic forecasting to ensure the project's success.
CLO2	Gain insights into pavement design, drainage considerations, and other essential elements for road infrastructure projects.
CLO3	Conduct thorough Environmental and Social Impact Assessments (ESIA) and implement mitigation strategies.
CLO4	Analyze the social impact of road projects and also determine the economic feasibility analysis for justification of investments
CLO5	Gain knowledge on various project funding options, the financial viability of Public- Private Partnership (PPP) projects, and the tendering and evaluation processes.

Module – 1	**08 Hrs**
Introduction: Project overview, objectives, Location stakeholder engagement plan, Project scope, Time-lines, Investigations for preparation of project reports for new and up-gradation of roads. Objects and scope of pre – feasibility, Feasibility and detailed studies for project preparation. Typical HR structure for preparations and implementation of projects, Key Acts related to Road / infrastructure Projects. Salient features of ongoing road/ infrastructure projects in India, Stakeholder analysis and engagement, Project scope and boundaries. **Text Book:1** Ch-5: 5.1,5.2,5.3 **Text Book: 3** Ch-1: 1.1,1.2	
Module – 2	**08 Hrs**
Surveys and investigations: Site investigation, Topographical survey and mapping, Finalization of horizontal alignment and vertical profile of roads, Application of GIS. Soil Investigations, Sequence of Operations, Preliminary Work, Site Reconnaissance, Determination of Soil Profile, Methods of Soil Exploration, Sampling, Material surveys for availability and choice of basic and alternate materials for construction and for soil stabilization. Cross drainage structures and drainage surveys, Interpretation of survey results. Traffic forecasting: classified traffic volume, Growth rate, Projected traffic for assessing roadway requirements, Origin- destination characteristics and studies, Road safety furniture, Mx Road. **Text Book:1** Ch-7: 7.1, 7.4, 7.9, 7.10	
Module – 3	**08 Hrs**

Design and Engineering: Need for Assessment of Various Alternatives, Steps involved in design, Design standards and guidelines, Geometric design of roads, Cross sectional elements, Horizontal and vertical alignment, Intersections-requirements, Capacity of roads, Roadway facilities, Pedestrian facilities, Bus bays, Truck lay byes, traffic, Medical and vehicle aid posts, Street lighting, Pavement design and materials, Drainage an Integral Part of Geometric Design. **Text Book:3** Ch-3: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6
Module – 4 **08 Hrs**
Environmental and Social Impact Assessment: Objectives, Procedure of environmental impact assessment, Socio economic survey, Analysis of Potential Environmental Impact & Mitigation Measures, Landscaping and tree plantation, Implementation of environment management plan, Environmental Cost Benefit Analysis, Key environmental legislations, Clearances required for road project-environmental, Forest, CRZ, Wildlife, Air, Noise quality standards, Social Management Plan, Community engagement and participation, Conflict resolution mechanism. **Text Book:3** Ch-10: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6
Module – 5 **08 Hrs**
Preparation of DPR: Design details, estimates, BOQ, Drawings and detailed project, Report, Use of software, Cost Estimation and Financial Analysis: Cost Benefit Analysis & Investment Criteria, Environmental & Sustainability Aspects, Financial analysis and viability, Project funding options and financing plan, Risk assessment and mitigation strategies, Public Private Partnership (PPP), Environmental economics, Toll collection, Economic viability PPP projects, Risk analysis, Case studies Rate Analysis: Prerequisites, Factors affecting rate analysis, overhead expenses, Procedure for rate analysis, Schedule of rates, Task work: labor requirement for different works, Material requirement for different works, Rate analysis of different items of work. Tendering process - Preparation of tender documents for different types of road/infrastructure projects, Tender evaluation. Salient clauses of tender document, Tender evaluation, Operations & Maintenance Plan. **Text Book:1** Ch-11: 11.1, 11.2, 11.3, 11.4, 11.5

Course Outcomes: After completing the course, the students will be able to	
CO1	Develop a comprehensive project plan, covering all critical aspects such as stakeholder engagement, project scope, timelines, and risk management.
CO2	Conduct various site investigations, interpret survey results, and apply advanced techniques like GIS to support road project development and traffic forecasting.
CO3	Design roads considering the best geometric standards, alignments, intersections, and essential roadway facilities, ensuring the project meets technical, safety, and operational standards.
CO4	Assess environmental and social impacts, mitigate adverse effects, and ensure compliance with environmental laws and standards, contributing to sustainable road infrastructure development
CO5	Develop expertise in cost estimation, financial analysis, risk management, and PPP models for road projects to evaluate economic viability and ensure optimal financing and tendering.

Text Books	
1	L.R. Kadyali, N.B.Lal, "Principles and Practices of Highway Engineering", Khanna Publishers, ISBN:9788193328439, 2010.
2	Dr. Raghavendra Kumar, "Principles of Road Design and Engineering: Geometric Design, Infrastructure, and Assessment", Wiley & Sons, 2012.
3	Srinivasa R Kumar., "Textbook of Highway Engineering", Orient Blacks wan Private Limited - New Delhi, ISBN-13, First Edition 1 January 2011.

Reference Books	
1	IRC: SP:19 - 2001, Manual for Survey, "Investigation and Preparation of Road Projects"- (first revision), Indian Roads Congress.
2	IRC: SP: 30 - 1993, "Manual on Economic Evaluation of Highway"- Projects in India (first revision), Indian Roads Congress.
3	IRC SP–38," Manual for Road Investment Decision Model"-1992, Indian Roads Congress.
4	IRC: 9-1972, 35 – 1997,38-1988, 39-1986, 52-2001, 54-974, 62-1976, 64-1990, 66-1976, 67-2001, 69-1977, 73-1980, 79-1981, 80-1981, 86-1983, 98-1997, 99-1988,103-1988, 104- 1988, 110-1996.
5	MoRTH "Specifications for Road Bridge Works"- 2001, fourth revision, Indian Roads Congress.
6	MoRTH "Standard and Bidding Document Procurement of Civil Works"- Part I and II, 2000, Indian Roads Congress.
7	MoRTH "Model Concession Agreement for Small Road Projects"-2000, Indian RoadsCongress.

Web links and Video Lectures (e–Resources)	
1	http://www.youtube.com/channel/UC5fUyyuRnwi7H4DPXUwW4sg
2	https://youtu.be/UXi9wl0w9sY?si=-zdhrBDXiWk3WSP_
3	https://youtu.be/9-MEVIXr3Ko?si=q0wAW7ZihMNe3_ez (IIT Roorkee)
4	https://youtu.be/2VehMMP70HE?si=4gWFt5hAWUYL9l4v (IIT Roorkee)
5	https://youtu.be/WGRdgvcwdI8?si=uwx3tSY_yi_A8hiw

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**	**1**	**3**	**1**	**1**
CO2	**3**	**3**	**2**	**2**	**1**	**1**
CO3	**3**	**2**			**1**	**1**
CO4	**2**	**3**		**2**	**1**	**1**
CO5	**3**	**1**		**2**	**1**	**1**

Semester: I						
Advanced Survey and Location						
Course Code	:	MCV115C		**Credits**	:	3
Hours/Week (L: T: P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	20L + 20SDA		**SEE**	:	50 Marks
Course Type	:	PCC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Engineering Survey
Knowledge on Fundamental Concepts	Principles of both traditional and modern surveying, Exposure of surveying equipment's
Knowledge on Connected Tools (If any)	Basic computer knowledge

Course Learning Objectives: This course will enable the students to	
CLO1	Understand geodetic surveys, including measurements, coordinate systems, and techniques like total station traverse, triangulation, and levelling.
CLO2	Learn the basics of remote sensing, including energy interactions, spectral signatures, and image resolutions.
CLO3	Explore the principles, configurations, and applications of GPR, including signal characteristics, data sampling, resolution, and its use in various media.
CLO4	Analyze LiDAR systems, their components, data processing techniques and applications in areas like hydrology and disaster management.
CLO5	Apply the concepts, systems, and architectures of Location-Based Services (LBS) and their applications in navigation, spatial databases, and mobile communication.

Module – 1	**08 Hrs**
Geodetic Surveying: Plane and geodetic classification, principles of survey, linear and angular measurements, Control survey; Total station traverse, Triangulation, Trilateration, Spirit levelling, Trigonometric levelling, Detailed survey; original, revision, up-dation; Geodetic Control (Horizontal and Vertical) – Geodetic co-ordinate System, Rectangular or Cartesian Co- ordinate System; Geo potential number - Orthometric height, Normal height, Dynamic height and their corrections – single and reciprocal observation of vertical angle. **Text Book 1:** Chapter 1, 2, 4, 6, 7	
Module – 2	**08 Hrs**
Remote Sensing: Introduction, Electromagnetic Spectrum, Energy Interaction with Atmosphere/Earth Surface, Blackbody and Atmospheric window, Spectral signature in RS, Types of Resolutions, Multi-concepts in RS, Satellite Orbits, Various sensors and Platforms -I & II, Very High-Resolution RS Data, Thermal, Microwave and Hyperspectral Images, Visual Interpretation Method. **Text Book 2:** Chapter 1, 2, 3, 4, 5, 6, 8, 10	
Module – 3	**08 Hrs**
Ground Penetrating Radar (GPR): GPR system and signals, measurement configurations, bands, polarizations; Characteristics of host medium, measure of the propagation velocity in a Masonry, Homogeneous soil, Lossy, Magnetic and Dispersive media; GPR data sampling- Frequency and Time steps, shape and thickness of the GPR pulses; Diffraction tomography, horizontal resolution, vertical resolution, spatial step; application field.	

Text Book 3: Chapter 1, 2, 3, 4, 5, 6	
Module – 4	**08 Hrs**
Light Detection and Ranging (LIDAR): Principles and Properties- different LiDAR System- Space Borne and airborne LiDAR missions – Typical parameters of LiDAR system. Data Processing – geometric correction-data quality enhancement – filtering - LiDAR mapping applications: Hydrology, Disaster mitigation and management, etc. Unmanned Aerial Vehicles (UAV): Introduction, Classification, Various components of Drone & their functions. **Text Book 4:** Chapter 1, 2, 3, 4, 5, 6, 7, 8 **Text Book 5:** Chapter 1, 2, 4, 5, 7	
Module – 5	**08 Hrs**
Location Based Services (LBS) & Applications: Concept of location, General Aspects of Location Based Services, Navigation and positioning Systems, A Spatial Database Perspective, Middleware for Location G-Based Services, Interoperability through Standards, Data Collection, Data Transmission in Mobile Communication Systems, Architectures and Protocols for LBS, Network Architecture, Functional Entities, Location Procedures, Applications of LBS. **Text Book 6:** Chapter 1, 2, 3, 4, 5, 6, 7	

Course Outcomes: After completing the course, the students will be able to	
CO1	Adopt geodetic survey techniques to establish control points and precise elevation calculations with necessary corrections.
CO2	Analyze energy interactions in remote sensing, spectral signatures, and sensor data for image interpretation.
CO3	Utilize Ground Penetrating Radar (GPR) techniques to measure propagation velocity, process data and subsurface conditions in various media.
CO4	Apply LiDAR systems and data processing techniques to enhance mapping quality in applications like hydrology and disaster management.
CO5	Develop Location-Based Services (LBS) systems by integrating navigation, spatial databases, and communication protocols for various applications.

Text Books	
1	Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Surveying" Vol. IIL Laxmi Publications, ISBN-10: 9788170088530, ISBN-13:978-8170088530
2	Basudeb Bhatta, "Remote Sensing and GIS", 3rd. Edition, Oxford Higher Education, ISBN-10: 0199496641, ISBN-13: 978-0199496648
3	Harry M. Jol, "Ground Penetrating Radar Theory and Applications" 2009, Elsevier Science, Amsterdam, ISBN-10: 0444533486, ISBN-13: 978-0444533487
4	Pinliang Dong and Qi Chen, LiDAR "Remote Sensing and Applications CRS Press",Taylor and Francis Group, ISBN-10:9781138747241, ISBN-13:978-1138747241
5	George Joseph and S.K. Duggal, "Fundamentals of Remote Sensing and UAVs",3rd Edition, Universities Press, ISBN-10:9386235463, ISBN-13:978-9386235466
6	Axel Kupper, "Location-Based Services: Fundamentals and Operation Wiley publications", ISBN-10:0470750049, ISBN-13:978-0470750049

Reference Books	
1	Raffaele Persico, Wiley, "Introduction to Ground Penetrating Radar – Inverse Scattering and Data Processing", IEEE Press, ISBN-10 : 9781118305003, ISBN-13:978- 1118305003

2	David Clark, "Plane and Geodetic Surveying for Engineers-Higher Surveying", Vol 2 –ISBN-10:9788123911731, ISBN-13:978-8123911731
3	Thomas M. Lillesand, Ralph W. Kiefer, and Jonathan W. Chipman, "Remote Sensing and Image Interpretation" ISBN-10:8126532238, ISBN-13:978-8126532230
4	J. Clendenning, "The Principles of Surveying", Legare Street Press, ISBN-10: 1016289944, ISBN-13:978-1016289948
5	Pinliang Dong and Qi Chen, "LiDAR Remote Sensing and Applications", ISBN-10:9781138747241, ISBN-13: 978-1138747241
6	Georg Gartner, Felix Ortag, "Advances in Location - Based Services"8th International Symposium on Location - Based Services, Vienna 2011, Editors – Springer.

