SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

Faculty of Engineering & Technology

Department of Civil Engineering

2-Year Full-Time Program

Master of Technology in Civil Engineering (Structural Engineering/ Transportation Engineering/ Remote Sensing and GIS)

With Effect from Year 2024

TABLE OF CONTENTS

Sl. No.	Topic/Content	Page No.
1	Nature and Extent of the Program	3
2	Program Education Objectives (PEOs)	4
3	Post-Graduate Attributes	5
4	Qualifications Descriptors	7
5	Program Outcomes (POs)	9
6	Program-Specific Outcomes (PSOs)	10
7	Course structure	11
8	Semester-wise Course Details • Semester I • Semester II • Semester III • Semester IV	15
9	Mapping of Course Outcomes, Program Outcomes and Program Specific Outcomes	217

HOD, CED **DEAN, FEAT** **DEAN Academics**

1. NATURE AND EXTENT OF THE PROGRAM

A Master of Technology in Civil Engineering is a postgraduate program that focuses on advanced studies and research in various aspects of civil engineering. The program is designed to provide students with a deeper understanding of theoretical concepts, practical applications, and research methodologies in the field of civil engineering.

Master of Technology in Civil Engineering offers specializations in areas such as Structural Engineering, Geotechnical Engineering, Transportation Engineering, Environmental Engineering, Water Resources Engineering, and Construction Management.

The curriculum typically includes a mix of core courses, elective courses, and a research-based thesis or project. Core courses cover fundamental principles of civil engineering, while elective courses allow students to develop into specific areas of interest. The nature of Master of Technology in Civil Engineering is characterized by its focus on advanced education, research orientation, practical application, and a commitment to preparing graduates for successful careers in civil engineering. The program is designed to provide a well-rounded and in-depth understanding of the chosen specialization while fostering critical thinking and research skills.

A significant component of Master of Technology in Civil Engineering is the research work and the completion of a thesis. Students are required to identify a research topic, conduct a literature review, and undertake original research under the guidance of a faculty advisor. The thesis work provides an opportunity for students to contribute to the existing knowledge in their chosen specialization.

The Master of Technology in Civil Engineering program is typically delivered through a combination of classroom lectures, student's interactive sessions, industry expert lectures, seminars, hands-on workshops, live projects, laboratory sessions, Thesis writing and practical training.

Upon completion of the program, Graduates with an Master of Technology in Civil Engineering can pursue careers in various sectors, including construction and infrastructure development, consulting firms, research and development organizations, government agencies, and academia. Job roles may include structural engineer, geotechnical engineer, transportation planner, environmental consultant, and project manager.

In conclusion, Master of Technology in Civil Engineering provides students with the knowledge, skills, and research capabilities needed to excel in the field and contribute to advancements in civil engineering practices. The extent of Master of Technology in Civil Engineering program is

dynamic and ensure graduates are well-prepared for the challenges and opportunities in the field of civil engineering.

2. PROGRAM EDUCATION OBJECTIVES (PEOs)

After completing Master of Technology in Civil Engineering, students will be able to:

PEO No.	Education Objective
PEO1	Graduates of the program will have in-depth knowledge to identify and formulate challenging problems of Civil Engineering, apply appropriate research methodologies, use modern engineering tools and provide economical and sustainable solutions.
PEO2	To develop the design capability among students so that have the ability to innovate, develop and implement it in various interdisciplinary fields of civil engineering.
PEO3	To promote quality research and undertake research projects related to experimental investigation and use of software techniques, keeping in view the present and future needs of the civil industry.
PEO4	To develop the post-graduate civil engineers to undertake safe, economical and sustainable design of civil and other structures.
PEO5	To inculcate in the students the sense of ethics, morality, professionalism, creativity, leadership, independent thinking and self-confidence.

3. GRADUATE ATTRIBUTES

Sl. No.	Attributes	Description
1	Pool of knowledge	Apply knowledge of civil engineering fundamentals and an engineering specialization to the solution of challenging civil engineering problems.
2	Critical thinking	Real-world experience through internships and practical training including Problem Identification, Analysis of Data, Risk Assessment and Analyze complex engineering problems contributes significantly to the development of critical thinking abilities in civil engineering professionals.
3	Problem solving	Conduct investigations of civil engineering complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
4	Research skill	Develop the ability to search for, locate, extract, organize, evaluate and use or present information that is relevant to a particular topic.
5	Modern tool usage	Integration of modern tools in civil engineering enhances efficiency, accuracy, and collaboration throughout the entire lifecycle of a construction project—from planning and design to construction and maintenance.
6	Collaborative and multidisciplinary work	Embracing diverse perspectives and expertise enhances the industry's ability to address complex challenges and contribute to sustainable, resilient, and efficient infrastructure development.
7	Project management	Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

8	Communication	Ensures that all stakeholders are well-informed, promotes collaboration, and helps manage challenges effectively, ultimately contributing to the successful planning, design, and implementation of infrastructure projects.
9	Life-long learning	Recognize the need to have a natural drive to explore, learn and grow to improve self-quality of life and sense of self-worth by paying attention to the ideas and goals in the field of Civil Engineering.
10	Ethical practices and social responsibility	Understand the impact of professional engineering solutions in societal and ethical contexts and apply ethical principles and commit to professional ethics responsibilities and norms of engineering practice.
11	Independent and reflective learning	Recognize the need for and have the preparation and ability to Engage in independent and reflective learning in the broadest context of technological Change.

4. QUALIFICATION DESCRIPTORS:

The Master of Technology in Civil Engineering program is designed to provide students with advance education in the principles and practices of civil engineering. The qualification descriptor of the Master of Technology in Civil Engineering program includes:

1. **Knowledge & Understanding:**
    - Demonstrate a dedicated understanding in field of civil engineering, its different learning areas and applications, and its linkages with related disciplinary areas/subjects.
    - Demonstrate procedural knowledge that creates different types of professionals related to the specialized domain of civil engineering, including research and development, teaching and academics and also the industrial sector.
    - Aware about eco-friendly construction materials, energy-efficient design, and sustainable urban development to address environmental concerns with emphasis on sustainable practices in civil engineering.
2. **Technology & Skill:**
    - Exposes students to cutting-edge technologies and innovations in civil engineering. This may include advancements in materials, construction techniques, smart infrastructure, and the integration of digital tools like Building Information Modeling (BIM) and simulation software.
    - Acquire knowledge of project management principles, including planning, scheduling, budgeting, and resource allocation. This prepares them for leadership roles in managing complex engineering projects.
    - Acquire understanding of national and international codes and standards relevant to civil engineering practices. Adherence to these codes ensures that projects meet regulatory requirements and industry benchmarks.

3. Communication and Competence:

- Development of effective communication and presentation skills. Students learn to convey complex engineering concepts to diverse audiences, including technical and non-technical stakeholders.
- Aware students to global challenges and international best practices in civil engineering. This includes exposure to case studies and projects from around the world, allowing students to apply a global perspective to their work.

Overall, Master of Technology in Civil Engineering program aims to produce graduates who possess a deep understanding of their chosen specialization, are capable of conducting independent research, and can apply their knowledge to address real-world civil engineering challenges. The curriculum is designed to balance theoretical knowledge with practical application, ensuring that graduates are well-prepared for leadership roles in academia, research, and industry.

5. PROGRAM OUTCOMES

PO No.	Attribute	Competency
PO1	Engineering knowledge	Student will be able to apply the knowledge of engineering to understand and analyse individual components related to the relevant specialization of Civil Engineering.
PO2	Research knowledge	Student will be able to carry out systematic research, design appropriate experiments and tools, and interpret experimental and analytical data for development of technological knowledge in civil engineering
PO3	Conduct research-based investigations of Complex Problems	Student will be able to design and conduct experiments, interpret, critically analyze data and carry out independent research on complex problems of civil engineering
PO4	Implementation of Advance Tools	Student will be able to create, adopt, and apply modern computational tools to analyze Civil engineering problems with understanding of limitations.
PO5	Engineer and Society	Student will comprehend their ethical and professional responsibilities while operating in inter-disciplinary engineering teams, with view on social responsibilities.
PO6	Life Long Learning	Students will be able to engage themselves in higher studies or life-long learning and keep on updating themselves with technological advance.

6. PROGRAM SPECIFIC OUTCOMES

PSO No.	Competency
PSO1	Graduates of the program will have in-depth knowledge to identify and formulate challenging problems in Structural/ Transportation/ Remote Sensing and GIS Engineering, apply appropriate research methodologies, use modern engineering tools and provide technically sound, economical and sustainable solutions.
PSO2	Graduates will have ability for higher studies and undertake high value research.
PSO3	Graduate of program will actively engage in a professional career as a Civil Engineer with sound analytical and lateral thinking ability to engage in lifelong learning for professional advancement to cope up with multidisciplinary and changing technologies in Civil Engineering.
PSO4	Graduates of the program will have sense of social responsibility, will demonstrate ability to communicate and work effectively as an individual or in a team having acquired leadership skills and manage projects in multidisciplinary environments.

7. COURSE STRUCTURE

SEMESTER – I

Course Code	Course Title	Credit Distribution (Hours/Week)				Marks Distribution		
		L	T	P	C	IAE	ESE	Total
13160138	Research Methodology & IPR	3	0	0	3	**40**	**60**	**100**
13160107	Seminar	0	0	2	1	**20**	**30**	**50**
Choose these subjects for specialization in Transportation Engineering								
13160132	Pavement Materials	3	0	0	3	**40**	**60**	**100**
13160133	Urban Transportation System Planning	3	0	0	3	**40**	**60**	**100**
13160134	Geometric Design of Transportation Facilities	3	0	0	3	**40**	**60**	**100**
13160135	Ground Improvement	3	0	0	3	**40**	**60**	**100**
13160136	Pavement Materials Lab	0	0	2	1	**20**	**30**	**50**
13160137	Geometric Design Lab	0	0	2	1	**20**	**30**	**50**
Choose these subjects for specialization in Structural Engineering								
13160114	Advance Pre-Stressed Concrete Design	3	0	0	3	**40**	**60**	**100**
13160115	Structural Dynamics	3	0	0	3	**40**	**60**	**100**
13160116	Matrix Methods of Structural Analysis	3	0	0	3	**40**	**60**	**100**
13160117	Design of Concrete Structural Systems	3	0	0	3	**40**	**60**	**100**
13160118	Matrix Methods of Structural Analysis Lab (STAAD PRO)	0	0	2	1	**20**	**30**	**50**
13160119	Design of Concrete and Structural Systems Lab (STAAD PRO)	0	0	2	1	**20**	**30**	**50**
Choose these subjects for specialization in Remote Sensing and GIS								
13160143	Principles of Remote Sensing	3	0	0	3	**40**	**60**	**100**
13160108	Geographical Information Systems	3	0	0	3	**40**	**60**	**100**
13160139	Photogrammetry	3	0	0	3	**40**	**60**	**100**
13160140	Application of Remote Sensing	3	0	0	3	**40**	**60**	**100**
13160141	Geographical Information Systems Lab	0	0	2	1	**20**	**30**	**50**
13160142	Photogrammetry Lab	0	0	2	1	**20**	**30**	**50**
	Total	**15**	**0**	**6**	**18**	**260**	**390**	**650**

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination.