Web links and Video Lectures (e–Resources)	
1	https://www.youtube.com/playlist?list=PLLy_2iUCG87DwNVc3Mz1yYlRA42jSQ1tB
2	https://www.youtube.com/@introductiontogeographicin1189
3	https://www.youtube.com/@gpssurveying9740
4	https://www.youtube.com/@digitallandsurveyingandmap9896

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**	**2**	**3**	**1**	**2**
CO2	**3**	**2**	**2**	**3**	**1**	**2**
CO3	**3**	**2**	**2**	**3**	**1**	**2**
CO4	**3**	**2**	**2**	**3**	**1**	**2**
CO5	**3**	**2**	**2**	**2**	**1**	**2**

Semester: I						
COMPOSITE MATERIALS						
Course Code	:	MCV115D		**Credits**	:	3
Hours/Week (L: T: P)	:	2:0:2		**CIE**	:	50 Marks
Total Hours	:	20L+20T/SDA		**SEE**	:	50 Marks
Course Type	:	PCC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Advanced Concrete Technology, Special Concrete, Strength of Materials
Knowledge on Fundamental Concepts	Basic knowledge on material properties, Matrix Method of Structural Analysis and Mechanics of Deformable Bodies
Knowledge on Connected Tools (If any)	---

Course Learning Objectives: This course will enable the students to	
CLO1	Explore the basic concept and applications of composite materials in civil and structural engineering.
CLO2	Assess the macro-mechanical behaviour of anisotropic materials and their stress -strain relations.
CLO3	Analise the micro-mechanical behaviour of laminas and compute engineering constants.
CLO4	Apply classical laminate theory and failure criteria for composite materials.
CLO5	Implement theoretical knowledge in solving numerical problems and practical engineering scenarios.

Module – 1	**08 Hrs**
Introduction: Introduction to Composite materials, classifications (thermoset and thermoplastic) and civil/structural engineering applications. Constituent materials of composites–Reinforcements and matrix. Rule of mixture. Selection of materials. Manufacturing techniques–Hand layup method and compression moulding method. Basics Of fiber reinforced composite (Synthetic and natural FR Polymer composites). Advantages and Limitations of composites. **Text Book 1:** Ch1:1.1-1.8	
Module – 2	**08 Hrs**
Macro-mechanical behaviour of a Lamina: Introduction, Stress –Strain Relations for Anisotropic Materials. Stiffness's, compliances, and Engineering constants for orthotropic materials. Restrictions on engineering constants. Numerical problems. **Text Book 1:** Ch2:2.1-2.4	
Module – 3	**08 Hrs**
Macro-Mechanical Behaviour of a Lamina contd... Stress-strain relations for plane stress in an orthotropic material. Stress-strain relations for a lamina of arbitrary orientation. Invariant properties of an orthotropic lamina. Strengths of an orthotropic lamina, thermal and mechanical stress analysis. Numerical problems. **Text Book 1:** Ch2:2.5-2.9	
Module – 4	**08 Hrs**

Micro-mechanical behavior of a lamina: introduction, mechanics of materials approach to stiffness. Determination of material constant E1. Determination of material constant E2. Determination of material constant V12. Determination of material constant G12. Numerical problems **Text Book 1:** Ch3:3.1-3.4

Module – 5	**08 Hrs**
Classical composite lamination theory: Cross and angle – play laminates, Symmetric, anti- symmetric and general symmetric laminates. Mechanical coupling. Analysis of simple laminated structural elements ply-stress and strain, lamina failure theories concepts – Maximum Stress Failure Criterion, Maximum Strain Failure Criterion and Tsai-Hill Failure Criterion. Numerical Problems **Text Book 1:** Ch4:4.1-4.6	

Course Outcomes: After completing the course, the students will be able to	
CO1	Infer the types, applications, and manufacturing techniques of composite materials.
CO2	Derive and analyse stress-strain relations for orthotropic materials and laminas under various conditions.
CO3	Compute engineering constants using the mechanics of materials approach.
CO4	Apply laminate theories to analyse and design composite structural elements.
CO5	Solve numerical problems involving composite behaviour and evaluate material failure using failure criteria.

Text Books	
1	Robert M. Jones, "Mechanics of Composite Materials", 2014,2nd Edition, Taylor & Francis, ISBN:9781315272986
2	Isaac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", 2005, 2nd Edition, Oxford University Press, ISBN:0195075064
3	Ever J. Barbero, "Introduction to Composite Materials Design", 2017 3rd Edition, CRC Press, ISBN:1315296489
4	Ronald F. Gibson," Principles of Composite Material Mechanics", 2016 4th Edition, CRC Press, ISBN:1439850054

Reference Books	
1	Krishan K. Chawla, "Composite Materials and Processing", 2013, Springer (Indian Edition) ISBN:3030289834
2	P.K. Mallick," Fibre-Reinforced Composites, Materials, Manufacturing, and Design"CRC Press, Taylor & Francis Group Third Edition- 2007, ISBN:1420005987
3	Madhujit Mukhopadhyay, "Mechanics of Composite Materials", 2005, Universities Press, ISBN:8173714770
4	K. Rajagopal," Engineering Mechanics of Composite Materials", 2017, Vikas Publishing House.
5	K. Shivakumar and A. V. Krishnamurthy, "Introduction to Composite Materials",2015, IK International Publishing House, ISBN:0521381908
6	K. Srinivasan, "Composite Materials: Production, Properties, Testing and Applications",2018, Narosa Publishing House,ISBN: 978-81-7319-929-5

Web links and Video Lectures (e – Resources)

1	Dr. Nachiketa Tiwari, IIT Kanpur: https://www.youtube.com/watch?v=0kB0G6WKhKE&list=PLSGws_74K01-bdEEUElQ9
2	Dr. Kamal Sharma, GLA University, Mathura: https://youtu.be/9yoMPAJ25ss
3	Prof. K Krishna Kishore: https://youtu.be/OurwNsTdLhA?si=G9hFfkeCfD8dy3Z5
4	Dr. Michael Okereke: https://youtu.be/BWdTDYXUd2U?si=j1qx1fzAVwGku1wt
5	Chandra Sekhar Pendyala: https://youtu.be/_OqxGs0gg4E
	Skill Development Activities Suggested: • Comparison Study on composite materials • Technical Presentation on specific type of fiber-reinforced polymer (natural or synthetic) and its application. • Flipped Classroom activities to prepare and present on the practical applications of symmetric, anti-symmetric, and angle-ply laminates in structural engineering.

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**3**	**3**	**2**	**3**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**1**
CO3	**3**	**3**	**3**	**2**	**2**	**1**
CO4	**3**	**3**	**3**	**3**	**2**	**1**
CO5	**2**	**2**	**2**	**2**	**2**	**1**

Semester: I						
Road Safety Engineering and Management						
Course Code	**:**	MCV115E		**Credits**	**:**	3
Hours/Week (L: T: P)	**:**	2:2:0		**CIE**	**:**	50 Marks
Total Hours	**:**	20L + 20SDA		**SEE**	**:**	50 Marks
Course Type	**:**	Professional Elective		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Traffic Engineering
Knowledge on Fundamental Concepts	Traffic Characteristics, Traffic flow parameters
Knowledge on Connected Tools (If any)	---

Course Learning Objectives: This course will enable the students to	
CLO1	Analyze the factors influencing highway safety and the strategies for road safety management.
CLO2	Design a road safety improvement program plan.
CLO3	Analyze accident data and suggest safety measures.
CLO4	Conduct different stages of road safety audit.
CL05	Interpret accident data using statistical analysis.

Module – 1	**08 Hrs**
Highway Safety in India: Traffic crashes on Indian highways, traffic on national highways and state highways, safety on national highways. Introduction to safety: Road accidents, Trends, causes, Collision and Condition diagrams, Highway safety, human factors, Vehicle factors, Road Safety Management System: Multi-causal dynamic systems approach to safety, crash vs accident, road safety improvement strategies, elements of a road safety plan, Safety Data Needs. **Text Book 1:** Ch- 4, 5, 6 **Text Book 2:** Ch- 4, 5	
Module – 2	**08 Hrs**
Statistical Interpretation and Analysis of Crash Data: Before-after methods in crash analysis, Advanced statistical methods, Black Spot Identification & Investigations, Case Studies. Urban Safety and Mobility, Traffic Calming. **Text Book 3:** Ch- 6, 7, 10, 12	
Module – 3	**08 Hrs**
Road Safety Audits: Key elements of a road safety audit, Road Safety Audits & Investigations, Crash investigation and analysis, describe methods for identifying hazardous road locations, Vulnerable Road Users, Case Studies. **Text Book 4:** Ch-3, 5, 7, 9, 11	
Module – 4	**08 Hrs**
Crash Reconstruction: Describe the basic information that can be obtained from the roadway surface, understand basic physics related to crash reconstruction, speed for various skid, friction, drag, and acceleration scenarios, variables involved in jump and flip crashes, variables involved in pedestrian crashes, Case	

Studies. **Text Book 5:** Ch- 2, 3, 5, 8, 10
Module – 5 **08 Hrs**
Mitigation Measures: Accident prevention by better planning, Accident prevention by better design of roads, Crash Countermeasures, Highway operation and accident control measures, Highway Safety Measures during construction, Highway geometry and safety. Road safety management, road safety policy-making, stakeholders involved, developing the road safety management system, capacity building. **Text Book 1:** Ch- 6, 7, 8, 9

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the effect of driver characteristics, roadway characteristics, and climatic factors on highway safety.
CO2	Analyze crash data using statistical methods to identify black spots and improve urban traffic safety and mobility.
CO3	Conduct road safety audits to identify hazards, analyze crashes, and address issues related to vulnerable road users.
CO4	Analyze crash reconstruction using physics and evaluating factors like skid speed, friction, and pedestrian crashes.
CO5	Apply accident prevention and road safety measures, focusing on design, construction, and management systems

Text Books	
1	L.R. Kadiyali, Traffic Engineering and Transport Planning, Khanna Publications, ISBN-13:978-8174092205
2	S.K. Khanna, C.E.G. Justo, and A. Veeraragavan, Highway Engineering, 10th Edition, Nem Chand & Bros. Publications, ISBN 978-81-85240-72-5
3	Fred L. Mannering & Scott S. Washburn, Principles of Highway Engineering and Traffic Analysis,7th edition, ISBN-10:1119723191
4	Martin Belcher, Steve Proctor and Phil Cook, Practical Road Safety Auditing, Third edition, ICE Publications, 2015, ISBN-10:9780727760166, ISBN-13:978-0727760166
5	Gitam Tiwari, Dinesh, and Mohan, Transport Planning and Traffic Safety : Making Cities, Roads, and Vehicles Safer, CRC Press, ISBN: 9781498751452

Reference Books	
1	Ezra Hauer, Observational Before-After Studies in Road Safety, Pergamon Press,1997 (reprinted 2002)
2	Institute of Transportation Engineers (ITE), The Traffic Safety Toolbox: A Primer onTraffic Safety, ITE, 1999.
3	J. Stannard Baker, Traffic Collision Investigation, Northwestern University Center for Public Safety, 2002.
4	Rune Elvik and Truls Vaa,The Handbook of Road Safety Measures,Elsevier, 2004.
5	IRC: SP:88-2019, Manual on Road Safety Audit

Web links and Video Lectures (e–Resources)	
1	https://www.icevirtuallibrary.com/isbn/9780727760166
2	https://www.routledge.com/Transport-Planning-and-Traffic-Safety-Making-Cities-Roads-and-Vehicles/Tiwari-Mohan/p/book/9781498751452
3	https://www.amazon.in/Highway-Design-Traffic-Engineering-Handbook/dp/0070382956
4	https://archive.nptel.ac.in/courses/105/105/105105215/

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**	**3**	**3**	**3**	**1**
CO2	**2**	**3**	**2**	**3**	**2**	**2**
CO3	**3**	**2**	**2**	**3**	**3**	**2**
CO4	**3**	**1**	**3**	**3**	**2**	**1**
CO5	**3**	**2**	**2**	**3**	**3**	**3**

Semester: I						
COMPUTATIONAL LAB-1						
Course Code	:	MCVL106		**Credits**	:	2
Hours/Week (L: P: T)	:	0:4:0		**CIE**	:	50 Marks
Total Hours	:	40		**SEE**	:	50 Marks
Course Type	:	PCCL		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	2D Drawing CAD Lab & Software Application Lab
Knowledge on Fundamental Concepts	3D Structural Drawings & Design of Structures
Knowledge on Connected Tools (If any)	Autodesk Revit, Civil 3D & STAAD Pro/ ETABS.

Course Learning Objectives: This course will enable the students to	
CLO1	Create and annotate detailed floor plans in Revit Structure.
CLO2	Manage schedules in constructing structural models in Revit Structure.
CLO3	Apply knowledge of Structural Analysis and Design concepts to analyze structures using any FE based software.
CLO4	Apply practical skills and theoretical knowledge in road design using Autodesk Civil 3D.