SEMESTER – II

Course Code	Course Title	Credit Distribution (Hours/Week)				Marks Distribution		
		L	T	P	C	IAE	ESE	Total
13160238	Minor Project	0	0	6	3	**20**	**30**	**50**
Transportation Engineering (Choose these subjects for specialization)								
13160232	Analysis and Design of Pavement	3	1	0	4	**40**	**60**	**100**
13160233	Transport Economics	3	0	0	3	**40**	**60**	**100**
13160234	Traffic Engineering and Management	3	0	0	3	**40**	**60**	**100**
13160235	Airport Infrastructure, Planning and Design	3	0	0	3	**40**	**60**	**100**
13160236	Pavement Design Lab	0	0	2	1	**20**	**30**	**50**
13160237	Traffic Lab	0	0	2	1	**20**	**30**	**50**
Structural Engineering (Choose these subjects for specialization)								
13160214	Finite Element Analysis	3	0	0	3	**40**	**60**	**100**
13160215	Theory of Elasticity and Plasticity	3	0	0	3	**40**	**60**	**100**
13160216	Limit State Design of Steel Structures	3	1	0	4	**40**	**60**	**100**
13160217	Earthquake Resistant Design	3	0	0	3	**40**	**60**	**100**
13160218	Structural Engineering lab (CASTING)	0	0	2	1	**20**	**30**	**50**
13160239	Finite Element Analysis Lab	0	0	2	1	**20**	**30**	**50**
Remote Sensing and GIS (Choose these subjects for specialization)								
13160240	Geospatial Data Processing and Modelling	3	1	0	4	**40**	**60**	**100**
13160241	Satellite Image Processing	3	0	0	3	**40**	**60**	**100**
13160242	Advanced GIS	3	0	0	3	**40**	**60**	**100**
13160243	GPS & Surveying	3	0	0	3	**40**	**60**	**100**
13160244	Advanced GIS Lab	0	0	2	1	**20**	**30**	**50**
13160245	Satellite Image Processing Lab	0	0	2	1	**20**	**30**	**50**
Total Credits for the semester		**12**	**1**	**10**	**18**	**220**	**330**	**550**

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination.

SEMESTER – III

Course Code	Course Title	Credit Distribution (Hours/Week)				Marks Distribution		
		L	T	P	C	IAE	ESE	Total
13160367	Dissertation Phase-I	0	0	12	6	**20**	**30**	**50**

Transportation Engineering (Choose these subjects for specialization)								
13160357	Intelligent Transportation Systems	3	1	0	4	**40**	**60**	**100**
Program Elective-I Pool (Choose One from the pool)								
13160355	Construction Project Management & BOT	3	0	0	3	**40**	**60**	**100**
13160368	Traffic Management and Road safety							
13160359	Highway Construction Practices							
Program Elective-II Pool (Choose One from the pool)								
13160369	Pavement Evaluation, Rehabilitation & Maintenance	3	0	0	3	**40**	**60**	**100**
13160363	Environment Impact Assessment							
13160365	Bridge Engineering							

Structural Engineering (Choose these subjects for specialization)								
13160305	Theory & Design of Plate and Shell	3	1	0	4	**40**	**60**	**100**
Program Elective-I Pool (Choose One from the pool)								
13160325	Pre-Fabricated Structures	3	0	0	3	**40**	**60**	**100**
13160327	Design of Industrial Structures							
13160329	Maintenance & Rehabilitation of Structures							
Program Elective-II Pool (Choose One from the pool)								
13160331	Design of Bridges	3	0	0	3	**40**	**60**	**100**
13160333	Composite Structures							
13160335	Design of Tall Buildings							

Remote Sensing and GIS (Choose these subjects for specialization)								
13160370	Digital Image Processing	3	1	0	4	**40**	**60**	**100**
Program Elective-I Pool (Choose One from the pool)								
13160371	Web and Mobile GIS	3	0	0	3	**40**	**60**	**100**
13160372	Argo Remote Sensing							
13160373	Remote Sensing Geology							
Program Elective-II Pool (Choose One from the pool)								
13160374	Global Navigation Satellite System	3	0	0	3	**40**	**60**	**100**
13160375	Advanced Surveying and Cartography							
13160376	Pattern Recognition and Machine Learning							

Total Credits for the semester	**9**	**1**	**12**	**16**	**140**	**210**	**350**

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination.

SEMESTER – IV

Course Code	Course Title	Credit Distribution (Hours/Week)				Marks Distribution		
		L	T	P	C	IAE	ESE	Total
13160432	Dissertation Phase-II	0	0	16 Week	16	**80**	**120**	**200**
Total Credits for the semester		**0**	**0**	**16 Week**	**16**	**80**	**120**	**200**

Note – L: Lecture Hour/week, T: Tutorial Hour/week, P: Practical Hour/week, C: Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination.

OVERALL CREDIT DISTRIBUTION TABLE

SEMESTER	HOURS PER WEEK			Total Credit	Marks Distribution		
	L	T	P	TC	IAE	ESE	Total
SEMESTER – I	**15**	**0**	**6**	**18**	**260**	**390**	**650**
SEMESTER – II	**12**	**1**	**10**	**18**	**220**	**330**	**550**
SEMESTER – III	**9**	**1**	**12**	**16**	**140**	**210**	**350**
SEMESTER – IV	**-**	**-**	**-**	**16**	**80**	**120**	**200**
Total	**36**	**2**	**28**	**68**	**700**	**1050**	**1750**

Note – L: Lecture Hour, T: Tutorial Hour, P: Practical Hour, TC: Total Credits, IAE: Internal Assessment Examination, ESE: End Semester Examination.

8. SEMESTER-WISE COURSE DETAILS

SEMESTER - I

Course Code	Course Title
13160138	Research Methodology & IPR
13160107	Seminar
Choose these subjects for specialization in Transportation Engineering	
13160132	Pavement Materials
13160133	Urban Transportation System Planning
13160134	Geometric Design of Transportation Facilities
13160135	Ground Improvement
13160136	Pavement Materials Lab
13160137	Geometric Design Lab
Choose these subjects for specialization in Structural Engineering	
13160114	Advance Pre-Stressed Concrete Design
13160115	Structural Dynamics
13160116	Matrix Methods of Structural Analysis
13160117	Design of Concrete Structural Systems
13160118	Matrix methods of Structural Analysis Lab (STAAD PRO)
13160119	Design of Concrete and Structural Systems Lab (STAAD PRO)
Choose these subjects for specialization in Remote Sensing and GIS	
13160143	Principles of Remote Sensing
13160108	Geographical Information Systems
13160139	Photogrammetry
13160140	Application Of Remote Sensing
13160141	Geographical Information Systems Lab
13160142	Photogrammetry Lab

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160138
Course Title	**Research Methodology & IPR**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	
Course Synopsis	The aim of the course is to make students understand the importance of Research Paper Writing. Also, it covers all the concepts which involved in writing the Research Paper.

Course Outcomes:
At the end of the course students will be able to:

CO1	Recognize the various steps involved in research.
CO2	Collect data from samples, Examine and analyze the data.
CO3	Develop models for problems.
CO4	Explain the entire process in the form of a report.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**
CO2	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**
CO3	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**
CO4	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**
Average	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1	Define Research (C1, Remember), Classify research, and discuss Research process and steps (C2, Understand), Explain Hypothesis, Research Proposal and aspects (C2, Understand) Describe Research Design- Need, Problem Definition, Variables, Research Design concepts (C2, Understand), Use of Literature survey and review (C3, Apply), Explain Research design process, Errors in research (C2, Understand), Compare the Research Modeling- Types of

	models, model building and stages, Data consideration (C4, Analyze)
2	Discuss Sampling and data collection (C2, Understand)- Compare the Techniques of sampling, Random, Stratified, Systematic, Multistage-sampling, Primary and secondary sources of data (C4, Analyze), Design of questionnaire (C6, Create)
3	Design of Experiments- Objectives, strategies (C6, Create), Examine Factorial experimental design, designing engineering experiments, basic principles-replication, randomization, blocking, guidelines for the design of experiments (C4, Analyze)
4.	Discuss and explain Single factor experiment- Hypothesis testing, analysis of Variance component (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effect model, estimation of variance components, Model adequacy checking (C2, Understand) Examine the Structure and components of Scientific Reports (C4, Analyze), compare the Types of Report, Technical Reports and Thesis (C4, Analyze); Distinguish Different steps in the preparation – Layout, structure and Language of typical reports; Illustrations and tables, Bibliography, Referencing and foot notes (C4, Analyze)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	25
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	8
Case/Project Based Learning (CBL)	12
Revision	6
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce

	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		
Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through Google forms	

References:	
	Text Books 1. Research Methodology – Methods and Techniques – C.R. Kothari, New Age International, New Delhi, 2004. **Reference Books** 1. Design and Analysis of Experiments – Douglas C. Montgomery, Wiley India, 8th Edition, 2012. 2. Practical Research: Planning Design – Paul D. Leddy, London, 1980.

SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

NAAC A+

Master of Technology in Civil Engineering (Transportation Engineering) 1st Semester

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160132
Course Title	**Pavement Materials**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	Soil Mechanics and concrete technology
Course Synopsis	Soil composition and structure, Properties and test on road aggregate, Bitumen materials.

Course Outcomes:
At the end of the course, students will be able to:

CO1	Identify different pavement materials.
CO2	Apply appropriate tests to characterize pavement materials.
CO3	Characterize various material inputs for different pavement design procedures.
CO4	Develop suitable performance tests and material specifications.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) &Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	1	1	2	2	3	3
CO2	3	3	2	2	1	1	2	2	3	3
CO3	3	3	2	2	1	1	2	2	3	3
CO4	3	3	2	2	1	1	2	2	3	3
Average	3	3	2	2	1	1	2	2	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	0	0	3

Unit	Content
1	Define soil composition and structure (C1, Remember), Explain soil classification for engineering purposes (C2, Understand), Discuss Origin, Classification and requirements (C2, Understand).
2	Define properties and tests on road aggregates (C1, Remember), Explain aggregate classification (C2, Understand), Discuss volumetric analysis of aggregate (C2, Understand).
3	Define origin (C1, Understand), Discuss preparation (C2, Understand), Classify properties and tests (C2, Understand), Classify constituent of bituminous (road binders) (C2, Understand), Bituminous Emulsions and Cutbacks: Demonstrate preparation, characteristics, uses and tests (C3, Apply).

4	State Mechanical properties (C1, Remember) –Define Resilient modulus, dynamic modulus and fatigue characteristics of bituminous mixes (C1, Remember). Demonstrate Weathering and Durability of Bituminous Materials and Mixes (C3, Apply) –Differentiate Performance based Bitumen Specifications (C4, Analyze) – Develop Super pave mix design method (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	35
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	2
Problem Based Learning (PBL)	4
Case/Project Based Learning (CBL)	2
Revision	--
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Quiz	Mid Semester Examination 1
Seminars	Mid Semester Examination 2
Problem Based Learning (PBL)	University Examination
	Short Answer Questions (SAQ)
	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz	✓	✓	✓	✓
VIVA				
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through Google forms	
References:	
	Text Books 1. S.K. Khanna & C.E.G. Justo, Highway Engineering, Name chand & Bros. publication. 2. S.K. Khanna & C.E.G. Justo, Highway Materials and Pavement Testing, Name chand & Bros. publication. **Reference Books** 1. Martin Rogers and Bernard Enright, Highway Engineering, Wiley publication. 2. IRC, "Steel Fiber Reinforced Concrete for Pavements", IRC: SP – 46, 1997, Indian Road Congress.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160133
Course Title	**Urban Transportation System Planning**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	Survey, Highway Engineering
Course Synopsis	Understanding the travel pattern of urban users, Trip analysis and forecasting and to understand the necessity of mass transit system in urban areas, rout selection.