Exercises
1. Basic 3D Building Information Modeling (BIM). • Setup building levels and grids, draw walls, insert doors, and place windows.
2. Create the building's roof and floors, place columns and footings at grids. • Generate elevation views and 3D views.
3. Create custom families such as furniture, windows, or doors in Revit.
4. Develop detailed floor plans with a notations such as dimensions, room tags, and text notes.
5. Generate sheets with proper layout and title blocks.
6. Generate schedules (e.g., Door schedule, Window schedule, Room schedule) from the Revit model.
7. A) Develop a structural framing model using beams,columns,and foundations in Revit Structure. • Setup levels and grids for the structural system. • Add structural columns and beams to create the building frame. Or B) Analysis and Design of Continuous Beams. Or C) Create a Surface Model using Civil 3D. • Import survey points, create a surface, add break lines, and generate contours
8. A) Place foundations and footings at the base of columns • Review the 3D structural framing model and ensure alignment with architectural plans Or B) Analysis and Design of Plane Frames. Or C) Design Horizontal Alignments using Civil 3D. • Create alignments, edit alignment geometry, and add alignment labels.

9. A) Detailing of Columns, Beams, and Foundations in Revit Structure • Create a new project, define building levels and grids, Detailing Structural Components Or B) Analysis and Design of Plane Trusses. Or C) Generate Profiles and Profile Views using Civil 3D. • Create surface profiles, design profiles, and generate profile views.
10. A) Develop different types of foundation and show rebar detailing. Or B) Analysis and Design of Multi-Stored RCC Buildings. Or C) Create Road Corridors using Civil 3D.

Course Outcomes: After completing the course, the students will be able to	
CO1	Develop proficiency in Creating 3D architectural building models using Autodesk Revit.
CO2	Analyze and design the various Civil Engineering structures using FE based software.
CO3	Create Surface Model and Design Horizontal Alignments & Road Profiles using Autodesk Civil 3D.

Reference Books	
1	BIS & ACI CODE OF PRACTICE • BIS: IS 13920. (2016). DUCTILE DETAILING OF REINFORCED CONCRETE STRUCTURES SUBJECTED TO SEISMIC FORCES — CODE OF PRACTICE. • BIS: IS 1893 Part 1. (2002). CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES PART 1 GENERAL PROVISIONS AND BUILDINGS. • BIS: IS 456. (2000). INDIAN STANDARD PLAIN AND REINFORCED CONCRETE - CODE OF PRACTICE. • BIS: IS 875 Part 1. (1987). CODE OF PRACTICE FOR DESIGN LOADS FOR BUILDINGS AND STRUCTURES-PART-1- DEAD LOAD. • BIS: IS 875 Part 2. (1983). CODE OF PRACTICE FOR DESIGN LOADS (OTHER THAN EARTHQUAKE) FOR BUILDINGS AND STRUCTURES- PART 2, IMPOSED LOADS. • ACI 318-14. (2014). ACI 318-14: BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE.

Web links and Video Lectures (e–Resources)	
1	https://help.autodesk.com/view/RVT/2025/ENU/
2	https://help.autodesk.com/view/RVT/2025/ENU/?guid=GUID-6419C9CE -F12D- 4A6B-9677-949F186D9546
3	https://help.autodesk.com/view/CIV3D/2025/ENU/
4	https://help.autodesk.com/view/CIV3D/2025/ENU/?guid=GUID-9AB0843F-9077-473C-8EF5-83C12DFAD712

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**2**	**2**	**2**	**2**	**3**
CO2	**3**	**2**	**2**	**2**	**3**	**3**
CO3	**3**	**2**	**2**	**2**	**3**	**3**



Estd : 1986

||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

AICTE Approved, Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME, CV & AE), Gold Rated by QS I-Gauge

P.B. No.20, B.B Road, Chikkballapur - 562 101, Karnataka

www.sjcit.ac.in

Scheme of Teaching and Examinations

Department of Civil Engineering

Specialization-MTech 2nd Semester in Civil Structural Engineering

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

II SEMESTER (Core Courses related to main Engineering Stream)

Course Type	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
			Theory	Practical/ Seminar	Tutorial/ SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
			L	P	T/SDA					
PCC	MCV201	Computational Structural Mechanics – Classical & FE Approach	03	00	00	03	50	50	100	3
PCC	MCV202	Structural Dynamics and Earthquake Resistant Design of Structures	03	00	02	03	50	50	100	4
PCC	MCV203	Advanced Design of Structural Elements	03	00	00	03	50	50	100	3
PCC	MCV204	MODB & Fracture Mechanics	03	00	00	03	50	50	100	3
PEC	MCV215X	Professional Elective - 3	03	00	00	03	50	50	100	3
PEC	MCV216X	Professional Elective – 4	03	00	00	03	50	50	100	3
PCCL	MCVL207	Computational Lab - 2	01	02	00	03	50	50	100	2
AEC/SEC	MCV258	Skill and Ability enhancement courses	00	02	---	02	50	50	100	1
			01	00	----	01				
		TOTAL	**20**	**04**	**02**	**24**	**400**	**400**	**800**	**22**

Professional Elective- 3		**Professional Elective -4**	
MCV215A	Advanced Foundation Engineering	MCV216A	Design of Plates and Shells
MCV215B	Construction Materials and their properties	MCV216B	Advanced Structural Analysis
MCV215C	Modern Construction Materials	MCV216C	Bridge Engineering
MCV215D	Advanced Pre-stressed Concrete	MCV216D	Reliability Analysis and Reliability Based Design of Structures

Ability Enhancement Courses (AEC): These courses are designed to help students enhance their skills in communication, language, and personality development. They also promote a deeper understanding of subjects like social sciences and ethics, culture and human behaviour, human rights, and the law. **Skill Enhancement Course (SEC):** Skill Enhancement Course means a course designed to provide value-based or skill-based knowledge and should contain both theory and lab/hands- on/training/fieldwork. The main purpose of these courses is to provide students with life skills in the hands-on mode to increase their employability.

If AEC/SEC courses are ONLINE (MOOCs) courses suggested by the concerned board of studies. These courses will be made available on **www. online.vtu.ac.in**, however online courses are not considered for vertical progression, but qualifying in online courses is mandatory for the award of the degree.

PCC/PCCL/IPCC/PEC/MDC/PCC(PB): These are the courses which will suit the individual specializations

Semester: II						
Computational Structural Mechanics- Classical & FE Approach						
Course Code	**:**	MCV201		**Credits**	**:**	3
Hours/Week (L: T: P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	PCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Strength of Material, Analysis of Structures
Knowledge on Fundamental Concepts	Supports, Loads, SFD and BMD
Knowledge on Connected Tools (If any)	Programming Language

Course Learning Objectives: This course will enable the students to	
CLO1	Explain the direct stiffness method and apply it to analyze trusses under different support and loading conditions.
CLO2	Apply the direct stiffness method to analyze continuous beams and 2D frames for various boundary and loading cases.
CLO3	Describe the basic concepts, steps, and applications of the Finite Element Method (FEM) and discretization techniques.
CLO4	Derive and interpret displacement and shape functions for different finite elements
CLO5	Compute element stiffness matrices using direct and variational approaches and implement them through programming.

Module – 1	**08 Hrs**
Direct Stiffness Method–Analysis of Trusses Degrees of static and kinematic indeterminacies, degrees of freedom, discrete and continuous systems, local and global coordinate systems. Concepts of flexibility and stiffness, local and global coordinate systems, rotation transformation matrix, and element stiffness matrix for two-noded bar elements and two-noded beam elements. Analysis of simple pin-jointed trusses with and without initial strains for different combinations of support conditions (upto3DOF)and simple problems of trusses involving support settlement. **Self-Study Component:** Develop a program for generating the overall stiffness matrix for a truss using any programming language. **Text Book 1:** Ch1: 1.1-1.4, Ch 2: 2.1-2.5, 2.8.1 **Text Book 2:** Ch 3:1.1-1.3, Ch 3:3.1-3.8, Ch 4:4.3	
Module – 2	**08 Hrs**
Direct Stiffness Method-Analysis of Continuous Beams and 2-DFrames: Analysis of continuous beams for different types of boundary conditions, such as fixed, hinged, roller, slider, elastic (spring)supports and support settlement. Analysis of simple 2-D frames with and without sway. **Self-Study Component:** Develop a program for the analysis of continuous beams and 2-D frames using any programming language. **Text Book 2:** Ch 5: 5.1-5.8	
Module – 3	**08 Hrs**
Introduction to FEM & Discretization: Basic steps in FEM, Advantages & disadvantages. Types of elements – Natural subdivision at discontinuities, minimization of band width, element aspect ratio, discretization of very large bodies and infinite bodies. Rayleigh Ritz method applied cantilever and simply supported beams, with point loads. **Self Study Component:** Learn about different elements available in different finite element packages **Text Book 4:** Ch 8: 8.1-8.5, Ch 9: 9.1-9.4, Ch 10: 10.1-10.	
Module – 4	**08 Hrs**

Displacement Functions and Shape Functions:
Selection of displacement functions, convergence requirements, geometric invariance, Pascal triangle, Different coordinate systems. Shape functions, Lagrange's shape functions for one dimensional and two dimensional rectangular elements. Serendipity elements & isoperimetric elements.
Self Study Component: Learn to draw the various shape function diagrams.
Text Book 5: Ch 22: 22.1-22.10, Ch 23: 23.9-23.13

Module – 5	**08 Hrs**

Computation of Element Stiffness Matrix
Derivation of element stiffness matrix for truss element and beam element by direct approach and variational approach, Lumped loads, Numerical problems on analysis of plane trusses and beams.
Self-Study Component: Develop a program for generating the overall stiffness matrix for beam elements using any programming language.
Text Book 1: Ch 3: 3.1, 3.7

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze trusses by direct stiffness method
CO2	Analyze beams by direct stiffness method
CO3	Interpret FEM basic concepts
CO4	Develop proficiency in deriving shape functions and stiffness matrices and apply them to real-world engineering problems.
CO5	Apply the computer programming knowledge to generate stiffness matrices and analyze trusses, continuous beams, and 2D frames.

Text Books	
1	Rajasekaran. S, "Computational Structural Mechanics", PHI, NewDelhi2001.
2	Reddy. C. S, "Basic Structural Analysis" TMH, NewDelhi2001
3	Robert D Cook et al, "Concepts and Applications of Finite Element Analysis", 3rd Edition, JoWiley and Sons, New York,2007

Reference Books	
1	Beaufait, F. W. et al., "Computer Methods of Structural Analysis", Prentice Hall, 1970.
2	Weaver, W. and Gere, J. H., "Matrix Analysis of Framed Structures", Van Nostrand, 1980.
3	Rubinstein, M. F., "Matrix Computer Methods of Structural Analysis", Prentice Hall, 1966.
4	Bathe, K. J, "Finite Element Procedures in Engineering Analysis", PHI, New Delhi, 2006

Web links and Video Lectures (e – Resources)	
1	https://archive.nptel.ac.in/courses/105/107/105107209/
2	https://archive.nptel.ac.in/courses/105/107/105107209/

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**	**3**	**3**	**2**	**1**
CO2	**3**	**2**	**3**	**3**	**2**	**1**
CO3	**2**	**2**	**3**	**3**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Semester: II						
Structural Dynamics and Earthquake Resistant Design of Structures						
Course Code	**:**	MCV202		**Credits**	**:**	4
Hours/Week (L:P: SDA)	**:**	3:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	40L+10 SDA		**SEE**	**:**	50 Marks
Course Type	**:**	PCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Engineering Mechanics, Structural Analysis
Knowledge on Fundamental Concepts	Free body diagrams, stress-strain, load paths
Knowledge on Connected Tools (If any)	MATLAB, ANSYS, ETABS, SAP2000, STAAD Pro

Course Learning Objectives:	
CLO1	Explain the dynamic behavior of SDOF systems using fundamental concepts and vibration principles.
CLO2	Apply numerical methods to analyze forced vibration response of SDOF systems.
CLO3	Analyze vibration response of MDOF systems using mode shapes and natural frequencies.
CLO4	Evaluate the effect of irregularities and infill walls in buildings as per IS 1893 provisions.
CLO5	Evaluate and interpret ductile detailing provisions and retrofitting strategies for RC structures subjected to seismic forces.

Module - 1	**08 Hrs**
Introduction: Introduction to Dynamic problems in Civil Engineering, Concept of degrees of freedom, D'Alembert's principle, principle of virtual displacement and energy principles. **Dynamics of Single degree-of-freedom systems:** Mathematical models of Single-degree-of-freedom systems system, Free vibration response of damped and undamped systems including methods for evaluation of damping. **Text Book 2:** Ch 1,2,3,4 **Text Book 3:** Ch 1,2 **Text Book 4:** Ch 2,3,5	
Module-2	**08 Hrs**
Response of Single-degree-of-freedom systems to harmonic loading including support motion, vibration isolation, transmissibility. Numerical methods applied to Single-degree-of-freedom systems – Duhamel integral. Principle of vibration measuring instruments– seismometer and accelerometer. **Text Book 2:** Ch 5,6 **Text Book 3:** Ch 2,3 **Text Book 4:** Ch 4,6,9	
Module - 3	**08 Hrs**

Dynamics of multi-degree freedom systems: Mathematical models of multi-degree-of-freedom systems, Shear building concept, free vibration of undamped multi-degree-of-freedom systems – Natural frequencies and mode shapes – Orthogonality of modes. Response of Shear buildings for harmonic loading without damping using normal mode approach. Response of Shear buildings for forced vibration for harmonic loading with damping using normal mode approach.
Text Book 2: Ch 9,10,11
Text Book 3: Ch 4
Text Book 4: Ch 7,8,10

Module - 4	**08 Hrs**

Structural Configuration for earthquake resistant design, Concept of plan irregularities and vertical irregularities, Soft storey, Torsion in buildings. Design provisions for these in IS- 1893. Effect of infill masonry walls on frames, modeling concepts of infill masonry walls. Behaviour of masonry buildings during earthquakes, failure patterns, strength of masonry in shear and flexure, Slenderness concept of masonry walls, concepts for earthquake resistant masonry buildings – codal provisions.
Text Book 3: Ch 6,8,10
Text Book 4: Ch 13,14,15

Module - 5	**08 Hrs**

Design of Reinforced Concrete Buildings for Earthquake Resistance: Load Combinations. Confinement of concrete for ductility, design of columns and beams for ductility, and ductile detailing provisions as per IS 1893.
Seismic response control concepts: Seismic demand, seismic capacity, Overview of linear and nonlinear procedures of seismic analysis. Performance Based Seismic Engineering methodology, Seismic evaluation and retrofitting of structures.
Text Book 3: Ch 7,9,11
Text Book 4: Ch 16,17

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain dynamic concepts and response of SDOF systems including damping.
CO2	Apply analytical and numerical methods for forced vibration and transmissibility of SDOF systems.
CO3	Analyze free and forced vibration in MDOF systems and compute mode shapes.
CO4	Evaluate structural configuration and infill influence using IS 1893 provisions.
CO5	Assess detailing strategies and seismic retrofitting solutions in RC structures.

Text Books	
1	Mario Paz, William Leigh, “Structural Dynamics: Theory and Computation”, 6th Edition, 2004, Springer, ISBN: 9781402076674
2	Anil K. Chopra, “Dynamics of Structures: Theory and Applications to Earthquake Engineering”, 5th Edition, 2020, Pearson Education, ISBN: 9780134555121
3	Pankaj Agarwal, Manish Shrikhande, “Earthquake Resistant Design of Structures”, 2022, PHI Learning, ISBN: 9789355439509
4	V.K. Damodarasamy, S. Kavitha, “Structural Dynamics and Earthquake Engineering”, 1st Edition, 2009, PHI Learning, ISBN: 9788120336281
Reference Books	

1	David J. Dowrick, "Earthquake Resistant Design and Risk Reduction", 2nd Edition, 2009, Wiley, ISBN: 9780470742754
2	S.K. Duggal, "Earthquake Resistant Design of Structures", 3rd Edition, 2022, Oxford University Press, ISBN: 9780198083528
3	T.K. Datta, "Seismic Analysis of Structures", 1st Edition, 2010, Wiley-Blackwell, ISBN: 9780470824610

Web links and Video Lectures (e -resources)	
1	https://archive.nptel.ac.in/courses/105/101/105101209/
2	https://onlinecourses.nptel.ac.in/noc24_ce32/preview
3	https://ocw.mit.edu/courses/2-003sc-engineering-dynamics-fall-2011/
4	https://archive.nptel.ac.in/courses/105/106/105106151/
5	https://archive.nptel.ac.in/courses/105/101/105101006/
6	https://archive.nptel.ac.in/courses/105/101/105101004/
7	https://onlinecourses.nptel.ac.in/noc19_ce27/preview

Skill Development Activities (SDA)	
1	**Modeling and Simulation:** Use MATLAB/ANSYS/SAP2000 to simulate SDOF and MDOF systems under dynamic loading.
2	**Vibration Isolation Experiments:** Conduct lab experiments to analyze vibration isolation and transmissibility.
3	**Numerical Methods:** Implement numerical methods (e.g., Newmark-beta) for dynamic problems using Python or MATLAB.
4	**Seismic Analysis Case Studies:** Analyze earthquake data and structural responses using seismic response spectra.
5	**Structural Health Monitoring and Retrofitting**: Learn NDT techniques and retrofitting methods for seismic evaluation.
6	**Seismic Design with Software**: Use ETABS/STAAD Pro to design earthquake-resistant structures as per IS 1893.
7	**Collaborative Project**: Work in teams to design a multi-story building with seismic considerations, integrating various skills.

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**2**	**3**	**3**	**2**	**1**
CO2	**3**	**2**	**3**	**3**	**2**	**1**
CO3	**3**	**2**	**3**	**3**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Semester: II						
Advanced design of Steel Structures						
Course Code	:	MCV203		**Credits**	:	3
Hours/Week (L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40		**SEE**	:	50 Marks
Course Type	:	PCC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Structural Analysis, Design of Steel Structures
Knowledge on Fundamental Concepts	Equilibrium and material properties, mechanics of materials covering stress, strain, and loading behavior. Reinforced concrete and steel design concepts, as well as knowledge of relevant design codes
Knowledge on Connected Tools (If any)	**--**

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the background to the design provisions for hot-rolled and cold-formed steel structures, including the main differences between them.
CLO2	Proficiency in applying the provisions for design of columns, beams, beam-columns
CLO3	Enable students to understand the behavior, load considerations, and design principles of plate and gantry girders.
CLO4	Design structural sections for adequate fire resistance

Module – 1	**08 Hrs**
Laterally Unrestrained Beams: Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Mono-symmetric and non-uniform beams – Design Examples. Concepts of -Shear Center, Warping, Uniform and Non-Uniform torsion. **Text Book 1:** Ch 10	
Module – 2	**08 Hrs**
Beam- Columns in Frames: Behaviour of Short and Long Beam - Columns, Effects of Slenderness Ratio and Axial Force on Modes of Failure, Biaxial bending, Strength of Beam Columns, Sway and Non-Sway Frames, Strength and Stability of rigid jointed frames, Effective Length of Columns-, Methods in IS 800 – Examples **Text Book 1:** Ch 13 **Text Book 2:** Ch 12	
Module – 3	**08 Hrs**
Design of Plate and Gantry Girders: Introduction, General consideration of plate girder and gantry girder, Load consideration, Design of plate girder using IS 800 provision, Design of Gantry Girder **Text Book 1:** Ch 11, 12 **Text Book 3:** Ch 8, 9	
Module – 4	**08 Hrs**
Cold formed steel sections: Techniques and properties, advantages, typical profiles, stiffened and unstiffened elements, local buckling effects, effective section properties, IS 801 and 811 code provisions— numerical examples, beam design, column design. **Text Book 1:** Ch 1 **Text Book 3:** Ch 16	
Module – 5	**08 Hrs**
Fire resistance: Fire resistance level, period of structural adequacy, properties of steel with temperature, limiting steel temperature, protected and unprotected members, methods of fire protection, fire resistance ratings, and numerical examples. **Text Book 1:** Ch 16	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the concept of lateral buckling in beams and apply IS 800 provisions to design laterally unrestrained beams.
CO2	Analyze the behavior of short and long beam-columns under combined loading and apply IS 800 methods to determine stability of sway and non-sway frames.
CO3	Design plate and gantry girders in accordance with IS 800 provisions, considering their behavior, load conditions, and structural design requirements.
CO4	Interpret the behavior and design principles of cold-formed steel sections.
CO5	Assess fire resistance levels of steel structures, understanding material behavior under temperature effects and methods of fire protection.

Text Books	
1	N. Subramanian, "Design of Steel Structures", Oxford, IBH 2016, ISBN: 13:978-0-19-946091-5
2	Salmon and Johnson, "Steel Structure- Design and Behaviour" Harper and Row. – 1980, ISBN: 13:978-0-13-206119-3
3	Duggal,S.K. "Design of Steel Structures", Tata McGraw-Hill3, ISBN: 13:978-0-07-026068-9

Reference Books	
1	IS 800: 2007, IS 801-2010 , IS 811-1987, BS5950 Part- 8
2	INSDAG Teaching Resource Chapter 11 to 20
3	Handbook for Structural Engineers, SP: 6(6)-1972.

Web links and Video Lectures (e – Resources)	
1	www.steel-insdag.org
2	https://youtu.be/jHOuIrW8jtc?si=X8vgM2tkVEdz_GOa

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**			**1**	**3**	
CO2	**2**			**1**	**3**	
CO3	**2**			**1**	**3**	
CO4	**2**			**1**	**3**	
CO5	**1**			**1**	**1**	**2**

Semester: II						
MODB & Fracture Mechanics						
Course Code	**:**	MCV204		**Credits**	**:**	3
Hours/Week (L:P: SDA)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40L		**SEE**	**:**	50 Marks
Course Type	**:**	PCC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Engineering Mechanics, Strength of Materials, Structural Analysis
Knowledge on Fundamental Concepts	Stress-strain behavior, axial/bending/shear/torsion theories, elasticity concepts
Knowledge on Connected Tools (If any)	Basics of MATLAB or Python for numerical simulations; exposure to ANSYS/ABAQUS for stress analysis

Course Learning Objectives:	
1	Explain the basic equations of elasticity, stress and strain in Cartesian and polar coordinates.
2	Apply stress and strain transformations to determine principal values and invariants.
3	Apply Airy's stress function to solve plane stress and plane strain problems.
4	Solve 3D elasticity problems using finite difference methods and torsion analogies.
5	Evaluate the behavior of concrete using fracture mechanics and quasi-brittle models.

Module - 1	**08 Hrs**
Theory of Elasticity: Introduction, Definition of stress and strain, and strain at a point; components of stress and strain at a point in Cartesian and polar coordinates. Constitutive relations, equilibrium equations, compatibility equations, and boundary conditions in 2-D and 3-D cases. **Text Book 1:** Ch 1,2,3 **Text Book 2:** Ch 1,2 **Text Book 3:** Ch 1,2	
Module - 2	**08 Hrs**
Transformation of Stress and Strain at a Point: Principal stresses and principal strains, invariants of stress and strain, hydrostatic and deviatoric stress, spherical and deviatoric strains, maximum shear strain. **Text Book 1:** Ch 4 **Text Book 2:** Ch 3 **Text Book 3:** Ch 3,4	
Module - 3	**08 Hrs**

Plane Stress and Plane Strain: Airy's stress function approach to 2-D problems of elasticity, simple problems of bending of beams. Solution of axisymmetric problems, stress concentration due to the presence of a circular hole in plates.

Text Book 1: Ch 5,6,7

Text Book 2: Ch 5,6

Text Book 3: Ch 5,6

Module - 4	**08 Hrs**

Elementary Problems of Elasticity in Three Dimensions: Stretching of a prismatic bar by its own weight, twist of circular shafts, torsion of non-circular sections, membrane analogy, propagation of waves in solid media. Applications of finite difference equations in elasticity.

Text Book 1: Ch 8,9

Text Book 2: Ch 7,9

Text Book 3: Ch 7,8

Module - 5	**08 Hrs**

Fracture of Concrete: Introduction to fracture mechanics and limitations of theories of linear elastic fracture mechanics in concrete. Review of concrete behavior in tension and compression. Kaplan's experiments, concept of fracture energy, definition of a quasi-brittle material, concept of softening.

Text Book 4: Ch 1,2,3,5,10

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the fundamental concepts of stress, strain, and governing equations in elasticity.
CO2	Apply stress and strain transformations to determine principal components and invariants.
CO3	Apply elasticity concepts to solve 2D plane stress/strain and axisymmetric problems.
CO4	Analyze torsion, wave propagation, and finite difference formulations in 3D elasticity.
CO5	Evaluate fracture behavior of concrete using quasi-brittle theory and softening models.

Text Books	
1	Timoshenko & Goodier "Theory of Elasticity", , 3rd Edition, 1987, McGraw Hill, ISBN: 9780070858053
2	Ansel C. Ugural, "Advanced Mechanics of Materials and Elasticity", 5th Edition, 2021, CRC Press, ISBN: 9780367332125
3	Srinath L. S, "Advanced Mechanics of Solids", 10th Edition, 1994, McGraw Hill, ISBN-10: 0070139881, ISBN-13: 978-0070139886
3	T. L. Anderson, "Fracture Mechanics Fundamentals and Applications", 4th Edition, 2017, CRC Press, ISBN-10: 1498728138, ISBN-13: 978-1498728133

Reference Books	
1	Fracture Mechanics of Concrete, Surendra P. Shah, S.E. Swartz, C.O. Ouyang, 1st Edition, 1995, Wiley, ISBN: 9780471307334
2	Fracture and Size Effect in Concrete and Other Quasibrittle Materials, Z.P. Bazant & Planas, 1st Edition, 1998, CRC Press, ISBN: 9780849382840

Web links and Video Lectures (e -resources)	
1	https://ocw.mit.edu/courses/3-11-mechanics-of-materials-fall-1999/e5bca953e1dbd0cd0376f0f77033dc0d_MIT3_11F99_frac.pdf
2	https://onlinecourses.nptel.ac.in/noc19_me42/preview
3	https://nptel.ac.in/courses/113105106
4	https://onlinecourses.nptel.ac.in/noc19_me42/preview
5	https://onlinecourses.nptel.ac.in/noc22_mm42/preview

Skill Development Activities (SDA)	
1	**Case Studies Analysis**: Analyze real-world case studies related to elasticity and fracture mechanics to understand practical applications.
2	**Software Simulations**: Use software tools (like ANSYS or ABAQUS) to simulate stress and strain analysis in various structures.
3	**Group Discussions**: Facilitate group discussions on recent advancements in elasticity and fracture mechanics to encourage collaborative learning.
4	**Research Project**: Conduct a mini-research project on a specific topic within the elasticity domain, focusing on emerging theories or applications.
5	**Workshops:** Participate in workshops on advanced material testing techniques for analyzing the mechanical properties of concrete and other materials.