Course Outcomes:
At the end of the course, students will be able to:

CO1	Identify urban transportation problems.
CO2	Develop data base for calibration of travel demand models.
CO3	Estimate urban travel demand.
CO4	Plan urban transport networks.
CO5	Identify urban transport corridors and prepare urban transportation plans

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**3**		**2**	**2**	**3**		**2**	**2**	**3**	**3**
CO2	**3**		**2**	**3**	**3**		**2**	**2**	**3**	**3**
CO3	**3**		**2**	**3**	**2**		**2**	**2**	**3**	**3**
CO4	**3**		**2**	**2**	**2**		**2**	**2**	**3**	**3**
CO5	**3**		**2**	**3**	**2**		**2**	**2**	**3**	**3**
Average	**3**		**2**	**2.6**	**2.4**		**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content	Competencies
1	Define Mass transit systems (C1,Remember), Discuss Elements / components of transit systems (C2, Understand); Describe Urban Mass Transit systems (C2, Understand)-Explain the types, characteristics, suitability and adaptability of these systems (C2, Understand); Demonstrate the evolution of urban transportation (C3, Apply).	
2	Discuss planning needs (C2, Understand); Explain Short-term and long-term planning (C2, Understand); Demonstrate Planning procedures and methodology,	

	Data collection (C3, Apply); Describe Medium performance transit systems and high performance transit systems (C2, Understand); Investigate trends in transit planning (C6, Create).
3	Design transit demand forecasting (C6, Create); Discuss transit mode evaluation (C2, Understand); Examine the comparison and selection of most suitable transit mode (C4, Analyze).
4	Define Basic operational elements (C1, Remember); Discuss transit travel characteristics (C2, Understand); Define transit scheduling (C1, Remember); Discuss transit line analysis (C2, Understand) – Explain planning objectives, geometry, types and their characteristics, capacity of transit lines, system procedures for improving transit line capacity (C2, Understand).

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	33
Practical	--
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	4
Case/Project Based Learning (CBL)	4
Revision	--
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Objective Structured Practical Examination	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Quiz	✓	✓	✓	✓	✓
VIVA					
Assignment / Presentation	✓	✓	✓	✓	✓
Unit test	✓	✓	✓	✓	✓
Practical Log Book/ Record Book					
Mid Semester Examination 1	✓	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through Google forms	
References:	
	Text Books 1. C A O'Flaherty, 'Transport Planning and Traffic Engineering', Butter worth Heinemann, Burlington. 2. John W. Dickey and others, "Metropolitan Transportation Planning", Tata McGraw-Hill Book Company Ltd., New Delhi **Reference Books** 1. C Jotin Khisty and B Kent Lall, "Transportation Engineering" Prentice Hall of India Pvt. Ltd., New Delhi.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160134
Course Title	**Geometric Design of Transportation Facilities**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	Surveying, Highway Engineering
Course Synopsis	Road classification, Understanding the various government guidelines for geometric design of road, importance of cross-sectional elements, sight distances and curves, design of intersection.

Course Outcomes:
At the end of the course students will be able to:

CO1	Examine geometric characteristics and design elements of highways and streets
CO2	Analyze and design uncontrolled and signalized intersections.
CO3	Plan and Design parking facilities.
CO4	Design street lighting system for roads.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**2**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**3**
CO2	**1**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**2**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**3**
CO4	**1**	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**
Average	**1.5**	**3**	**2.75**	**2.75**	**2.5**	**2**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content	Competencies
1.	State Pavements surface characteristics (C1, Remember), Explain Various cross section elements (camber, carriageway width, median, kerbs, road margins, safety barriers and others) (C2, Understand), Describe IRC guidelines for cross-sectional elements (C2, Understand).	
2.	Define Stopping sight distance (C1, Remember), Define Passing signt distance (C1, Remember), Define overtaking sight distance (C1, Remember), Define headlight sight distance (C1, Remember), Describe sight triangle (C2, Understand).	
3.	Explain Horizontal curve (C2, Understand), Describe super-elevation	

	(C2, Understand), Define transition curve (C1¸Remember), Discuss back-sight distance vertical curves (summit & valley curve) (C2, Understand).
4.	Describe the Types of un-signalized intersection (C1, Remember), Demonstrate sight distance consideration, channelization(C3, Apply), Define mini roundabouts (C1, Remember), Design the layout of roundabouts (C6, Create), Discuss Inter-changes: major and minor interchanges, entrance and exit ramps, acceleration and deceleration lanes (C2, Understand)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	38
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	3
Case/Project Based Learning (CBL)	4
Revision	--
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Quiz	Mid Semester Examination 1
Seminars	Mid Semester Examination 2
Problem Based Learning (PBL)	University Examination
	Short Answer Questions (SAQ)
	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz	✓	✓	✓	✓
VIVA				
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through Google forms	
References:	
	Text Books 1. S.K. Khanna & C.E.G. Justo, Highway Engineering, Name chand & Bros. publication. 2. AASHO, A policy on Geometric Design of Rural Highway, American Association of State highway Officials; Washington. **Reference Books** 1. Relevant IS and IRC codes 2. AASHTO Green Book, 2001

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160135
Course Title	**Ground Improvement**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	Soil Mechanics
Course Synopsis	Soil Mechanistic properties, Soil drainage characteristics, Soil stabilization methods and deep exploration.

Course Outcomes:
At the end of the course students will be able to:

CO1	Understand sub grade soil properties by using various tests.
CO2	Understand various soil stabilization techniques.
CO3	Learn ground improvement methods.
CO4	Reinforcement of soil to increase its load bearing capacity.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**2**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
CO2	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**2**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**
Average	**2**	**3**	**3**	**3**	**2.5**	**2**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content	Competencies
1.	Compare the Engineering properties of soft (C4, Analyze), Describe the weak and compressible deposits and problems associated with weak deposit (C2, Understand), Investigate the Requirements of ground improvements (C6, Create) – explain and identify the different engineering ground modification, need and objectives (C2, Understand).	
2.	Describe soil stabilization (C2, Understand), Compare and investigate the different stabilization/modification techniques i.e. mechanical modification, Hydraulic modification, Dewatering systems, Chemical modification, Modification by admixtures like lime, Cement, Bitumen etc. (C4, Analyze, C6, Create), Describe Grouting and Deep jet mixing	

	method (C2, Understand).
3.	Explain and Compare the recent Ground improvement techniques-stabilization using industrial waste (C2, Understand; C4, Analyze), Examine the modification by inclusion and confinement – soil nailing – stone column – compaction piles – dynamic compaction – prefabricated vertical drains – preloading – electro – osmosis – soil freezing vacuum consolidation – deep explosion – dry powdered polymers – enzymes (C4, Analyze)
4.	Describe the concept of reinforced earth and Mechanisms (C2, Understand), Differentiate the various types of reinforcements – Soil – Reinforcement – Interaction studies (C4, Analyze), Investigate the Internal & External stability criteria – Design Principles of steep reinforced soil slops – pavements – Embankments on soft soils (C2, Understand; C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	35
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	3
Problem Based Learning (PBL)	3
Case/Project Based Learning (CBL)	4
Revision	--
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Quiz	Mid Semester Examination 1
Seminars	Mid Semester Examination 2
Problem Based Learning (PBL)	University Examination
	Short Answer Questions (SAQ)
	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz	✓	✓	✓	✓
VIVA				
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through Google forms	
References:	(List of books)
	Text Books 1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw – Hill International Editions, 1990. 2. Purushotham Raj, Ground Improvement Techniques, Laxmi Publications, New Delhi **Reference Books** 1. Jones C. J. F. P, Earth Reinforcement and Soil Structures, Butterworths, London. 2. PCA, Soil-cement Laboratory Hand Book, Portland cement association, Chicago. 3. Moreland, H. and Mitchell, H. "Lime Soil Mixture" Highway Research Board Bulletin 304, 1961.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160136
Course Title	**Pavement Materials Lab**
Academic Year	I
Semester	I
Number of Credits	1
Course Prerequisite	Highway Engineering lab
Course Synopsis	Tests on aggregate to determine mechanical properties Test on binding material and test on soil.

Course Outcomes:
At the end of the course students will be able to:

CO1	Characterize the pavement materials.
CO2	Perform quality control tests on pavement and pavement materials.
CO3	Evaluate functional response characteristics of in-service pavements
CO4	Estimate structural response characteristics of in-service pavements

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**3**
CO2	**2**	**1**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**2**	**1**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
Average	**2.75**	**1.75**	**2**	**2.5**	**2.5**	**1.75**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	**0**	**2**	**2**

Experiment No.	Content
1.	OMC determination of soil (C1,Remember; C2,Understand; C4,Analyze)
2.	MDD determination of soil (C1,Remember; C2,Understand; C4,Analyze)
3.	CBR test to determine the load-bearing capacity of sub grade material (C1,Remember; C2,Understand; C3,Apply; C4,Analyze)
4.	Shape tests - Elongation, Flakiness Index & Combined Index (C3,Apply; C4,Analyze)
5.	Aggregate impact value test (C3,Apply;C4, Analyze)
6.	Los Angeles abrasion value test (C4,Analyze; C5,Evaluate)
7.	Specific gravity determination (C4,Analyze; C5,Evaluate)
8.	Striping value test (C4,Analyze; C5,Evaluate)

9.	Ductility test (C4,Analyze; C5,Evaluate)
10.	Penetration test (C4,Analyze; C5,Evaluate)
11.	Viscosity test (C4,Analyze; C5,Evaluate)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	24
Seminar/Journal Club	--
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	--
Case/Project Based Learning (CBL)	4
Revision	--
Others If any:	--
Total Number of Contact Hours	30

Assessment Methods:

Formative	**Summative**
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Demonstration	✓	✓	✓	✓
Mid Semester Examination 1				
Mid Semester Examination 2				
University Examination(External Practical)	✓	✓	✓	✓
Feedback Process	1. Student's Feedback			
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through Google forms				

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160137
Course Title	**Geometric Design Lab**
Academic Year	I
Semester	I
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	Civil 3D/Open Roads software for road highway geometric design.

Course Outcomes:
At the end of the course students will be able to:

CO1	Understand various design and editing tools
CO2	Understand input data structure and file format
CO3	Excavation and filling work calculation to align the profile
CO4	Understand curve design as per the applicable standards

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**3**
CO2	**2**	**1**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**2**	**1**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
Average	**2.75**	**1.75**	**2**	**2.5**	**2.5**	**1.75**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	**0**	**2**	**2**

Experiment No.	Content
1.	Basic concepts and view control (C1,Remember; C2,Understand)
2.	Survey input and validation (C3,Apply; C4,Analyze)
3.	String name and drawing style (C3,Apply; C4,Analyze)
4	Surface checker, string creation and edition (C5, Evaluate)
5	Surface analysis and earth work calculation (C5, Evaluate)
6	Alignment creation (horizontal and vertical curve)
7	Carriageway design (C5,Evaluate; C6,Create)
8	Junction design (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	22
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	4
Case/Project Based Learning (CBL)	4
Revision	--
Others If any:	--
Total Number of Contact Hours	30

Assessment Methods:

Formative	Summative
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination	Objective Structured Practical Examination
Problem Based Learning (PBL)	

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book	✓	✓	✓	✓
Demonstration	✓	✓	✓	✓
Mid Semester Examination 1				
Mid Semester Examination 2				
University Examination(External Practical)	✓	✓	✓	✓
Feedback Process	1. Student's Feedback			
Students Feedback is taken through various steps 1 Regular feedback through Mentor Mentee system 2. Feedback between the semester through Google forms				

SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

NAAC A+

Master of Technology in Civil Engineering (Structural Engineering) 1st Semester

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160114
Course Title	**Advanced Pre-stressed Concrete Structures**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	Design of concrete structure
Course Synopsis	In this course, student will learn about Pre-stressed concrete. Its advantages, different methods and its application. Different types of losses in pre-stressed concrete structure and design.

Course Outcomes:
At the end of the course students will be able to:

CO1	Know the concepts, methods and materials of pre-stressing systems.
CO2	Design the pre-stressed concrete members.
CO3	Calculate the deflections in pre-stressed concrete members.
CO4	Design anchorage zones and composite pre-stressed concrete members.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	-	-	**3**	**3**	**3**	**3**	-	-	-	-
CO3	-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO4	-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Average	-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
3	**0**	**0**	**3**

Unit	**Content**
1.	Differentiate reinforced and pre-stressed concrete (C4, Analyze), State the principles of pre-stressing (C1, Remember), Methods and systems of pre-stressing – Principles of pre-stressing – Classify pre-stressed concrete structures (C2, Understand), Discuss High strength concrete

	and High strength steel, Stress-strain diagram (C2, Understand), Examine Losses in pre-stress (C4, Analyze)
2.	Describe Section Modulus and pre stressing force (C2, Understand), Design of prismatic pre-stressed concrete members for bending at service load (C6, Create), Design recommendation, Design of pre tensioned and post tensioned flexural members (C6, Create)
3.	Identify the Factors affecting deflection (C2, Understand), Compare Short term and long term deflection of Cracked and Un-cracked member (C4, Analyze), Demonstrate the Simple cable profiles and Calculation of deflections (C3, Apply), Design of beams for shear and torsion at working and ultimate loads (C6, Create)
4.	Stress distribution, Anchorage zone stress, Anchorage zone reinforcement, Design of Anchorage zone by Guyon's method – Concept of Magnel's method – IS: 1343 recommendations.

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	20
Practical	--
Seminar/Journal Club	3
Small group discussion (SGD)	3
Self-directed learning (SDL) / Tutorial	12
Problem Based Learning (PBL)	3
Case/Project Based Learning (CBL)	--
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		

Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through google forms	
References:	
	Text Books 1. Krishna Raju.N, (2010), Problems & Solutions Pre-stressed Concrete, Second Edition, CBS Publishers, ISBN-13: 9788123907154. **Reference Books** 1. Dayarathnam P, (1996), Pre-stressed Concrete Structures, Fifth Edition, Oxford & IBH – Pubs Company, ISBN-13: 9788120400450. 2. Sinha N. C and Roy S. K., Fundamentals of Pre-stressed Concrete, Third Edition, S.Chand & Company, ISBN-13: 9788121924276.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160115
Course Title	**Structural Dynamics**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	Seismology
Course Synopsis	Study of Single degree of freedom system (SDOF Systems)**,** Study of structure under Harmonic and Impulse Loading**,** Vibration Analysis**,** Study of multi degree of freedom system (MDOF Continuous Systems).

Course Outcomes:
At the end of the course students will be able to:

CO1	Solve the problems on single degree of freedom system.
CO2	Understanding concepts of harmonic loading and impulse loading and related analysis.
CO3	Understanding the concepts of multi degree of freedom system.
CO4	Evaluate the mode shapes for different structures.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	-	-	3	3	3	3	3	3	3	3
CO2	-	-	3	3	3	3	-	-	-	-
CO3	-	-	3	3	3	3	3	3	3	3
CO4	-	-	3	3	3	3	3	3	3	3
Average	-	-	3	3	3	3	3	3	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	0	0	3

Unit	Content
1	Define Single Degree of Freedom System and free vibration (C1, Remember), State Alembert's principle (C1, Remember), Derive Mathematical models for SDOF system (Analyze), Differentiate Damped and un-damped, Critical damping (C4, Analyze)
2	Interpret Response to Harmonic Loading and Impulse Loading (C3, Apply), Analysis of un-damped system - damped system - general dynamic loading (C4, Analyze)
3	Develop Mathematical models of multi-degree-of-freedom systems (C6,

	Create), Define Shear building concept (C1, Remember), Discuss and examine free vibration of un-damped multi-degree-of- freedom systems – Natural frequencies and mode shapes, Orthogonality of modes (C2, Understand, C4, Analyze), Differentiate Vibration Analysis - Rayleigh's method - Approximate Analysis - Improved Rayleigh method C4, Analyze)
4	Investigate the Response of Shear buildings for harmonic loading without damping using normal mode approach (C6, Create), Investigate the Response of Shear buildings for forced vibration for harmonic loading with damping using normal mode approach (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	18
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	14
Problem Based Learning (PBL)	8
Case/Project Based Learning (CBL)	--
Revision	05
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		
Quiz						
VIVA						

Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	2. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through Google forms	
References:	
	Text Books 1. Mario Paz, (2004), Structural Dynamics - Theory and Computation, Second Edition, CBS Publishers, ISBN-13: 9788123909783. **Reference Books** 1. J. Humar, (2012), Dynamics of Structures, Third Edition, CRC Press, ISBN- 13: 9780415620864. 2. Anil K. Chopra, (2003), Dynamics of Structures - Theory and Applications to Earthquake Engineering, Third Edition, Pearson India, ISBN-13: 9788131713297.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160116
Course Title	**Matrix Methods of Structural Analysis**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	Structural Analysis
Course Synopsis	This course mainly deals with matrix analysis of structures. It begins with a review of the basic concepts of structural analysis and matrix algebra, and shows how the latter provides an excellent mathematical framework for the former. This is followed by detailed descriptions, and demonstrations through many examples, of how matrix methods can be applied to linear static analysis of skeletal structures (plane and space trusses; beams and grids; plane and space frames) by the stiffness method, and also the flexibility method.

Course Outcomes:
At the end of the course students will be able to:

CO1	Solve different structures by flexibility matrix method and stiffness matrix method.
CO2	Visualize and analyze space trusses and space frames.
CO3	Understand the effect of settlement of supports.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO 6	PSO1	PSO2	PSO3	PSO4
CO1	-	-	3	3	3	3	3	3	3	3
CO2	-	-	3	3	3	3	-	-	-	-
CO3	-	-	3	3	3	3	3	3	3	3
Average	-	-	3	3	3	3	3	3	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	0	0	3

Unit	Content
1	Define static indeterminacy and kinematic indeterminacy (C1,

	Remember), Differentiate between static indeterminacy and kinematic indeterminacy (C2, Understand; C4, Analyze), Compare flexibility matrix and stiffness matrix (C4, Analyze), Discuss the properties of matrices (C2, Understand), - explain coordinate system (C2, Understand), Analyze the beam (C4, Analyze), Formulate and derivation of stiffness matrix of beam element from strain energy (C6, Create)
2	Formulate Displacement transformation matrix (C6, Create), explain global stiffness matrix (C2, Understand), analysis of continuous beams (C4, Analyze), analysis of rigid frames and trusses (C4, Analyze).
3	Analysis of continuous beam (C4, Analyze), Compare and analyze the plane truss and plane frame by stiffness matrix method ((C2, Understand; C4, Analyze), Investigate the Internal forces due to thermal expansion and lack of fit (C6, Create), discuss the effect of settlement of supports (C2, Understand).
4	Use, analyze and investigate the bar, truss, beam, and frame structures of determinate and indeterminate ones using direct stiffness method (C3, Apply; C4, Analyze; C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	18
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	15
Problem Based Learning (PBL)	8
Case/Project Based Learning (CBL)	-
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)

Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**			
Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓			
Unit test	✓	✓	✓			
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓			
Mid Semester Examination 2	✓	✓	✓			
University Examination	✓	✓	✓			

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1.Regular feedback through Mentor Mentee system 2.Feedback between the semester through Google forms	
References:	
	Text Books 1. Pundit G.S. & Gupta S.P., (2008), Structural Analysis (A matrix approach), Second Edition, Tata McGraw Hill Education, ISBN-13: 9780070667358. **Reference Books** 1 J. S. Przemieniecki, (1985), Theory of Matrix Structural Analysis, New Edition, Dover Publication, ISBN-13: 97804866494. 2. Richard B. Nelson, Lewis P. Felton, (1997), Matrix Structural Analysis, John Wiley & Sons, Imported Edition, ISBN-13: 9780471123248.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160117
Course Title	**Design of Concrete Structural Systems**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	Design of concrete structure
Course Synopsis	Limit state design method, Deep Beams, Flat Slab, Columns and shear walls and framed buildings

Course Outcomes:
At the end of the course students will be able to:

CO1	Analysis of beam using limit state design
CO2	Analyze and design the deep beams and flat slab
CO3	Yield line theory
CO4	Design of slender columns. and stair case

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO4	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1	Define and explain Limit state analysis and design of beams in flexure (C1, Remember; C2, Understand), Demonstrate the Behavior of reinforced concrete members in bending (C3, Apply), Discuss the Plastic hinge and Rotation capacity (C2, Understand), explain factors affecting rotation capacity of a section and Plastic moment (C2, Understand), Demonstrate and formulate the Moment curvature relationship and Redistribution of moments (C4, Analyze; C6, Create)
2	Define and Design Steps of Deep Beams as per IS 456 (C1, Remember;

	C6, Create), Investigate the Detailing of Deep Beams and Checking for Local Failures (C2, Understand; C6, Create) Direct design method –Discuss and investigate the distribution of moments in column strips and middle strip moment and shear transfer from slabs to columns using direct design method (C2, Understand; C6, Create), Design for Shear in Flat slabs-Check for one way and two way shears (C6, Create), Describe Equivalent frame method and Direct design method (C2, Understand), Compare the distribution of moments in column strips and middle strip sketch showing reinforcement details (C4, Analyze).
3	Describe yield line analysis for slabs (C2, Understand), Differentiate Virtual work and equilibrium methods of analysis – For square circular, Rectangular, Triangular and Hexagonal with simple and continuous end conditions along with Reinforcement details (C4, Analyze).
4	Describe column and Euler theory (C2, Understand), Differentiate the different methods of design of Slender Columns (C4, Analyze), Design of slender column subjected to combined bending moment & axial force using SP: 16 (C6, Create). Explain staircase (C2, Understand), Compare the different types of staircases (C4, Analyze), Design of staircase as per IS code (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	25
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	10
Problem Based Learning (PBL)	6
Case/Project Based Learning (CBL)	--
Revision	04
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation

Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		
Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	2. Student's Feedback

Students Feedback is taken through various steps

3. Regular feedback through Mentor Mentee system
4. Feedback between the semester through Google forms

References:

Text Books

1. Krishnaraju N., (2013), Advanced Reinforced Concrete Design, Second Edition, CBS Publisher, *ISBN-13: 9788123912257*.

Reference Books

1. P. C. Varghese, (2009), Advanced Reinforced Concrete Design, Second Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120327870.
2. M. L. Gambhir, (2009), Design of Reinforced Concrete Structures, First Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120331938.
3. P. Dayaratnam, (2011), Design of Reinforced Concrete Structures, Fourth Edition, Oxford & IBH – Pubs Company, ISBN-13: 9788120414198.
4. B. C. Punmia, Ashok Kr. Jain, Arun Kr. Jain, (2006), R. C. C. Designs, Laxmi Publication (P) Ltd., ISBN-13: 9788131809426.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160118
Course Title	**Matrix Methods of Structural Analysis Lab**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	Structural Analysis
Course Synopsis	This course mainly deals with matrix analysis of structures. It begins with a review of the basic concepts of structural analysis and matrix algebra, and shows how the latter provides an excellent mathematical framework for the former. This is followed by detailed descriptions, and demonstrations through many examples, of how matrix methods can be applied to linear static analysis of skeletal structures (plane and space trusses; beams and grids; plane and space frames) by the stiffness method, and also the flexibility method.