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**2**	**3**	**3**	**2**	**1**
CO2	**3**	**2**	**3**	**3**	**2**	**1**
CO3	**3**	**2**	**3**	**3**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**2**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Semester: II						
Advanced Foundation Engineering						
Course Code	:	MCV215A		**Credits**	:	3
Hours/Week (L: T: P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40		**SEE**	:	50 Marks
Course Type	:	PEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Basics of Soil Mechanics, Strength of Materials, Structural Analysis
Knowledge on Fundamental Concepts	Soil behavior and classification, Stress and strain in materials, Basics of structural load transfer, Elementary vibration theory
Knowledge on Connected Tools (If any)	Relevant IS codes provision, Familiarity with lab testing equipment (CBR, SPT), Spreadsheet tools for calculations

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the role of foundations in structural safety and the factors influencing foundation type selection.
CLO2	Analyze soil–structure interaction and evaluate its impact on foundation behavior.
CLO3	Design pile foundations for axial and lateral loads considering group effects.
CLO4	Analyze and design raft/mat foundations for various structural conditions.
CLO5	Evaluate and recommend appropriate ground improvement methods for different soil problems.

Module – 1	**08 Hrs**
Introduction to Foundation Engineering Role of foundations in structural systems, Types of foundations: shallow, deep, Selection criteria for foundation types, Site investigation and geotechnical report, Basic soil properties relevant to foundation design **Text Book 1**: Ch 1–3, Page No.1–78	
Module – 2	**08 Hrs**
Soil–Structure Interaction Basic concepts of soil–structure interaction (SSI), Importance of SSI in design of foundations, Contact pressure distribution under foundations, Rigid vs. flexible foundations, Effects of loadings on soil behavior, Modeling soil-structure systems, Introduction to Winkler and elastic continuum models **Text Book 1:** Ch 4–3, Page No.79–104	
Module-3	**08 Hrs**
Deep Foundations and Pile Foundation Classification and types of deep foundations, Load carrying mechanism of piles, Design of single and group piles under axial loads, Pile capacity by static and dynamic methods, Pile group efficiency and settlement, Lateral load analysis of piles, Pile load tests and IS code provisions **Text Book 1:** Ch 9–11, Page No.355–456	
Module – 4	**08 Hrs**
Raft and Mat Foundations Introduction to mat foundations, Types of rafts: flat, beam and slab, cellular, Analysis of rigid and flexible rafts. Pressure distribution and settlement analysis, Combined footings and interaction effects, Design of raft foundations as per IS code, Numerical examples and practical applications **Text Book 2**: Ch 10, Page No.471–532	
Module – 5	**8 Hrs**

Ground Improvement Techniques
Need for ground improvement, Mechanical methods: compaction, vibro techniques, Hydraulic methods: dewatering, preloading, Chemical methods: grouting, stabilization, Use of geosynthetics and stone columns **Text Book 2:** Ch 15, Page No.712–765

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain types of foundations and interpret site investigation reports for appropriate design.
CO2	Assess contact pressure and model soil–structure interaction using relevant methods.
CO3	Calculate capacity and settlement of piles and pile groups as per IS codes.
CO4	Design raft foundations considering soil behavior and structural requirements.
CO5	Select suitable ground improvement techniques for challenging soil conditions.

Text Books	
1	B.M. Das, "Principles of Foundation Engineering", ISBN: 978-0357117785,Cengage, Learning,9th Ed., 2021
2	J.E. Bowles, "Foundation Analysis and Design", ISBN: 978-0071188449, McGraw Hill,5th Ed., 1996
3	N.P. Kurian, "Design of Foundation Systems", ISBN: 978-8173715779, Narosa Publishing, Reprint 2005
4	Swami Saran, "Soil Dynamics and Machine Foundations", ISBN: 978-8120335063, Galgotia, Publications,3rd Ed., 2009

Reference Books	
1	Terzaghi, Peck & Mesri, "Soil Mechanics in Engineering Practice", ISBN: 978-0471086581, Wiley 3rd Ed., 1996
2	Braja M. Das & Khaled Sobhan, Principles of Geotechnical Engineering, ISBN: 978-1337705023Cengage,9th Ed., 2017
3	Tomlinson & Woodward, Pile Design and Construction Practice, ISBN: 978-0419237212, CRC Press, 5th Ed., 2007
4	Prakash & Puri, Foundations for Machines: Analysis and Design, ISBN: 978-8122422198, Wiley Eastern, 2nd Ed., 2007

Web links and Video Lectures (e – Resources)	
1	**NPTEL:** *Soil-Structure Interaction* by Prof. G.L. Sivakumar Babu (NPTEL link) *Foundation Engineering* by Prof. B.V.S. Viswanadham (NPTEL link)
2	**YouTube:** Geotechnical Engineering lectures by Dr. K.R. Arora Practical site investigation videos — channels like The Constructor or Civil Mentor
3	**IS Codes Online:** IS 2911 (Piles), IS 2950 (Rafts),IS 2974 (Machine Foundations)
Skill Development Activities Suggested:	
	• Conduct field visits for soil investigation and bore log preparation. • Lab experiments on SPT, CPT, and soil property tests. • Design a machine foundation for a small industrial unit. • Group project: Compare ground improvement methods for a real site

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**2**	**3**	**3**	**3**	**1**
CO2	**3**	**2**	**3**	**3**	**2**	**1**
CO3	**3**	**2**	**3**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Semester: II						
Construction Materials and their Properties						
Course Code	**:**	MCV215B		**Credits**	**:**	3
Hours/Week (L:P: SDA)	**:**	3:0:2		**CIE**	**:**	50 Marks
Total Hours	**:**	40L		**SEE**	**:**	50 Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Materials science, Concrete Technology and Building Materials and Construction
Knowledge on Fundamental Concepts	Engineering Materials or Construction Materials
Knowledge on Connected Tools (If any)	Basic computer programming

Course Learning Objectives:	
CLO1	The course aims to provide a fundamental understanding of calorimetry, X-ray diffraction, and microscopy techniques for analyzing construction materials.
CLO2	Students will evaluate the thermal, mineralogical, and microstructural properties of these materials using various analytical methods.
CLO3	The course will cover advanced techniques such as spectroscopy, porosimetry, and impedance analysis, focusing on effective data interpretation.
CLO4	Students will explore recent advancements in material characterization, fostering innovation and contributing to the development of the construction materials field.

Module - 1	**08 Hrs**
Introduction; Structure of Construction Materials – An Overview. Calorimetry: Introduction to calorimetry, definition and principles, types of calorimeters, thermal properties of construction materials, hydration reactions in cementitious materials, calorimetry of bituminous materials, calorimetry of concrete and mortar, advanced applications, case studies, and research applications. **Text Book 1:** Ch 2 **Text Book 2:** Ch 4 **Text Book 4:** Ch 5	
Module - 2	**08 Hrs**
X-ray Diffraction: Introduction to XRD, principles of XRD, instrumentation and data collection, data analysis and interpretation, phase identification and quantification in cement, concrete, geopolymers, and alternative binders, mineralogical analysis of aggregates, identification of clay minerals, analysis of asphalt cement and aggregates in XRD, in-situ XRD and time-resolved studies, high-temperature and high-pressure XRD, XRD imaging and mapping, recent research developments in XRD for construction materials, industrial applications, and collaborations. Surface Area Measurement: Introduction, definition, principles, and importance of surface area measurement in construction materials, methods and instruments for surface area measurement, BET (Brunauer-Emmett-Teller) theory and method, Langmuir and Freundlich isotherms, mercury porosimetry, nitrogen adsorption and desorption, image analysis and stereology. **Text Book 1:** Ch 4	

Text Book 2: Ch 8,13
Text Book 4: Ch 4,6,9

Module - 3	**08 Hrs**

Optical Microscopy: Introduction to optical microscopy, principles of light microscopy, types of optical microscopes (compound, stereo, polarized light), instrumentation and accessories, sample preparation,
image formation and contrast, microstructure of cement paste and concrete, identification of hydration products and phases, analysis of porosity, cracking, and degradation, microscopy of aggregates and rocks, microstructure of asphalt and bituminous materials, advanced techniques (polarized light microscopy, fluorescence microscopy, confocal microscopy), recent research developments in optical microscopy for construction materials.
Scanning Electron Microscopy: Principles, techniques, and applications of SEM in analyzing construction materials, sample preparation, image formation and interpretation, advanced techniques like energy dispersive spectroscopy and electron backscatter diffraction, microstructure of cement, concrete, aggregates, rocks, asphalt, and bituminous materials, and their degradation mechanisms. Case studies and research applications.
Text Book 1: Ch 8
Text Book 2: Ch 7
Text Book 4: Ch 7-10

Module - 4	**08 Hrs**

Image Analysis: Introduction to image analysis, image processing techniques, feature extraction and measurement, texture analysis, pattern recognition, applications in construction materials (cement, concrete, aggregates, asphalt, etc.), case studies, and research applications.
Spectroscopic Techniques: Introduction to spectroscopy, principles of spectroscopy, types of spectroscopy (infrared (IR), Raman, nuclear magnetic resonance (NMR)), principles and applications in construction materials, other spectroscopic techniques (ultraviolet-visible (UV-Vis), X-ray fluorescence (XRF), X-ray absorption (XAS)), recent research developments in spectroscopic techniques for construction materials.
Text Book 2: Ch 5,6,19
Text Book 4: Ch 13-15

Module - 5	**08 Hrs**

Mercury Intrusion Porosimetry: Introduction to porosimetry, definition, principles and importance, types of porosimetry (mercury intrusion, gas adsorption, etc.), mercury intrusion technique, Washburn equation and its limitations, contact angle and surface tension effects, instrumentation and sample preparation, pore size distribution (PSD) calculation, pore volume, porosity, and density calculations, data interpretation and limitations, applications of MIP in construction materials (cement paste, concrete, aggregates, rocks, asphalt, and bituminous materials), advanced data analysis techniques (fractal analysis, etc.).
Impedance Analysis and Ultrasonic Methods: Introduction to impedance analysis, principles, instrumentation, and measurement techniques, data analysis and interpretation, impedance spectroscopy technique and its applications in materials characterization, principles of ultrasonic testing, instrumentation and measurement techniques, ultrasonic velocity and attenuation, elastic properties and stiffness, applications in materials characterization, impedance analysis of cement-based materials, ultrasonic testing of concrete and aggregates, case studies in construction materials research and industry.
Text Book 1: Ch 9
Text Book 2: Ch 14,17
Text Book 4: Ch 16,17

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the principles and applications of calorimetry in analyzing the thermal properties of construction materials.

CO2	Analyze mineralogical compositions and structural properties of construction materials using advanced techniques such as X-ray diffraction and optical microscopy.
CO3	Evaluate the microstructure of construction materials through scanning electron microscopy and image analysis methods.
CO4	Apply spectroscopic techniques to identify and characterize chemical properties of construction materials.
CO5	Utilize porosimetry and impedance analysis to assess the performance characteristics of construction materials in various applications.

Text Books	
1	Karen Scrivener, Ruben Snellings, Barbara Lothenbach–"A Practical Guide to Microstructural Analysis of Cementitious Materials", CRC Press, 2015.
2	V. S. Ramachandran and James J. Beaudoin (Eds.) – "Handbook of Analytical Techniques in Concrete Science and Technology", William Andrew Publishing, New York, 2001.
3	D.A. St. John, A.W. Poole, and I. Sims, "Concrete Petrography: A Handbook of Investigative Techniques", Arnold Publishing, London, 1998.
4	William D. Callister, "Materials Science and Engineering: An Introduction", Sixth Edition, John Wiley and Sons, 2003.

Reference Books	
1	J. M. Illston and P. L. J. Domone, "Construction Materials: Their Nature and Behaviour", Third Edition, Spon Press, 2001.
2	Jan Skalny, "Materials Science of Concrete", Volumes I – VII, American Ceramic Society, 1989 – 2005.
3	J.F. Young, S. Mindess, R.J. Gray, and A. Bentur, "The Science and Technology of Civil Engineering Materials", Prentice Hall, 1998.

Web links and Video Lectures (e -resources)	
1	https://youtube.com/playlist?list=PLyqSpQzTE6M_SPzoDiGiemXR3DjZnDDPw&si=6sEV_C0jKaoDcg-T

Skill Development Activities (SDA)	
1	**Calorimetry Lab Experiment:** Conduct a hands-on experiment to measure the heat of hydration in cement samples using a calorimeter, documenting the results and analyzing the implications for construction materials
2	**XRD Analysis Workshop:** Participate in a workshop focused on X-ray diffraction analysis, learning how to interpret data for identifying mineral compositions in construction materials.
3	**Microscopy Techniques Practice**: Gain practical experience by preparing and analyzing samples using optical and scanning electron microscopy, focusing on hydration products and microstructure of concrete
4	**Image Analysis Project:** Utilize image analysis software to evaluate microstructures of various construction materials, applying techniques such as texture analysis and feature extraction.

5	**Porosity Measurement Exercise:** Perform a mercury intrusion porosimetry exercise to measure pore size distribution in cement and aggregates, interpreting the results to understand their impact on material properties.