Course Outcomes:
At the end of the course students will be able to:

CO1	Solve different structures by flexibility matrix method and stiffness matrix method.
CO2	Visualize and analyze space trusses and space frames.
CO3	Understand the effect of settlement of supports.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	-	-	**3**	**3**	**3**	**3**	-	-	-	-
CO3	-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Average	-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
0	**0**	**2**	**2**

Experiment No.	**Content**
1.	Analysis of propped cantilever beam (C4, Analyze)
2.	Analysis of two span continuous beams(C4, Analyze)
3.	Analysis of statically determinate plane truss(C4, Analyze)

4.	Analysis of statically indeterminate plane truss(C4, Analyze)
5.	Analysis of kinematically indeterminate plane truss(C4, Analyze)
6.	Analysis of one bay – one storey plane frame(C4, Analyze)
7.	Analysis of multi bay – multi storied plane frame(C4, Analyze)
8.	Analysis of space truss(C4, Analyze)
9.	Analysis of space frame(C4, Analyze)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	13
Seminar/Journal Club	--
Small group discussion (SGD)	04
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	13
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	30

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**			
Quiz						
VIVA	✓	✓	✓			
Assignment / Presentation						
Unit test						
Practical Log Book/ Record Book	✓	✓	✓			
Mid Semester Examination 1						

Mid Semester Examination 2						
University Examination (External Practical)	✓	✓	✓			
Feedback Process	2. Student's Feedback					
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through Google forms						

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160119
Course Title	**Design of Concrete and Structural Systems Lab (STAAD PRO)**
Academic Year	I
Semester	I
Number of Credits	2
Course Prerequisite	Design of Concrete Structural Systems
Course Synopsis	Limit state design method, Beams, Slab, Columns and framed buildings & design of these by using STAAD Pro.

Course Outcomes:
At the end of the course students will be able to:

CO1	Analyze and design the frame.
CO2	Analyze and design the beams.
CO3	Design shears wall buildings and slabs.
CO4	Design of slender columns.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	-	3	3	3	3	1	-	3	3
CO2	1	-	3	3	3	3	1	-	3	3
CO3	1	-	3	3	3	3	1	-	3	3
CO4	1	-	3	3	3	3	1	-	3	3
Average	1	-	3	3	3	3	1	-	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	4	2

Experiment No.	Content
1.	Design of propped cantilever RCC beam (C6, Design)
2.	Design of two span continuous RCC beams (C6, Design)
3.	Analysis and design one bay – one storey plane frame (C6, Design)
4.	Analysis and design of multi bay – multi storied plane frame (C6, Design)
5.	Analysis and design of space frame (C6, Design)
6.	Case study (C6, Investigate)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	15
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	4
Case/Project Based Learning (CBL)	11
Revision	--
Others If any:	--
Total Number of Contact Hours	30

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4		
Quiz						
VIVA	✓	✓	✓	✓		
Assignment / Presentation						
Unit test						
Practical Log Book/ Record Book	✓	✓	✓	✓		
Demonstration	✓	✓	✓	✓		
Mid Semester Examination 1						
Mid Semester Examination 2						
University Examination (External Practical)	✓	✓	✓	✓		

Feedback Process	2. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through Google forms	

SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

Master of Technology in Civil Engineering (Remote Sensing and GIS) 1st Semester

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160143
Course Title	**Principles of Remote Sensing**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	Students should have basic knowledge of surveying and contours at undergraduate level.
Course Synopsis	To provide the students with data acquisition, processing and sensors, this can be used in their respective fields.

Course Outcomes:
At the end of the course students will be able to:

CO1	Select the type of remote sensing data for mapping earth surface features
CO2	Analyze the energy interactions with the atmosphere and earth surface features
CO3	Identify the earth surface features from satellite images
CO4	Apply remote sensing techniques for natural resources evaluation

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	-	-	-	-	-	-	1	1
CO2	3	2	-	-	-	-	-	-	1	1
CO3	3	2	-	-	-	-	-	-	1	1
CO4	3	1	-	-	-	-	-	-	1	1
Average	3	1.75	-	-	-	-	-	-	1	1

Course Content:				
L (Hours/ Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hour/Week**
3	-	-		**3**

Unit	Content and Competency
1	Sources of Energy (C2, Understand), Active and Passive Radiation. (C2, Understand), Radiation - Reflectance, Transmission, Absorption (C3, Application), Thermal Emissions, Interaction with Atmosphere (C1 , Remember), Atmospheric windows. (C1, Remember), Spectral reflectance of Earth's surface features (C3, Application), Multi concept of Remote Sensing. (C3, Application)
2	1. Various types of platforms C2 (Understand), different types of aircraft, manned and unmanned spacecrafts used for data acquisition (C6 , Create), characteristics of different types of platforms (C5, Evaluate), IRS Satellite Sensors, LANDSAT, SPOT, IKONOS, Quickbird, Geoeye, Kompsat, Worldview II & III, Microwave, ALOS, Planet Data, Sentinel, SMAP, MODIS (C2, Understand)
3	Optical, thermal and microwave (C2, Understand), Resolutions-spatial, spectral, radiometric and temporal (C1, Remember), signal to noise ratio (C3, Application), LiDAR data acquisition and processing. (C1, Remember)
4	Explain the applications of Remote sensing in various Engineering and Science domains. C2 (Understand), Explain the Agriculture, Forest, Soil, Geology, LU/LC, Water Resources, Urban, Disaster Management, etc. (C2, Understand)

Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2

Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	2. Student's Feedback			
References:	**Textbooks:** 1. Introduction to Remote Sensing, James B. Campbell & Randolph H. Wynne., The Guilford Press, 2011. 2. Introduction to the physics and techniques of Remote Sensing, Charles			

	Elach & Jakob van Zyl., John Wiley & Sons publications, 2006. 3. Remote Sensing and Image Interpretation, Lilles and T.M & Kiefer R.W., John Wiley and Sons, 2015
	References: 1. Thermal microwave radiation: Applications for remote sensing, Chritian Matzler., The institution of Engineering and Technology, London, 2006 2. Remote Sensing: Models and Methods for Image Processing, Schowengerdt, R. A., Academic Press, 2007. 3. Introduction to Remote Sensing, Cracknell, A.P., Second Edition, Tylor & Francis, London, 1991.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160108
Course Title	**Geographical Information Systems**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	Geographic information system (GIS) is a data management, analysis, and mapping system. GIS integrates location data with all forms of descriptive information to create a map. This lays the groundwork for mapping and analysis in research and nearly every sector. Basic Introduction to Remote Sensing, Concept of Photogrammetry, Remote Sensing: Applications and Errors.

Course Outcomes:

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

CO1	Analyze the basic components of GIS
CO2	Classify the maps, coordinate systems and projections
CO3	Process spatial and attribute data and prepare thematic maps
CO4	Identify and rectify mapping inaccuracies

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1	1	1	-	-	-	-	1	1
CO2	2	1	-	-	-	-	-	-	1	1
CO3	-	1	-	1	-	-	-	-	1	1

CO4	1	2	1	2	2	-	-	-	1	1
Average	**1**	**1.25**	**1**	**1**	**2**	-	-		**1**	**1**

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**CL (Hours/Week)**	**Total Hour/Week**
3	**-**		**-**	**3**

Unit	**Content and Competency**
1	Mapping concepts, analysis with paper based maps, limitations, Computer Automated Cartography. C2 (Understand), History and Developments, GIS- Definition, advantages of digital maps. C2 (Understand), projections and coordinate systems. C1 (Remember), Information Systems, Modelling Real World Features Data.C1 (Remember), Data Models – Spatial and Non-spatial, Components, Data Collection and Input, Data Conversion, Metadata. C4 (Analyze)
2	Database Structures, Files; Standard Data Formats, Compression Techniques. C5 (Evaluate), Explain the concepts of Hardware and Software. C2 (Understand), Define Types of Errors, Editing and Error Rectification. C2 (Understand), Analyze the types of Topology. C4 (Analyze), Modelling topological Relationships and Tolerances. C4 (Analyze)
3	Explain the concepts of Proximity Analysis, Overlay Analysis, Buffer Analysis, Network Analysis. C2 (Understand), Recall the purpose of the Route alignment, Canal alignment; Digital Elevation Models. C1 (Remember), Describe Map composition, Preparation of qualitative and quantitative maps. C2 (Understand)
4	Explain the principles of Understanding the Requirements, Phases of Planning. C2 (Understand), Specifications, and Procedure for analysis projects and design projects. C5 (Evaluate)

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**

Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Clinical Examination (OSCE)	University Examination
Objective Structured Practical Examination (OSPE)	Dissertation
Quiz	Multiple Choice Questions (MCQ)
Seminars	Short Answer Questions (SAQ)
Problem Based Learning (PBL)	Long Answer Question (LAQ)
Journal Club	Practical Examination & Viva-voce
	Objective Structured Clinical Examination (OSCE)
	Objective Structured Practical Examination (OSPE)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓

Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	1. Student's Feedback			

References:	**Books** 1. Geographic Information systems and Science, Paul Longley., John Wiley & Sons, 4th Edition,2015. 2. Introduction to Geographic Information Systems, 9th Edition, Kang Tsung Chang., Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2018. 3. Concepts and Techniques of Geographic Information Systems, C.P.Lo & Albert K. W.Yeung, second Edition, Prentice Hall India Pvt. Ltd, 2016.
	References: 1. Principles of GIS for Land Resource Assessment, Burrough, P.A., Oxford Publications, 2005. 2. The design and implementation of Geographic Information Systems, John E. Harmon & Steven J. Anderson., John Wiley & Sons, 2003.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160139
Course Title	**Photogrammetry**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	Fundamental of aerial photography system, scale, Stereoscopes, Analytical Photogrammetry, aerial triangulation, digital Photogrammetry, unmanned air vehicle and its application.

Course Outcomes:

At the end of the course, students will be able to:

CO1	Acquire, measure and analyze aerial photographs
CO2	Interpret aerial photographs
CO3	Perform orientation of photos to generate ortho photos and mosaics using aerial photographs and UAV data
CO4	Analyze the point cloud data for documentation and archiving of features

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	1	2	-	3	1	-	-	1	2
CO2	3	2	2	-	-	1	-	2	3	2
CO3	3	2		-	-	-	-	1	3	2
CO4	3	2	3	3	1	-	-	2	3	2
Average	3.0	1.8	2.3	3	2	1	-	1.3	2.5	2.0

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
3	**0**	**0**	**3**

Unit	Content & Competencies
1	Historical development –classification, application–analogue and digital cameras–geometry of vertical photographs. C1 (Remember) Scale – coordinate transformations, relief displacement – tilted and oblique photographs, Flight Planning, Interpretation keys. C2 (Understand) Stereoscopes, stereoscopic view and its exaggeration – parallax equation – parallax measurement. C2 (Understand) Parallax bar-measurement of heights and determination of slopes- stereoscopic plotting instruments. C1 (Remember)
2	Concepts of orientation-interior, relative and absolute orientation of aerial photographs C1 (Remember) Aerial triangulation, Block adjustment, Ortho photos, Kinds of mosaics- controlled, semi-controlled, uncontrolled. C2 (Understand)
3	Automatic DTM acquisition from stereo pairs or image blocks. C1 (Remember) Colour balancing, Digital image enhancement, Feature extraction. C2 (Understand) DEM Applications in Civil Engineering. C2 (Understand)
4	History of unmanned air vehicle (UAV) development. C2 (Understand) Classifications and components of UAVs – Design standards and Regulatory aspects. C2 (Understand) Environment, Budget & Time, Airframe Design & Payload, Flight planning, Mosaicing, Ground control. C3 (Application) Feature detection and mapping, Point cloud, 3D Models, C3 (Application) DEM generation, Ortho photo generation, UAV Applications. C2 (Understand)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	

Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1,2, End term
Viva-voce	--
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	Multiple Choice Questions (MCQ)
Seminars	Multiple Choice Questions (MCQ)
Problem-Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Assignment / Presentation	✓	✓	✓	✓
Mid-Semester Examination 1	✓	✓	✓	✓
Mid-Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback 2. Course Exit Survey
References:	
	1. Digital Photogrammetry Theory and Applications, Wilfried Linder., Springer 2013 2. Unmanned Aircraft Systems, Reg Austin, Wiley Publications, 2010 3. Aerial Photography and Image Interpretation, Paine D. P., Kiser J. D., John Wiley & Sons, Inc., 2012. 4. Introductory Course in Photogrammetry, Zorn H.C., Sixth Edition, ITC, Netherlands, 1980.