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	3	2	1
CO2	3	2	3	3	2	1
CO3	3	2	3	3	2	2
CO4	3	3	3	3	2	2
CO5	3	3	3	3	3	3

Semester: II						
Modern Construction Materials						
Course Code	**:**	MCV215C		**Credits**	**:**	3
Hours/Week (L: T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Strength of Materials, and Structural Analysis
Knowledge on Fundamental Concepts	knowledge of materials science concepts and construction materials, to effectively understand and apply the course concepts.
Knowledge on Connected Tools (If any)	--

Course Learning Objectives: This course will enable the students to	
CLO1	Enable students to: understand the fundamental principles of materials science and engineering, classify and characterize various materials.
CLO2	Analyze material properties and behavior, apply materials selection criteria for structural engineering applications.
CLO3	Evaluate material failure mechanisms, and develop sustainable material solutions.
CLO4	Demonstrate in-depth knowledge of materials science, critical thinking, and problem-solving skills to design, analyze, and optimize materials for structural engineering applications.

Module – 1	**08 Hrs**
Introduction to the science, engineering, and technology of materials: the need for material science training; materials used in modern civil engineering; levels of information about materials; selection of materials. Review of atomic bonding, elements in the periodic table, Bohr model, electronic configuration, interaction of atoms, interatomic bonds, and bonding energies. Classification of solids, crystal structure of metals, silica, silicates, kaolinite, polycrystalline structure, defects in crystals, amorphous and polymeric states.	
Module – 2	**08 Hrs**
Movement of atoms in solids: slip, dislocation, and atomic diffusion; diffusion mechanisms; development of microstructure; crystallization from melts and solutions; phase changes on heating and cooling; phase diagrams; binary phase diagrams; sintering; surface energy and tension; behavior of liquids on solids; superhydrophobic surfaces; adhesion of liquid to solid; surfactants; capillary rise; pressure on liquid surfaces; vapor pressure of liquids; adsorption; stability of colloids. **Response to stress:** definition of stress and strain, elastic properties, Hooke's law, Young's modulus, plasticity, yielding in polycrystalline and amorphous materials, post-yield behavior, stress-strain response, ductile failure, strain hardening, cold working, brittle failure, ductile to brittle transition, fatigue failure, creep of metals, and loading rate effects.	
Module – 3	**08 Hrs**
Failure theories: failure of structural materials, uniaxial behavior of metals, complex inelastic response of metals, rocks, and concrete; idealized plastic stress-strain curve; multiaxial loading; Rankine theory; Tresca criteria; von Mises theory; maximum shear stress criteria; distortional strain energy theory; Mohr- Coulomb failure theory; modified failure theories. Introduction to fracture mechanics: stress concentration, linear elastic fracture mechanics, brittle-ductile transition, fracture toughness, brittle fracture, elasto-plastic fracture, fracture in polymers, composites, and concrete. Nonlinear fracture mechanics and applications. **Rheology:** time-dependent material response, rheological models, viscous behavior of liquids, Newtonian and non-Newtonian behavior, hysteresis, and thixotropy. Thermal properties: heat capacity, thermal expansion, thermal stress, thermal conductivity.	
Module – 4	**08 Hrs**

Wood and wood products: structure, engineering properties, effect of temperature and moisture, processing, and application of timber; wood-based composites and applications. Introduction to polymers: transition temperature, stress response, use of polymers, additives, fillers, weathering, and durability; fiber-reinforced polymer composites; fiber performance in aggressive environments; composite production technologies; multilayered composites; elastic response; effects of fiber orientation; applications of FRP in repair and strengthening of structures; advantages and disadvantages of FRP; prestressed FRP laminates; behavior of FRP-wrapped concrete.
Metals: forming, joining, oxidation, corrosion prevention, cold-rolled and heat-treated steels, stainless steel, TMT bars, non-ferrous metals, and alloys. Bituminous materials: composition, structure, properties, and specifications of bitumen; asphalt paving mixtures; asphalt-bitumen interaction; issues due to excessive plastic deformation.
Smart and Intelligent Materials for intelligent buildings - Special features

Module – 5	**08 Hrs**

Concrete: cement composition, hydration, rate of heat evolution during hydration, morphology of hydration products, role of aggregates, size gradation, mineral admixtures, pozzolanic reactions, supplementary cementitious materials, and chemical admixtures. Requirements of concrete in the fresh state; factors affecting workability; composite response of hardened concrete; modeling concrete failure for structural analysis; nature and effect of shrinkage and creep; types of creep; deterioration due to chemical reactions; effect of fire on concrete.
Glass in buildings: properties, light transmission, performance guidelines, safety and security glass, thermally toughened glass, role in fire protection. Advancements in waterproofing materials: need for waterproofing, basics of natural and conventional waterproofing, waterproofing materials, challenges in modern RCC buildings, damp proofing, and integral and external waterproofing.

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the fundamental principles of materials science and engineering, including atomic structure, bonding, and classification of solids.
CO2	Analyze the relationship between material structure, properties, and behavior, including atomic movement, microstructure development, and stress-strain response.
CO3	Evaluate the failure mechanisms and theories in materials, including fracture mechanics, nonlinear fracture mechanics, and rheological models.
CO4	Apply knowledge of material properties and behavior to select and design materials for specific applications, including wood, polymers, composites, metals, and bituminous materials.
CO5	Analyze the composition, properties, and behavior of concrete, glass, and waterproofing materials, and evaluate their performance in various environments.

Text Books	
1	P.C. Varghese, “Building Materials”, Prentice-Hall India, 2555.
2	W.D. Callister, John Wiley “Materials Science and Engineering: An introduction”, , 1994.

Reference Books	
1	V. Raghavan, “Materials Science and Engineering”, Prentice Hall, 1990.
2	R.A. Higgins, “Properties of Engineering Materials”, Industrial Press, 1994.
3	Eds. J.M. Illston and P.L.J. Domone, “Construction materials: Their nature and behaviour”, 3rd ed., Spon Press, 2551.
4	J.F. Young, S. Mindess, R.J. Gray & A. Bentur, “The Science and Technology of Civil Engineering Materials”, Prentice Hall, 1998.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=cx5gPKp9QEc&list=PLbMVogVj5nJQU7M0LdA77p_XaaWBJniNc
2	https://www.youtube.com/watch?v=cx5gPKp9QEc&list=PLbMVogVj5nJQU7M0LdA77p_XaaWBJniNc
3	https://www.youtube.com/watch?v=RSnNrQUTEnY&list=PLJAQaaJgEtI11reTaRrGWTDzezOAtGY4q

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	3	2	1
CO2	3	2	3	3	2	1
CO3	3	2	3	3	2	2
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	3

Semester: II						
Advanced Pre-stressed Concrete						
Course Code	:	MCV215D		**Credits**	:	3
Hours/Week (L:P: SDA)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40L		**SEE**	:	50 Marks
Course Type	:	PEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Engineering Mechanics, Concrete technology
Knowledge on Fundamental Concepts	Materials of construction
Knowledge on Connected Tools (If any)	Material testing equipment's

Course Learning Objectives: This course will enable the students to:	
COL1	Understand the principles and concepts of prestressed concrete structures
COL2	Analyze and design prestressed concrete members for various loads and conditions
COL3	Apply design codes and standards for prestressed concrete structures
COL4	Develop problem-solving skills in prestressed concrete design

Module - 1	**08 Hrs**

Introduction to Design of Pre-Stressed Concrete Structures.

Analysis of Members: Analysis of Members Under Axial Load – Introduction, Analysis at transfer, Analysis at services loads, Analysis of ultimate strength, Analysis of behavior, Analysis of Member Under Flexure Introduction, Analysis at Service Loads, Based on stress concept, Based on force concept, Based on load balancing concept, Cracking moment, Kern point, Pressure line, Variation of stress in steel, Condition at ultimate limit state, Analysis of Rectangular Sections, Analysis of Flanged Sections, Analysis of Partially Prestressed Sections, Analysis of Un-bonded Post-tensioned Beams, Analysis of Behaviour. Numerical problems

Text Book 1: Ch 1

Text Book 2: Ch 1,2

Module - 2	**08 Hrs**

Design of Members

Calculation of demand Design of members for Axial Tension -Design of prestressing force, Analysis of ultimate strength, Analysis of ultimate strength Design of Member for Flexure-Calculation of moment demand., Preliminary design Design of Sections for Flexure (Part I) Final design, Final design for type 1 members, Special case, Final design of type 2 members, Choice of sections, Determination of limiting zone, Post-tensioning in stages, Magnel's graphical method. Detailing Requirements for Flexure, Detailing Requirements for Shear, Detailing Requirements for Torsion Numerical problems.

Text Book 1: Ch 4,9
Text Book 2: Ch 4,5,7

Module - 3	**08 Hrs**

Analysis and Design for Shear and Torsion
Analysis for Shear - Introduction, Stress in an uncracked beam, Types of cracks, Components of shear resistance, Modes of failure, Effect of prestressing force, Design for Shear - Limit state of collapse for shear, Maximum permissible shear stress, Design of transverse reinforcement, Detailing requirement for shear, General comments, Design steps, Design of stirrups for flange, Analysis for Torsion -Introduction, Stresses in an uncracked beam, Crack pattern under pure torsion, Components of resistance for pure torsion, Modes of failure, Effect of prestressing force, Design for Torsion - Limit state of collapse for torsion, Design of longitudinal reinforcement, Design of transverse reinforcement, Detailing requirements, General comments, Design steps Numerical problems.
Text Book 1: Ch 6
Text Book 2: Ch 5,7

Module - 4	**08 Hrs**

Calculations of Deflection and Crack Width
Calculation of Deflection Deflection due to gravity loads, Deflection due to prestressing force, Total deflection, Limits of deflection, Determination moment of inertia, Limits of span-to-effective depth ratio, Calculation of Crack Width -Method of calculation, Limits of crack width Transmission of Prestress Introduction, Pre-tensioned members, Transmission length, Development length, End zone reinforcement, Post-tensioned members, End zone reinforcement, Bearing plate, Numerical problems.
Text Book 1: Ch 8
Text Book 2: Ch 6,7

Module - 5	**08 Hrs**

Cantilever and Continuous Beams Cantilever Beams –
Introduction, Analysis, Determination of limiting zone, Cable profile, Continuous Beams - Introduction, Analysis, Incorporation of moment due to reactions, Pressure line due to prestressing force, Concordant cable profile, Cable profiles, Partially continuous beams, Analysis at ultimate limit state, Moment redistribution, Numerical problems
Text Book 1: Ch 10,11
Text Book 2: Ch 7

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand behavior of pre-stressed concrete members under service and ultimate loads.
CO2	Apply design principles and Analyze members under axial load and flexure
CO3	Analyze pre-stressed concrete sections for flexure, shear, torsion, deflection, and cracking.
CO4	Evaluate different design strategies and choose appropriate section types, cable layouts, and reinforcement detailing for given structural requirements.

CO5	Design complete prestressed concrete members and structural systems by considerations of serviceability, strength, constructability, and durability.

Text Books	
1	Praveen Nagarajan, "Advanced Concrete Design", Person In Lib
2	P. Dayaratnam, "Prestressed Concrete Structures", Oxford & IBH-Pubs Company, Delhi, 5th Edition Not Available @#$ Lin T Y and Burns N H, 'Design of Pre - stressed Concrete Structures' , John Wiley and Sons, New York

Reference Books	
1	Lin T.Y. and H. Burns - John Wiley & Sons, "Design of Prestressed concrete structures" - 1982
2	G.S. Pandit and S.P. Gupta "Prestressed Concrete"- CBS Publishers, 1993.

Web links and Video Lectures (e -resources)	
1	https://www.youtube.com/watch?v=undsd92MM8w&list=PLbQO4xhI7wEDIYv90NoF7veaJIohpuf0Q

Skill Development Activities (SDA)	
1	Design Project: Prestressed Concrete Beam a. Objective: Apply analysis and design concepts for prestressed concrete beams. b. Task: Design a prestressed concrete beam for a given load and span.
2	Case Study: Shear and Torsion Analysis a. Objective: Analyze and design for shear and torsion in prestressed concrete members. b. Task: Analyze a real-world case study and design reinforcement for shear and torsion
3	Numerical Problem-Solving Session a. Objective: Develop problem-solving skills for prestressed concrete design. b. Task: Solve numerical problems related to prestressed concrete design.
4	Group Discussion: Prestressed Concrete Design Considerations a. Objective: Develop critical thinking and communication skills. b. Task: Discuss design considerations for prestressed concrete structures.
5	Technical Report Writing: Prestressed Concrete Design Objective: Improve writing and communication skills. Task: Write a technical report on a prestressed concrete design project

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**	**3**	**3**	**2**	**2**
CO2	**2**	**1**	**3**	**3**	**2**	**1**
CO3	**3**	**1**	**3**	**3**	**2**	**1**
CO4	**2**	**2**	**3**	**3**	**3**	**2**
CO5	**3**	**2**	**3**	**3**	**3**	**3**

Semester: II						
Design of Plates and Shells						
Course Code	**:**	MCV216A		**Credits**	**:**	3
Hours/Week (L: T: P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Strength of Materials, Structural Analysis, Advanced Structural Analysis
Knowledge on Fundamental Concepts	Basic understanding of stress–strain, bending, deflection, plate and shell behavior, and loading conditions.
Knowledge on Connected Tools (If any)	Basic use of MATLAB, ANSYS, or AutoCAD for analysis and visualization.