	BOOKS: 1. Elements of Photogrammetry with Application in GIS, Wolf P.R., Mc Graw Hill International Book Company, Fourth Edition,2014. 2. Photogrammetry, Moffitt, Francis H. & Mikhail, Edward M., Harper and Row Publishers, 1980. 3.Fundamentals of Computational Photogrammetry, Sanjib K Ghosh., Concept Publishing Company, 2005 4.Introduction to UAV Systems, Paul Gerin F & Thomas James Gleason., Wiley Publications, 2012

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160140
Course Title	**Application of Remote Sensing**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	Satellites are crucial in the development of various technologies, including global mapping, GPS, and city planning. Remote sensing is only one of the numerous breakthroughs made possible by the satellites orbiting the globe. Remote sensing has numerous applications in land use mapping, weather forecasting, environmental study and study of natural hazards etc.

Course Outcomes:

At the end of the course, students will be able to:

CO1	Apply application potentialities of remote sensing data separately and in combination with GIS techniques for Agriculture, Forestry
CO2	Impart knowledge about the various geological structures and Geomorphic Landforms.
CO3	Exposure to various Remote Sensing Applications to earth Sciences ,urban and regional planning
CO4	Understand the concepts involved in mapping of crop acreage and yield estimation, crop damage assessment.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4 `
CO1	2	3	3	-	3	3	-	3	3	1

CO2	2	3	2	-	-	2	-	2	3	2
CO3	2	3	2	-	-	3	-	1	3	2
CO4	2	3	3	3	3	2	-	2	3	1
Average	2	3	2.5	0.8	1.5	2.5	-	2	3.0	1.5

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
3	**0**	**0**	**3**

Sr. No.	**Content & Competencies**
1	Rocks types, forms, Minerals and their field characteristics, Image interpretation for delineation of lithology (Rocks) and minerals (C1, Remember), Geological structures - Folds, Faults and Joints and their field characteristics C1 (Remember), Various important land forms (C2, Understand) Image characteristics of geological structures and major land forms (C2, Understand)
2	Field Application: Urban Planning and management, Application of Archeology, Agriculture (C2, understand) Application in Disaster management, wet land management (C2, Understand) Wildlife management, Forest management (C2, Understand)
3	Hyper spectral RS and its application; Microwave RS and its application C2 (Understand), Thermal RS and its application; Optical RS and its application C2 (Understand)
4	P.C. I Geometica, Tacit View TNT mips, ERDAS, ENVI, Opticks, Dragon (C2, Understand) IDRISI, USGS Global Visualization Viewer (GloVis), NASA Earth Observation (NEO), USGS Earth, Explorer C2 (Understand) ESA's Sentinel data, NOAA, IPPMUS Terra, LANCE, VITO Vision, Bhuvam, MOSDAC, India- WRI C2 (Understand)

Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	32
Practical	
Seminar/Journal Club	2

Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback Course Exit Survey
References:	
	1. Remote Sensing: Principles and Interpretation: F. Sabins, Freeman Publication. 2. Remote Sensing of the Environment by J.R. Jensen, Pearson Publication

	BOOKS: 1. Remote Sensing and Image interpretation: Thomas Lilles and & R. W. Keifer, John Wiley and Sons (3rdEd.). 2. Manual of Remote Sensing, Vol. 1, American Society of Photogrammetry.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160141
Course Title	**Geographical Information Systems (GIS) Lab**
Academic Year	I
Semester	I
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	A geographic information system (GIS) is a system for storing, analysing, and mapping data. To build a map, GIS combines location data with all types of descriptive information. This establishes the foundation for mapping and analysis in research and almost every other field. Users may use GIS to look at trends, correlations, and their location's surroundings.

Course Outcomes:

At the end of the course, students will be able to:

CO1	Recall and Prepare the different geospatial layers
CO2	Compute geometric measurements and perform spatial analysis
CO3	Create high-quality maps and associated graphics
CO4	Integrate different geospatial layers

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	-	3	1	-	-	1	1
CO2	3	2	2	-	-	1	-	2	3	-
CO3	3	2		-	-	-	-	1	3	-
CO4	3	2	3	3	1	-	-	2	3	1
Average	3.0	1.8	2.3	0.8	1.0	0.5	-	1.3	2.5	0.5

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	2	2

Sr. No.	Content & Competencies
1	Importing maps and layers from various sources (C1, Knowledge)
2	Geo referencing and projection (C1, Knowledge)
3	Digitization of Points and Lines (C1, Knowledge)
4	Editing Map Elements (C1, Knowledge)
5	Attribute Data Entry and Manipulation (C1, Knowledge)
6	Cleaning, Building and Transformation (C1, Knowledge)
7	Buffer Analysis (C1, Knowledge)
8	Network Analysis (C1, Knowledge)
9	Data Analysis–Overlay, Buffer (C1, Knowledge)
10	Importing maps and layers from various sources (C1, Knowledge)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	15
Seminar/Journal Club	--
Small group discussion (SGD)	10
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	5
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	30

Assessment Methods:

Formative	Summative

Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
VIVA	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback 2. Course Exit Survey

Students Feedback is taken through various steps

1. Regular feedback through the Mentor Mentee system.
2. Feedback between the semester through Google forms.

Course Exit Survey will be taken at the end of the semester.

References:

1. Workshop Technology Vol. I & II - Hazra & Chaudhary, Asian Book Comp., New Delhi., Vol-I: ISBN-10: 8185099146, Vol-II: ISBN: 9788185099156.
2. Workshop Technology (Manufacturing Process) –S K Garg, Laxmi Publications; Fourth Edition (2018), ISBN-10: 8131806979.
3. Principles of Manufacturing Materials and Processes - Campbell, J.S. - McGraw- Hill, New Edition, ISBN-10: 0070992525

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160142
Course Title	**Photogrammetry Lab**
Academic Year	I
Semester	I
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	Understand various computer components.

Course Outcomes:

At the end of the course, students will be able to:

CO1	Understand about the Photogrammetry and its types
CO2	Identify about the stereoscopy.
CO3	Will able to learn about the analytical Photogrammetry

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	-	3	1	-	-	1	1
CO2	3	2	2	-	-	1	-	2	3	-
CO3	3	2		-	-	-	-	1	3	-
CO4	3	2	3	3	1	-	-	2	3	1
Average	3.0	1.8	2.3	0.8	1.0	0.5	-	1.3	2.5	0.5

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	**0**	**2**	**2**

Content & Competencies		
Sr. No.	**Title**	
1	Fundamentals of aerial photos and satellite image Interpretation (C3, Apply)	
2	Types of imaging (C3, Apply)	
3	Elements of interpretation (C3, Apply)	
4	Techniques of Visual interpretation (C3, Apply)	
5	Generations of Thematic maps (C3, Apply)	
6	Study of satellite image annotation (C3, Apply)	
7	Demarcation of contours & watershed (C3, Apply)	
8	Remote sensing applications (C3, Apply)	
9	Understanding of spectral response pattern of different landforms (C3, Apply)	
10	Image Interpretation and Analysis (C3, Apply)	

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	15
Seminar/Journal Club	--
Small group discussion (SGD)	10
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	5
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	30

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	--
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	--
Seminars	--
Problem Based Learning (PBL)	--
Journal Club	--

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
VIVA	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback Course Exit Survey
Students Feedback is taken through various steps 1. Regular feedback through the Mentor Mentee system. 2. Feedback between the semester through google forms.	

SEMESTER - II

Course Code	Course Title
13160238	Minor Project
Choose these subjects for specialization in Transportation Engineering	
13160232	Analysis and Design of Pavement
13160233	Transport Economics
13160234	Traffic Engineering and Management
13160235	Airport Infrastructure, Planning and Design
13160236	Pavement Design Lab
13160237	Traffic Lab
Choose these subjects for specialization in Structural Engineering	
13160214	Finite Element Analysis
13160215	Theory of Elasticity and Plasticity
13160216	Limit State Design of Steel Structures
13160217	Earthquake Resistant Design
13160218	Structural Engineering lab (CASTING)
13160239	Finite Element Analysis Lab
Choose these subjects for specialization in Remote Sensing and GIS	
13160240	Geospatial Data Processing and Modelling
13160241	Satellite Image Processing
13160242	Advanced GIS
13160243	GPS & Surveying
13160244	Advanced GIS Lab
13160245	Satellite Image Processing Lab

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160238
Course Title	**Minor Project**
Academic Year	I
Semester	II
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	Minor Project will include identification of the problem based on the literature review and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution

Course Outcomes:

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

CO1	Identify civil engineering problems by reviewing available literature.
CO2	Identify appropriate techniques to analyze complex problems related to civil engineering
CO3	Investigate and development of solution

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO 1	PO2	PO 3	PO4	PO 5	PO6	PSO1	PSO2	PSO3	PSO 4
CO1	3	3	2	3	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	3	2	3
CO3	3	3	2	3	3	3	3	3	2	3
Average	3	3	2	3	3	3	3	3	2	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week

0	**0**	**6**	**6**

Unit	Content
1.	Identify the problem (C2, Understand), Implement the suitable solution (C3, Apply), Experiments and tests (C4, Analyze), Investigate and develop the solution (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	13
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	26
Problem Based Learning (PBL)	--
Case/Project Based Learning (CBL)	13
Revision	--
Others If any:	--
Total Number of Contact Hours	52

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book/Drawing	✓	✓	✓	✓
Mid Semester Examination 1				
Mid Semester Examination 2				
University Examination (External Practical)	✓	✓	✓	✓
Feedback Process	1. Student's Feedback			
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through google forms				

SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

Master of Technology in Civil Engineering (Transportation Engineering) 2nd Semester

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160232
Course Title	**Analysis and Design of Pavement**
Academic Year	I
Semester	II
Number of Credits	4
Course Prerequisite	Soil Mechanics and concrete technology
Course Synopsis	Understanding the effect of various environmental factors effecting the pavement design, Traffic load calculation, Design, and analysis of flexible and rigid pavement

Course Outcomes:
At the end of the course students will be able to:

CO1	Students will learn about the behaviour of various materials under various environmental conditions
CO2	Design philosophy of flexible pavement
CO3	Design philosophy of rigid pavement
CO4	Analysis of flexible and rigid pavement

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**2**	**1**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**
CO2	**2**	**1**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**
CO3	**2**	**1**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**
CO4	**2**	**1**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**
Average	**2**	**1**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**1**	**0**	**4**

Unit	Content
1.	Classify the types and component of pavements (C2, Understand), Discuss the factors affecting design and performance of pavements(C2, Understand), Explain the significance of Highway and airport pavements (C2, Understand), Define the functions of pavement components (C1, remember)
2.	Explain the concept of design wheel load (C2, Understand), Discuss the strength characteristics of pavement materials, climatic variations, traffic - load equivalence factors and

	equivalent wheel loads (C2, Understand),Discuss aircraft loading, gear configuration and tyre pressure (C2, Understand). Explain the drainage – Estimation of flow, surface drainage, sub-surface drainage systems, design of sub-surface drainage structures (C2, Understand).
3	Discuss empirical, semi-empirical and theoretical approaches (C2, Understand), Explain the design of highway and airport pavements by IRC, AASHTO Methods (C2, Understand), Describe the applications of pavement design software (C2, Understand)
4.	Discuss the types of joints and their functions, joint spacing (C2, Understand); Explain the design of CC pavement for roads, highways and airports as per IRC, AASHTO, design of joints (C2, Understand). Explain the design of continuously reinforced concrete pavements (C2, Understand). Explain the reliability; Use of software for rigid pavement design (C2, Understand).

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	40
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	6
Problem Based Learning (PBL)	8
Case/Project Based Learning (CBL)	3
Revision	3
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Quiz	Mid Semester Examination 1
Seminars	Mid Semester Examination 2
Problem Based Learning (PBL)	University Examination
	Short Answer Questions (SAQ)
	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz	✓	✓	✓	✓
VIVA				
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through Google forms	
References:	
	Text Books (i) Yoder and Witczak, Principles of Pavement Design, John Wiley and Sons (ii) Yang. H. Huang, Pavement Analysis and Design, Second Edition, Prentice Hall Inc. (iii) Rajib B. Mallick and Tahar El-Korchi, Pavement Engineering – Principles and Practice, CRC Press (Taylor and Francis Group) (iv) W. Ronald Hudson, Ralph Haas and Zeniswki , Modern Pavement Management, McGraw Hill and Co (v) Relevant IRC Codes

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160233
Course Title	**Transport Economics**
Academic Year	I
Semester	II
Number of Credits	3
Course Prerequisite	Highway Engineering
Course Synopsis	Understanding the supply, demand and surplus, determinant of elasticity, Transportation cost calculation and economic analysis of project

Course Outcomes:
At the end of the course students will be able to:

CO1	Students will be able to understand the economics of road projects
CO2	Students will learn about the concept of elasticity and how it affects the supply demand
CO3	Students will understand the governing factors for the choice of travel mode
CO4	Students will learn about economic and financial analysis of highway project

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
CO2	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
CO3	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
CO4	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
Average	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1.	Describe transportation economics (C2, Understand), Explain transportation demand (C2, Understand), Discuss demand classification (C2, Understand), Examine determinants of demand (C4, Analyze), Discuss the demand function curve (C2, Understand), Discuss shift in demand curve (C2, Understand), Compare the temporal variation of transportation demand and peak problem and measures to mitigate (C4, Analyze), Implement price elasticity of demand (C3, Apply), Implement Price elasticity of linear demand curve (C3, Apply), Explain CRAFT

	model (C2, Understand), Distinguish direct and cross elasticity (C4, Analyze).
2.	Describe supply curve (C2, Understand), Explain the determinant of supply (C2, Understand), Explain the price elasticity of supply (C2, Understand), Implement determinant of price elasticity of supply (C3, Apply), Discuss constant elasticity supply function (C2, Understand), Contrast demand supply equilibrium and in-equilibrium (C4, Analyze).
3.	Explain consumer surplus (C2, Understand), Describe change in consumer surplus (C2, Understand), Explain latent demand (C2, Understand), Define producer surplus (C2, Understand), Classify change in producer surplus (C2, Understand), Explain Income elasticity (C2, Understand).
4.	Explain behavior analysis and its objective and application (C2, Understand). Organize Travel Behavior Analysis (TBA) (C4, Analyze), Explain Application of TBA (C2, Understand), Define Basic steps of TBA (C2, Understand), Design of survey instrument (C6, Create), Define Data types in behavior analysis (C2, Understand), Explain Preference elicitation techniques (C2, Understand), Develop Discrete choice experiment (C6, Create), Identification of attributes and its levels (C2, Understand), Conjecture of alternatives (C6, Create), Investigate Factorial design (C6, Create).

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	38
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	5
Case/Project Based Learning (CBL)	--
Revision	2
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Objective Structured Practical Examination	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz	✓	✓	✓	✓
VIVA				✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through Google forms	
References:	
	Text Books 1. Winfrey, Economic analysis for Highways, International Textbook Company, Pennsylvania, 1969 2. CRRI, Road User Cost Study in India, New Delhi, 1982 3. IRC, Manual on Economic Evaluation of Highway Projects in India, SP30, 2007

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160234
Course Title	**Traffic Engineering and Management**
Academic Year	I
Semester	II
Number of Credits	3
Course Prerequisite	Highway Engineering
Course Synopsis	Elements of traffic engineering, Road user facilities, Elements of road design, Traffic regulation & controls, Grade separated intersection design

Course Outcomes:
At the end of the course students will be able to:

CO1	Students will learn about the traffic studies, traffic forecasting and interpretation
CO2	Students will learn about the speed study
CO3	Students will learn about the various kind of traffic control system
CO4	Students will learn about road safety audit

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	3	2	2	2	2	3	3
CO2	3	1	3	3	2	2	2	2	3	3
CO3	3	1	3	3	2	2	2	2	3	3
CO4	3	1	3	3	2	2	2	2	3	3
Average	3	1	3	3	2	2	2	2	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	0	0	3

Unit	Content
1.	Define Road user (C1, Remember), vehicle and road way. Vehicle characteristics –Discuss IRC standards (C2, Understand) - Design speed, volume. Highway capacity and levels of service (C6,Create) - capacity of urban and rural roads –Examine PCU concept and its limitations (C4,Analyze)
2.	Define Road user facilities (C1, Remember)–Demonstrate Parking facilities (C3, Apply); Discuss Cycle tracks and cycle-ways (C2,Understand), Pedestrian facilities. Examine Traffic volume studies, origin destination studies, speed studies, travel time and delay studies, Parking studies, Accident studies (C4,Analyze)

3.	Design of Alignment - Cross sectional elements (C6, Create), Use of Stopping and passing sight distance (C3, Apply). Design of Horizontal curves and Vertical curves (C6, Create). Design problems(C3, Apply)
4.	Understand Signs and markings in Traffic System Management (C2, Understand); Design of at-grade intersections (C6, Create), Principles of design – Channelization - Design of rotaries(C6, Create); design of Traffic signals - pre-timed and traffic actuated. Design of signal setting - phase diagrams, timing diagram, signal coordination (C6, Create);

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	35
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	4
Case/Project Based Learning (CBL)	4
Revision	2
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Objective Structured Practical Examination	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
VIVA				
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination(External Practical)	✓	✓	✓	✓

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through Google forms	
References:	
	Text Books (i) ITE Hand Book, Highway Engineering Hand Book, McGraw - Hill (ii) R. J. Salter and N. B. Hounsel, Highway Traffic Analysis and Design, Macmillan Press Ltd, 1996 (iii) AASHTO A Policy on Geometric Design of Highway and Streets (iv) John Wiley & Sons Inc., ITE Brian, Traffic Engineering handbook

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160235
Course Title	**Airport Infrastructure, Planning and Design**
Academic Year	I
Semester	II
Number of Credits	3
Course Prerequisite	Airport Engineering
Course Synopsis	ICAO standard for airport and air traffic operation, Various safety standard for aircraft, Concept of Airport Planning & components, Zoning laws, Capacity and traffic determination, Runway design, Taxiway design, Marking & signal, Lighting

Course Outcomes:
At the end of the course students will be able to:

CO1	Students will be able to understand the various airport components
CO2	Students will be able to understand the different techniques used for air traffic calculation
CO3	Students will learn about the various factors affecting the runway orientation
CO4	Students will understand about the the ICAO standards & regulations

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**3**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
CO2	**2**	**3**	**2**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
CO3	**2**	**3**	**2**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
CO4	**2**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
Average	**2.5**	**2.75**	**2.5**	**3**	**2**	**2**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1.	Introduction to ICAO standards (C2, Understand). Planning for airport (C4, Analyze), Understand airport components, zoning laws etc. (C2, Understand)
2.	Understand various methods of air traffic forecasting (C2, Understand), Capacity determination method (C4, Analyze)
3.	Runway patterns design and understanding (C2, Understand, C4, Analyze). Taxiways alignment geometry and determination of turning

	radius exit taxiways (C6, Create)
4.	Design principles of critical, semi-critical, non-critical airport pavements and FAA and PCA methods (C6, Create). Airport hangars, their planning and design criteria (C5, Evaluate C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	32
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	5
Case/Project Based Learning (CBL)	5
Revision	3
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Quiz	Mid Semester Examination 1
Seminars	Mid Semester Examination 2
Problem Based Learning (PBL)	University Examination
	Short Answer Questions (SAQ)
	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz	✓	✓	✓	✓
VIVA				
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	1. Student's Feedback			

Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through Google forms	
References:	
	Text Books (i) Airport Engineering, N.J. Ashford, P.H. Wright, John Wiley (ii) Planning and Design of Airports, R.M. Horonjeff, F.X. McKelvey, W.J Sproule, Seth Young (iii) Airport Planning & Management, Wells, Alexander; Young, Seth, McGraw Hill (iv) TMH International Publishers (v) Airport Engineering (Planning and Design), S.C Saxena, CBS Publisher

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160236
Course Title	**Pavement Design Lab**
Academic Year	I
Semester	II
Number of Credits	1
Course Prerequisite	Highway Engineering lab
Course Synopsis	Understanding the effect of various environmental factors effecting the pavement design, Traffic load calculation, Design, and analysis of flexible and rigid pavement using E-layer and IITPAVE

Course Outcomes:
At the end of the course students will be able to:

CO1	Appreciate the importance of environmental factors for the pavement design
CO2	Road traffic evaluation and forecasting
CO3	Software application in road pavement design
CO4	Design and evaluation of multilayer pavement system

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**3**
CO2	**2**	**1**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**2**	**1**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
Average	**2.75**	**1.75**	**2**	**2.5**	**2.5**	**1.75**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	**0**	**2**	**2**

Experiment No.	Content
1.	Analysis of traffic survey data (C2, Understand; C3, Apply; C4, Analyze)
2.	Introduction to E-layer software (C1, Remember, C2, Understand)
3.	Single layer analysis using E-layer software (C4, Analyze, C6, Create)
4.	Multilayer analysis using E-layer software (C4, Analyze, C6, Create)
5.	Introduction to IITPAVE software interface (C2, Understand)
6.	Design and analysis of single layer flexible pavement (C6, Create)
7.	Design and analysis of multi-layer flexible pavement (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	22
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	--
Case/Project Based Learning (CBL)	8
Revision	--
Others If any:	--
Total Number of Contact Hours	30

Assessment Methods:

Formative	Summative
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book/Drawing	✓	✓	✓	✓
Mid Semester Examination 1				
Mid Semester Examination 2				
University Examination(External Practical)	✓	✓	✓	✓
Feedback Process	2. Student's Feedback			
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through Google forms				

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160237
Course Title	**Traffic Lab**
Academic Year	I
Semester	II
Number of Credits	1
Course Prerequisite	Highway Engineering
Course Synopsis	Vehicle speed and volume survey, Traffic volume calculation and forecasting of (ADT, AADT, etc.), Axle load study, Drivers reaction time and road accidents investigation, Parking study

Course Outcomes:

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

CO1	Students will understand the importance of traffic studies and traffic forecasting and how important it is for proper efficiency of any transport facility
CO2	Students able to understand that how to determine the speed criteria
CO3	Accidents analysis and mitigation
CO4	Parking studies

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO 1	PO2	PO 3	PO4	PO 5	PO6	PSO1	PSO2	PSO3	PSO 4
CO1	3	2	3	2	3	2	2	2	3	3
CO2	2	2	2	2	3	3	2	2	3	3
CO3	3	2	2	3	2	2	2	2	3	3
CO4	3	2	2	3	2	1	2	2	3	3
Average	2.75	2	2.25	2.5	2.5	2	2	2	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	0	2	2

Experiment No.	Content
1.	Examine the Traffic volume study using videography technique (C4, Analyze).
2.	Examine the Traffic speed study using videography technique (C4, Analyze).
3.	Investigate the Speed study by radar gun & endoscope (C6, Create)
4.	Determination of reaction time of driver (C4, Analyze)
5.	Examine the Parking study (C4, Analyze)
6.	Investigate the Accident investigation study (C6, Create)
7.	Examine the Study for improvement of an accident prone location (C4, Analyze)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	22
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	--
Case/Project Based Learning (CBL)	8
Revision	--
Others If any:	--
Total Number of Contact Hours	30

Assessment Methods:

Formative	Summative
Viva-voce	Practical Examination & Viva-voce
Objective Structured Practical Examination	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA	✓	✓	✓	✓
Assignment / Presentation				
Unit test				
Practical Log Book/ Record Book/Drawing	✓	✓	✓	✓
Mid Semester Examination 1				
Mid Semester Examination 2				
University Examination(External Practical)	✓	✓	✓	✓
Feedback Process	1. Student's Feedback			
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through google forms				

SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

Master of Technology in Civil Engineering (Structural Engineering) 2nd Semester

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160214
Course Title	**Finite Element Analysis**
Academic Year	I
Semester	II
Number of Credits	4
Course Prerequisite	Structure analysis
Course Synopsis	Basics of finite element analysis, study of different methods linear equations and matrix method, study by displacement models, analysis of structure such as frame and truss by finite element analysis, Basic study of Iso-parametric elements.