Course Learning Objectives: This course will enable the students to	
CLO1	Classify various types of plates and analyse their behaviour under bending.
CLO2	Derive and apply governing differential equations for plate bending problems.
CLO3	Analyse rectangular and circular plates under various boundary and loading conditions.
CLO4	Study the geometry and classification of shells and understand their membrane and bending actions.
CLO5	Apply analytical techniques for solving problems related to shells of revolution and cylindrical shells.

Module – 1	**08 Hrs**

Bending of Plates

Classification of plates and methods of analysis. Slope and curvature of slightly bent plates – curvature and twist in any arbitrary direction. Principal curvatures. Classical thin plate theory. Relation between bending moments and curvatures, principal bending moments. Differential equation for laterally loaded rectangular plates. Boundary conditions. Kirchhoff modification of boundary conditions at a free edge. Differential equation for the bending of orthotropic plates. Rectangular plates subjected to edge moments. Cylindrical bending of long rectangular plates. Structural effects due to bending of plates.

Module – 2	**08 Hrs**

Simply Supported Rectangular Plates

Subjected to harmonic loading, Navier's solution for simply supported plates subjected to uniformly distributed load (UDL), hydrostatic pressure, patch load, partial UDL, and concentrated load, etc. Bending of rectangular plates subjected to UDL by Levy's approach: (i) all edges simply supported, (ii) two opposite edges simply supported and the other two edges clamped. Bending of rectangular plates subjected to uniformly varying load (UVL): (i) all edges simply supported, (ii) two opposite edges simply supported and the other two edges clamped. Method of superposition for the analysis of rectangular plates with complex boundary conditions.

Module-3	**08 Hrs**

Symmetrical Bending of Circular Plates

Differential equation for symmetrical bending of laterally loaded circular plates. A round simply supported plate subjected to uniformly distributed load (UDL) over the entire surface, a central concentrated load, and constant edge moment. A round clamped plate

subjected to UDL over the entire surface and a central concentrated load. Method of superposition. Annular plate subjected to edge moments and UDL over the entire surface.
Module – 4 **08 Hrs**
Analysis of Shells Shapes and forms of shells, geometry of quadric surfaces; general form, standard equation, ellipsoid, hyperboloid, elliptic cone, elliptic paraboloid, hyperbolic paraboloid, quadric cylinder, etc.; classifications of shells, membrane action, and bending action. Membrane analysis of shells of revolution: domes and conical shells.
Module – 5 **08 Hrs**
Analysis of Shells (Contd…) Membrane analysis of hyperbolic paraboloid shells and membrane analysis of cylindrical shells. Lundgren's Beam theory for bending analysis of cylindrical shells.

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the classification and bending behavior of plates under various loading and support conditions.
CO2	Derive and apply classical thin plate theory and analyze rectangular plates using Navier's and Levy's solutions.
CO3	Evaluate the behavior of circular plates subjected to symmetric loads using analytical methods.
CO4	Apply principles of membrane and bending action in the analysis of shell structures, understanding their geometric properties and structural behavior and analyze domes and conical shells.
CO5	Perform membrane and bending analysis of cylindrical and hyperbolic paraboloid shells using appropriate theories.

Text Books	
1	Timoshenko & Woinowsky-Krieger, "Theory of Plates and Shells", McGraw Hill, 2nd Ed., 2017, ISBN: 9780070858617
2	K. Chandrashekhara, "Introduction to the Theory of Plates", Ane Books, 2009, ISBN: 9788180520502
3	Boresi & Sidebottom,"Advanced Mechanics of Materials", Wiley, 2002, ISBN: 9780471438816
4	Szilard, R., "Theory and Analysis of Plates: Classical and Numerical Methods," Prentice Hall, 1994

Reference Books	
1	Design of Plates and Shells by Szilard R. Springer, 2004, ISBN: 9783540004087
2	Zienkiewicz O.C, "Finite Element Analysis of Plates and Shells", Elsevier, 2005, ISBN: 9780750663212
3	Teng J.G., "Shell Structures in Civil and Mechanical Engineering", Springer, 1996, ISBN: 9780727725745

Web links and Video Lectures (e – Resources)	
1	**Web Platforms:** www.sciencedirect.com , www.engineeringtoolbox.com
2	**NPTEL Courses:** Plates and Shells – IIT Madras (Prof. K. Bhaskar), Advanced Structural Analysis – IIT Kharagpur
3	**YouTube Channels:** MIT Open Course Ware – Mechanics and Materials, Civil Engineering Academy – Plate/Shell Structure Tutorials
Skill Development Activities Suggested:	
1	• Plate Classification Exercise: Create a presentation or poster categorizing different types of plates based on geometrical and material properties, including applications for each type.

	• Create physical or 3D printed Poster Presentation on domes, conical, and cylindrical shells.
	• Group project on real-world structural shell design (e.g., stadium, dome roof).
	• Paper presentation or technical seminar on innovations in plate/shell structures.

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**2**	**1**	**3**	**3**	**2**	**2**
CO2	**3**	**1**	**3**	**3**	**2**	**2**
CO3	**3**	**1**	**3**	**3**	**2**	**2**
CO4	**3**	**2**	**3**	**3**	**3**	**2**
CO5	**3**	**2**	**3**	**3**	**3**	**3**

Semester: II						
ADVANCED STRUCTURAL ANALYSIS						
Course Code	**:**	MCV216B		**Credits**	**:**	03
Hours/Week (L:T:P)	**:**	3:0:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Strength of Materials, Structural Analysis
Knowledge on Fundamental Concepts	Basic knowledge of stress, strain, bending, shear, and deflection of beams.
Knowledge on Connected Tools (If any)	Basic use of Excel for solving numerical problems.

Course Learning Objectives: This course will enable the students to	
CLO1	Apply advanced analytical techniques
CLO2	Familiarize with structural behavior under various loads.
CLO3	Analyze complex structures subjected to various loads, including axial, flexural, and thermal loadings.
CLO4	Develop a deeper understanding of structural analysis principles.

Module – 1	**08 Hrs**
Curved Beams: Introduction to curved beams, including assumptions and the derivation of the Winkler-Bach equation. Discussion on the radius to the neutral surface of simple geometric figures and their limitations. Analysis of stress distribution in open curved members, such as hooks and chain links, as well as stress distribution in closed rings and chain links. Examination of deformations in open and closed rings.	
Module – 2	**08 Hrs**
Beams on Elastic Foundations: Governing differential equation for the elastic line, interpretation of constants. Analysis of infinite beams subjected to point load, moment, and UDL, with relevant problems. Semi-infinite beams with point load, moment, and UDL, along with problems over fixed and hinged support conditions.	
Module – 3	**08 Hrs**
Shear Centre: Concept of shear center in torsion-induced bending of beams. Expressions for the shear center in symmetrical and unsymmetrical sections. Derivation of the shear center for angles, channels, semicircular, and built-up sections, along with numerical problems.	
Module – 4	**08 Hrs**
Unsymmetrical Bending (Asymmetrical Bending): Theory behind unsymmetrical bending and its assumptions. Obtaining the stresses in beams, including simply supported and cantilever unsymmetrical beams subjected to inclined loading. Analysis of deflections in unsymmetrical simply supported and cantilever beams, accompanied by numerical problems.	
Module – 5	**08 Hrs**
Stability - Bending of Prismatic bars : Governing differential equation for axial and lateral loads, Problems on axial and conc. loads, Problems on axial and UDL, Beam column with different end conditions, Problems on Beam columns, **Buckling of columns**: Assumptions, Eulers theory of buckling Governing differential equation, Columns with different end conditions, Columns with different end conditions, Columns with varying cross sections, and frames, Introduction to energy method and problems, Numerical method applied to column, Problems on Numerical methods.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain concepts of stresses, moments, deformation and pressure in beams and columns
CO2	Classify and solve load response Behaviour of beams on elastic foundations with different end conditions.
CO3	Formulate equations for determining the shear center in both symmetrical and unsymmetrical sections from fundamental principles.
CO4	Analyze beams on elastic foundation, beam column and unsymmetrical bending.
CO5	Compare the concept of stability and analysis stability of non-prismatic structural members with different boundary conditions.

Text Books	
1	William F. Riley, Leroy D. Sturges and Don H. Morris, "Mechanics of Materials, John Wiley & Sons", 2001, New Delhi, ISBN: 978-0-471-43446-7
2	Srinath L. S., "Advanced Mechanics of Solids", Tenth Print, Tata McGraw-Hill Publishing Company, New Delhi, 1994.

Reference Books	
1	Vazirani V. N. and Ratwani M. M., "Advanced Theory of Structures and Matrix Method", 5th Edition, Khanna Publishers, Delhi, 1995.
2	Sterling Kinney, "Indeterminate Structural Analysis", Oxford & IBH Publishers.
3	Krishna Raju N. & Gururaj D. R., "Advanced Mechanics of Solids and Structures", NAROSA Publishers Company, Delhi.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=s4CN6aVKhPo&list=PLEE5D02698EAAF2C0
2	https://archive.nptel.ac.in
3	https://drmcet.digimat.in/nptel/courses/video/105106050/L02.html

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**1**	**3**	**3**	**2**	**2**
CO2	**3**	**1**	**3**	**3**	**2**	**2**
CO3	**3**	**1**	**3**	**3**	**2**	**2**
CO4	**3**	**2**	**3**	**3**	**3**	**2**
CO5	**3**	**2**	**3**	**3**	**3**	**3**

Semester: II						
BRIDGE ENGINEERING						
Course Code	**:**	MCV216C		**Credits**	**:**	3
Hours/Week (L:P: SDA)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40L		**SEE**	**:**	50 Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Structural Analysis, Reinforced Concrete Design, Prestressed Concrete Design, Engineering Mechanics
Knowledge on Fundamental Concepts	Bending moment and shear force, load distribution, limit state design principles, stress-strain behavior, IRC load classifications
Knowledge on Connected Tools (If any)	STAAD Pro, ETABS, AutoCAD for detailing, Excel for tabulated calculations

Course Learning Objectives:	
CLO1	Describe bridge types, site selection, forces, and load classifications per IRC to design slab culverts.
CLO2	Apply Pigeaud's and Courbon's methods to design T-beam bridge slabs and cross girders with IRC loads.
CLO3	Design box culverts under complex loading using moment distribution and the limit state method.
CLO4	Analyze PSC girders using Courbon's method, compute cable profiles, prestressing force, and stress distribution.
CLO5	Analyze and design balanced cantilever bridge elements with articulation for IRC Class AA tracked vehicle loads.

Module -1	**08 Hrs**
Introduction & Design of Slab Culvert: Overview of bridge engineering and its development in the past. Ideal site selection for bridges and bridge classifications. Discussion of forces acting on bridges and analysis for maximum bending moment (BM) and shear force (SF) at critical sections for dead and live loads, as per IRC Class A, B, and AA tracked and wheeled vehicles. Structural design of slab culverts using the limit state method including reinforcement details. **Text Book 1:** Ch 1,2,3 **Text Book 2:** Ch 1,2 **Text Book 3:** Ch 1,2	
Module -2	**08 Hrs**

Box Culvert: Introduction to box culverts and advantages of structural continuity. Analysis involves determining maximum bending moment (BM) and shear force (SF) at critical sections using the moment distribution method for various load combinations, including dead, surcharge, soil, water, and live loads (as per IRC Class A, B, and AA for tracked and wheeled vehicles). The structural design will utilize the Limit State Method with detailed reinforcement specifications.

Text Book 1: Ch 4

Text Book 2: Ch 3

Text Book 3: Ch 3,4

Module -3	**08 Hrs**

T-Beam Bridge: Components of T-Beam Bridge, Load transfer mechanism, Proportioning the Components, Analysis of Slab using Pigeauds Method for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles and design of Slab using limit state method with reinforcement details. Analysis of Cross Girder for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles and design of slab using limit state method with reinforcement details. Analysis of Main Girder using Courbon's Method for maximum BM and SF at critical sections for Dead and Live load as per IRC class A, B, AA tracked and wheeled vehicles and design of Main Girder using limit state method with reinforcement details.

Text Book 2: Ch 5,6

Text Book 3: Ch 5,6

Module -4	**08 Hrs**

PSC-Bridge: Introduction to Pre & Post Tensioning, Proportioning of Components, Analysis & Structural Design of Slab, Analysis of Main Girder Using Courbon's Method for IRC Class AA, Tracked vehicle, Calculations of Pre-stressing Force, Calculations of Stresses, Cable profile, Design of End Block, Detailing of Main Girder.

Text Book 2: Ch 7,9

Text Book 3: Ch 7,8

Module -5	**08 Hrs**

Balanced Cantilever Bridge: Introduction & Proportioning of Components, Analysis of Main Girder Using Courbon's Method for IRC Class AA, Tracked vehicle Design of Simply Supported Portion, Cantilever Portion, Articulation, using limit state method with reinforcement details.

Text Book 4: Ch 1,2,3,5,10

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain bridge classifications, site selection criteria, loading standards, and the structural behavior of slab culverts.
CO2	Design the slab of T-beam bridges and cross girders using IRC specifications and empirical methods.
CO3	Design box culverts under various combinations of loads using the limit state method and moment distribution.
CO4	Analyze the main girders of T-beam and PSC bridges using Courbon's method for Class AA loading.
CO5	Evaluate and design balanced cantilever bridge components considering articulation and support conditions.

Text Books	
1	Dr. D. Johnson Victor, "Essentials of Bridge Engineering", 7th Edition, 2006, Oxford & IBH Publishing Co., ISBN: 9788120417170
2	Dr. N. Krishna Raju, "Design of Bridges", 4th Edition, 2016, Oxford & IBH Publishing Co., ISBN: 9788120417170

Reference Books	
1	S. P. Bindra, "Principles and Practice of Bridge Engineering", Latest Edition, Dhanpat Rai & Sons, ISBN: 9788177000569
2	IRC 6 – 1966, IRC 21 – 1966, IS 456 – 2000, IS 1343 – 2012

Web links and Video Lectures (e -resources)	
1	https://archive.nptel.ac.in/courses/105/105/105105216/
2	https://onlinecourses.nptel.ac.in/noc22_ce63/preview
3	https://www.youtube.com/watch?app=desktop&v=FivRabGNaeM
4	https://www.scribd.com/document/792595464/Balanced-Cantilever-Bridge
5	https://www.youtube.com/playlist?list=PLVKlcD35jfiPfR7h8jQq02GelJlO83QW1

Skill Development Activities (SDA)	
1	**Bridge Design Software Training:** Learn industry-standard software (Civil 3D, STAAD, ETABS) to design various bridge types with skills in geometry, load calculation, analysis, and material selection.
2	**Model Bridge Building and Testing:** Design and test scale bridge models to develop hands-on skills in structural integrity, materials, and problem-solving through iterative improvements.
3	**Bridge Site Visits and Inspection:** Gain field experience by inspecting bridge components to develop skills in condition assessment, maintenance planning, and safety protocols.
4	**Online Courses/Certifications:** Stay updated on bridge engineering trends through platforms like ASCE, Coursera, and Udemy, gaining certifications and knowledge of modern design standards and technologies.
5	**Case Study Analysis:** Analyze real-world bridge successes and failures to develop critical thinking, problem-solving, and decision-making skills for improved design and construction practices.

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**	**1**	**3**	**3**	**2**	**2**
CO2	**3**	**1**	**3**	**3**	**3**	**2**
CO3	**3**	**1**	**3**	**3**	**3**	**2**
CO4	**3**	**2**	**3**	**3**	**3**	**2**
CO5	**3**	**2**	**3**	**3**	**3**	**3**

Semester: II						
Reliability Analysis and Reliability Based Design of Structures						
Course Code	**:**	MCV216D		**Credits**	**:**	3
Hours/Week (L:P: T)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40		**SEE**	**:**	50 Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Engineering Mathematics, Strength of Materials, Structural Analysis
Knowledge on Fundamental Concepts	Basic understanding of probability, statistics, and random variables. Knowledge of stress, strain, and material behavior in structures.
Knowledge on Connected Tools (If any)	Basic use of r Excel for statistical and numerical calculations.

Course Learning Objectives: This course will enable the students to	
CLO1	Equip with the necessary knowledge and skills to analyze and design structures with a focus on reliability and safety
CLO2	Apply statistical techniques to assess variability in structural elements,
CLO3	Determine appropriate safety formats for failure surfaces, and utilize regression and correlation methods to analyze relationships between variables
CLO4	Gain proficiency in reliability-based design principles, calculation of partial safety factors and the use of simulation techniques to derive statistics for design variables
CLO5	Prepare students to make informed decisions in structural engineering that prioritize safety, efficiency, and integrity.

Module-1	**8 Hrs**

Concept of Variability

- Applications of statistical principles to deal with randomness in basic variables.
- Statistical parameters and their significance.
- Description of various probability distributions: Binomial, Poisson, Normal, Log-Normal, Beta, and Gamma distributions.
- Testing the goodness of fit of distributions to actual data using the Chi-Square method and the Kolmogorov-Smirnov (K.S.) method.

Module-2	**8 Hrs**

Statistical Regression and Correlation

- Least squares and Chi-Square methods.
- Operations on one random variable, expectation, and multiple random variables.

- Reliability distributions and basic formulations.

Module-3	**8 Hrs**

Statistical Quality Control in Civil Engineering

- Sampling for quality control: Characteristic strength and characteristic load.
- Probability modeling of strength, geometrical dimensions, material properties, and loading.
- Statistical inference problems: Comparison of various acceptance and rejection testing.

Module-4	**8 Hrs**

Safety Assessment of Structures

- Reliability analysis using I, II, and III order reliability formats.
- Mean value method and its applications in structural designs.

Module-5	**8 Hrs**

Reliability of Structural Elements

- Simulation techniques: Monte Carlo method and its applications.
- Reliability index and reliability formulation in various limit states.
- Reliability-based design: Application to the design of reinforced concrete (RC), prestressed concrete (PSC), and steel structural elements under the Load and Resistance Factor Design (LRFD) concept.

Course Outcomes: After completing the course, the students will be able to	
CO1	Comprehend the concepts and techniques of reliability and probability distributions.
CO2	Define the safety format for failure surfaces for given actions and responses, along with their statistics.
CO3	Learn the statistical regression and correlation of two variables.
CO4	Determine the partial safety factors for a target reliability index.
CO5	Use simulation techniques to derive the statistics of design variables.

Text Books	
1	Ang, A.H.S., and Tang, W.H. “Probability Concepts in Engineering Planning and Design”, John Wiley & Sons, New York, Vol. I and II, First Edition (January 1, 1984).
2	Ranganathan, R. “Reliability Analysis and Design of Structures”, Tata McGraw-Hill Publishing Co. Ltd., New Delhi (2008).
Reference Books	
1	Sancheti D.C and Kapoor V.K. “Statistics: Theory, Methods & Applications”, (1996).
2	Devaraj V and Ravindra R. “Reliability-Based Analysis and Design for Civil Engineers”, IK International Publishing House Pvt. Ltd. (December 30, 2017).

Web links and Video Lectures (e – Resources)	
1	https://archive.nptel.ac.in/courses/105/103/105103140/
2	https://archive.nptel.ac.in/courses/105/105/105105209/
3	https://onlinecourses.nptel.ac.in/noc21_ce58/preview

Skill Development Activities Suggested

1	**Workshops on Software Tools:** Conduct hands-on workshops using reliability analysis software (e.g., MATLAB, R) to perform simulations and analyses.
2	**Case Studies and Group Projects:** Analyze real-life structural failures in groups, focusing on reliability assessments and safety factor calculations.
3	**Guest Lectures and Seminars:** Invite industry experts for lectures on reliability-based design and host student seminars to present findings.
4	**Statistical Data Analysis Exercises:** Practice statistical methods (e.g., regression, correlation) with civil engineering data sets to enhance data interpretation skills.
5	**Field Visits and Research Projects:** Arrange site visits to observe practical applications of reliability analysis and initiate research projects on innovative techniques.

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**2**	**1**	**3**	**3**	**2**	**2**
CO2	**3**	**1**	**3**	**3**	**2**	**2**
CO3	**3**	**1**	**3**	**3**	**2**	**2**
CO4	**3**	**2**	**3**	**3**	**3**	**2**
CO5	**3**	**2**	**3**	**3**	**3**	**3**

Semester: II						
COMPUTATION LABORATORY-II						
Course Code	**:**	MCVL207		**Credits**	**:**	2
Hours/Week (L:P: T)	**:**	1:2:0		**CIE**	**:**	50 Marks
Total Hours	**:**	10 to 12 Lab sessions		**SEE**	**:**	50 Marks
Course Type	**:**	PCCL		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	MATLAB/ Python Programming Laboratory, Software application Lab.
Knowledge on Fundamental Concepts	C Programming, 3D Structural Drawings & Design of Structures
Knowledge on Connected Tools (If any)	MATLAB/ Python Software & Bentley STAAD Pro/ ETABS.

Course Learning Objectives: This course will enable the students to	
CLO1	Apply knowledge of programming to analyze and design of structural elements using MATLAB/Python software.
CLO2	Apply knowledge of structural analysis concepts to analyze and design structures using any FE based software.

Sl. No.	**Exercises**
1.	Analysis and Design of RCC beam and column elements using MATLAB/Python
2.	Analysis and Design of RCC slabs for different end conditions using MATLAB/Python
3.	Structural Analysis of 2D beams with different loading and support conditions by using MATLAB/Python
4.	Analysis of unidirectional fiber reinforced composite materials by using MATLAB/Python to compute parameters of rule of mixture and engineering constants.
5.	Analysis of STEEL beam and column elements using MATLAB/Python
6.	Static and Dynamic analysis and design of Multi-storey Building structures using any FE software
7.	Analysis of RC Chimneys/silos/bunkers FE software.
8.	Analysis and design of large span roof structure (dome structure) using any FE software.
9.	Design of structural drawings for a multi-storied building using FE Software
10.	Experiments on vibration of multi storey frame models for Natural frequency and modes.
Demonstration Experiments	
11.	Analysis of unidirectional fiber reinforced composite materials by using MATLAB/Python to compute compliance matrix, stiffness matrix and other related parameters
12.	Analysis of unidirectional fiber reinforced composite materials by using MATLAB/Python to compute A-B-D matrix.
13.	Use of Non-destructive testing (NDT) equipment's – Rebound hammer, Ultra sonic pulse velocity meter and Profometer

Course Outcomes: After completing the course, the students will be able to	
CO1	Perform structural analysis and design of RC elements using MATLAB/Python software.
CO2	Analyze and design various structures for different loading and support conditions using FE-based software.

Reference Books

BIS & ACI Code of Practice

- BIS: IS 13920. (2016). CODE OF PRACTICE.
- BIS: IS 1893 Part 1. (2002) GENERAL PROVISIONS AND BUILDINGS.
- BIS: IS 456. (2000). CODE OF PRACTICE.
- BIS: IS 875 Part 1 & 2. (1987). CODE OF PRACTICE PART-1- DEAD LOAD & PART 2, IMPOSED LOADS.
- ACI 318-14. (2014). ACI 318-14: BUILDING CODE

Skill Development Activities Suggested

1. Conduction of technical seminars on recent research activities

2. Group Discussion

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	3	3	3
CO2	3	2	3	3	3	3

Semester: II						
Skill and Ability enhancement courses for PG Level Civil Engineering courses						
Course Code	**:**	MCV258		**Credits**	**:**	1
Hours/Week (L:T:P)	**:**	-		**CIE**	**:**	50 Marks
Total Hours	**:**	-		**SEE**	**:**	50 Marks
Course Type	**:**	- AEC/SEC		**SEE Duration**	**:**	-

Preamble

The Ability Enhancement and Skill Development Course at the postgraduate level is designed to strengthen students' core competencies and equip them with essential skills for academic and professional advancement. This course focuses on developing critical thinking, academic writing, research methodology, digital literacy, communication, and ethical reasoning to support advanced learning and scholarly engagement. It also emphasizes skill development in areas such as problem-solving, data analysis, entrepreneurship, project management, and the use of discipline-specific tools and technologies. Aligned with the objectives of the National Education Policy (NEP) 2020, the course aims to enhance employability, innovation capacity, and leadership qualities among postgraduate students.

Procedure to take up Skill and Ability enhancement courses for PG Level Civil Engineering courses

Students may opt the subjects from NPTEL (National Programme on Technology Enhanced Learning) online course list and VTU online courses offered during the current semester, subject to the approval of the Department and as per university regulations. The selected course must be relevant to the student's postgraduate program, contribute to academic or professional development, and not duplicate content already covered in the core curriculum. A NPTEL or VTU online course in the semester may be permitted for credit transfer or academic enrichment, provided the course includes assessments such as assignments and proctored examinations. Students must submit their course selection for departmental approval within the first two weeks of the semester. Successful completion of the course, including passing the final certification exam (online) will be required for academic credit or consideration under skill enhancement components.

Some of the Generalized Subjects but not limited for Skill Development Courses (SDC) and Ability Enhancement Courses (AEC)

- Environmental Data Analysis and Simulation Tools
- Disaster Risk Reduction and Management in Infrastructure
- Smart Infrastructure and IoT Applications in Civil Engineering
- Legal Aspects, Contracts, and Arbitration in Construction
- Technical Communication and Scientific Writing for Engineers
- Entrepreneurship and Innovation in Civil Engineering
- Project Formulation and Proposal Writing
- Digital Literacy and Software Tools for Engineering Research
- Intellectual Property Rights and Patent Drafting
- Leadership and Team Management in Engineering Contexts
- Other skill enhancement courses suggested by the respective programs

Institute Vision

Preparing Competent Engineering and Management Professionals to Serve the Society

Institute Mission

- Providing Students with a Sound Knowledge in Fundamentals of their branch of Study.
- Promoting Excellence in Teaching, Training, Research and Consultancy.
- Exposing Students to Emerging Frontiers in various domains enabling Continuous Learning.
- Developing Entrepreneurial acumen to venture into Innovative areas.
- Imparting Value based Professional Education with a sense of Social Responsibility.

Department Vision

Building Competent Civil Engineers with a Societal Perspective

Department Mission

- Providing Conducive Learning Environment focusing on Planning, Analysis, Design and Detailing of Sustainable Infrastructure
- Imparting Training, Research and Consultancy in Collaboration with Research Institutes and Industries.
- Equipping Students with Employability Skills through Internships, Industrial Interactions and Field Visits
- Exploring Comprehensive Environmental Aware Solutions for Various Fields of Civil Engineering with Multidisciplinary Approach
- Imbibing Lifelong Learning, Professionalism and Ethics among Civil Engineering Students

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

P.B. No.20, B.B Road,

Chikkaballapur - 562 101, Karnataka