Course Outcomes:
At the end of the course students will be able to:

CO1	Calculate strain-displacement matrix and stress-strain matrix.
CO2	Know the analysis procedure and the matrix operations.
CO3	Know the concepts of isoperimetric elements.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1.	Define Finite element method (C1, Remember) - Explain the steps for FEM (C2, Understand) – Discuss stiffness method (C2, Understand) - Demonstrate Stress and strain vectors (C3, Apply), Describe Stain displacement equations (C2, Understand), Explain Linear constitutive equations (C2, Understand) – Define overall stiffness matrix (C1, Remember) – Describe overall load matrix (C2, Understand) - Analysis of beams (C4, Analyze).
2.	Explain theory of Finite Element (C2, Understand) - Discuss concept of

	an element (C2, Understand) - Identify various elements shapes (C2, Understand) - Define displacement polynomials (C1, Remember) - Discuss convergence requirements (C2, Understand) - Classify shape functions (C2, Understand) - Examine element strains and stresses (C4, Analyze) - Explain direct formulation of element stiffness matrix for beam element and plane truss element (C3, Understand)
3.	Examine the discretization of a body or structure (C4, Analyze) - Discuss the minimization of band width (C2, Understand) - State the steps for construction of stiffness matrix and loads for the assemblage (C1, Remember) - Classify the boundary conditions (C2, Understand)- Contrast analysis of plane truss, space truss, plane frame (C4, Analyze).
4.	Describe plane stress (C2, Understand) - Describe Plane strain (C2, Understand) - Identify CST, LST & QST elements (C2, Understand)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	26
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	9
Problem Based Learning (PBL)	6
Case/Project Based Learning (CBL)	--
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**			

Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓			
Unit test	✓	✓	✓			
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓			
Mid Semester Examination 2	✓	✓	✓			
University Examination	✓	✓	✓			

Feedback Process	2. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through google forms	
References:	

Text Books

1. C. S. Krishnamoorthy, (2008), Finite Element Analysis, Second Edition, Tata McGraw Hill Education Pvt. Ltd., *ISBN-13: 978007462100.*

Reference Books

1. Cook R. D., Malkas D. S. & Plesha M. E, (2008), Concepts and applications of Finite Element analysis, Fourth Edition, Wiley India Pvt. Ltd., *ISBN-13*: 9788126513369.

2. Reddy, (2005), An Intro. To The Finite Element Methods, Third Edition, Tata McGraw Hill Education Pvt. Ltd., I*SBN*-13: 9780070607415.

3. Singiresu S. Rao, (2010), The Finite Element Method in Engineering, Fifth Edition, Elsevier Science, ISBN-13: 9780080952048.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160215
Course Title	**Theory of Elasticity and Plasticity**
Academic Year	I
Semester	II
Number of Credits	3
Course Prerequisite	Structure Mechanics
Course Synopsis	Structural analysis is the determination of the effects of loads on physical structures and their components. Structures subject to this type of analysis include all that must withstand loads, such as buildings, bridges, vehicles, machinery, furniture, attire, soil strata, prostheses and biological tissue.

Course Outcomes:
At the end of the course students will be able to:

CO1	Analyse the stresses and strains for two dimensional and three dimensional elements.
CO2	Understand the equilibrium and compatibility conditions.
CO3	Solve the problems on Torsion for different shaped bars.
CO4	Understand the concept of plasticity.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO4	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
3	**0**	**0**	**3**

Unit	**Content**
1.	Examine the analysis of Stress and Strain (C4, Analyze) - Describe the Elasticity approach (C2, Understand) – Definition and notation of stress (C1, Remember) – Components of stress and strain (C2, Understand) – Define Generalized Hooke's law (C1, Remember) - Examine Two

	dimensional Problems in Cartesian Coordinates (C4, Analysis) - Examine Plane stress and plain strain problems with practical examples (C4, Analysis) - Discuss Equations of equilibrium and compatibility conditions in Cartesian coordinates (C2, Understand) – Define Airy's stress function (C1, Remember) - Design Bending of simply supported beams (C6, Create).
2	Examine Two dimensional Problems in Polar Coordinates (C4, Analysis) - Explain Equations of equilibrium and compatibility conditions in polar coordinates (C2, Understand) – Investigate Axi-symmetrical problems (C6, create) - Discuss Thick cylinder under uniform pressure (C2, Understand) - Examine Circular arc beams subjected to pure bending (C4, Analysis).
3	Examine Torsion of circular shafts (C4, Analysis), Explain St. Venant's Approach (C2, Understand), Discuss torsion of non-circular sections (C2, Understand), Define membrane analogy (C1, Remember), Design narrow rectangular cross-section (C6, Create).
4	Discuss Introduction to plasticity (C2, Understand) – Explain Stress – Strain diagram (C2, Understand) – Discuss Plastic analysis (C2, Understand) – State Yield criteria (C1, Remember) – Define St. Venant's theory (C1, Remember) – State Von Mises criterion (C1, Remember) – Define Plastic work (C1, Remember) –Describe Strain hardening (C2, Understand).

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	28
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	4
Problem Based Learning (PBL)	9
Case/Project Based Learning (CBL)	--
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		
Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		
Feedback Process	2. Student's Feedback					
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through google forms						

References:	
	Text Books 1. Timoshenko and Goodier, (1970), Theory of Elasticity, Third Edition, McGraw Hill Professional, ISBN-13: 9780070858053. **Reference Books** 1. Srinath, (2002), Advanced Mechanics of Solids, Third Edition, Tata McGraw Hill Pvt. Ltd., ISBN-13: 9780070139886. 2. D. Peric, E. A. de Souza Neto & D. R. J. Owen, (2011), Computational Methods for Plasticity, Wiley, ISBN-13: 9781119964544.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160216
Course Title	**Limit State Design of Steel Structures**
Academic Year	I
Semester	II
Number of Credits	4
Course Prerequisite	Design of Steel Structure
Course Synopsis	Many civil engineering structures are made up of steel. Knowledge of designing and detailing of steel structures is very important for civil engineers in order to make structures safe and serviceable during its life span. Limit State design philosophy is currently used worldwide for design of steel structures and its various components. Also precise and correct detailing of structural drawing is necessary in order to get the correct behavior of structures and leads to smooth construction of structures. This course will provide detailed knowledge of design and detailing of steel structures as per Indian standards.

Course Outcomes:
At the end of the course students will be able to:

CO1	Design tension and compression members.
CO2	Design of steel structure using plastic design method
CO3	Design light gauge steel structures.
CO4	Design of chimney and roof truss

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO4	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content

1	Describe Tension member, net and effective area (C2, Understand), design of tension members (C6, Create), Define Compression member (C1, Remember), Design of compression members (C6, Create), Discuss built up compression member (C2, Understand), Design of lacing and batten (C6, Create), Describe column base (C2, Understand),Examine the types of column base (C4, Analyze), Design of base slab (C6, Create).
2	Introduction, Explain Shape factors (C2, Understand), Define load factor (C1, Remember), Discuss Plastic hinge (C2, Understand), Define length of plastic hinge (C1, Remember), Examine Mechanisms and types of mechanism (C4, Analyze), Define Theorem of plastic analysis (C1, Remember), Examine the Analysis of beams and portal frames (C4, Analyze).
3	Design of Light Gauge Steel Structures (C6, Create) - Differentiate the Types of cross sections (C4, Analyze) - Define Local buckling and lateral buckling (C1, Remember) - Design of compression and tension members (C6, Create) – Discuss Beams (C2, Understand) - Explain Deflection of beams (C2, Understand).
4	Discuss General consideration (C2, Understand), Describe Flexural strength (C2, Understand), Explain shear strength of web (C2, Understand), Explain stiffeners and their types (C2, Understand), design of plate girder with and without stiffeners (C6, Create). Introduction, Differentiate the types of roof truss (C4, Analyze), Describe spacing of truss (C2, Understand), Discuss loads on roof truss (C2, Understand), Examine the analysis of roof truss (C4, Analyze).

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	30
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	12
Problem Based Learning (PBL)	15
Case/Project Based Learning (CBL)	--
Revision	3
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1

Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		
Quiz						
VIVA	✓	✓				
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	2. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through google forms	

References:	
	Text Books 1. Dayarathnam. P., (1996), Design of Steel Structures, Second Edition, S. Chand and Publishers, ISBN-13: 0788121923200. **Reference Books** 1. Duggal S. K., (2014), Limit State Design of Steel Structures, Second Edition, McGraw Hill, ISBN-13: 9789351343509. 2. Ramchandra, Virendra Gehlot, (2010), Limit State Design of Steel Structures: Based on IS: 800-2007 IN S. I. Units, Scientific Publishers, ISBN-13: 9788172336141.

Faculty of Engineering & Technology	
Name of the Department	**Civil Engineering**
Name of the Program	**Master of Technology (Civil Engineering) with Structural Engineering**
Course Code	
Course Title	Earthquake Resistant Design
Academic Year	I
Semester	II
Number of Credits	3
Course Prerequisite	Structural Dynamics
Course Synopsis	The course aims to present to the students fundamental concepts of current seismic codes and technical seismology as well as the technical skills for the seismic design of structures and the evaluation of their seismic response.

Course Outcomes:
At the end of the course students will be able to:

CO1	Evaluate the behaviour of structures under dynamic loadings.
CO2	Know methodology for earthquake-resistant design of structures
CO3	Design consideration of the buildings for ductile detailing
CO4	Seismic evaluation and retrofitting techniques

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO4	**1**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
2.	Definition of different elements of Seismology (C1, Remember), Compare magnitude and Intensity (C4, Analyze), Describe general features of tectonics of seismic regions and Seismographs (C2, Understand)

	Describe Philosophy of earthquake resistant design (C2, Understand), Differentiate between earthquake proof v/s earthquake resistant design (C4, Analyze), Compare the four virtues of earthquake resistant structures (strength, stiffness, ductility and configuration) (C4, Analyze), Investigate the different seismic structural configuration (C6, Create)
2.	Define seismic load (C1, Remember), Describe Seismic Coefficient Method (C2, Understand), and evaluation of base shear and its distribution along height (C5, Evaluate). Explain Response spectrum (C2, Understand), value of IS code provisions during the design of structures (C5, Evaluate) Capacity Based design- an approach for earthquake resistant design of soft storey RC Building (C6, Create), Design of Earthquake resistant structure (C6, Create), Seismic analysis of RC building as per IS:1893 code (C4, Analyze)
3.	Describe the concepts of Ductile Detailing of various structural components as per IS: 13920 provisions in earthquake resistant structure (C2, Understand), Investigate the strong Column weak beam concept (C6, Create)
4.	Describe irregularity (C2, Understand), Differentiate the types of irregularity (C4, Analyze), compare effect of structural irregularities on the performance of structure (C4, Analyze), Investigate the seismic evaluation and retrofitting, techniques used for the retrofitting of RC and masonry structures (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	20
Practical	--
Seminar/Journal Club	3
Small group discussion (SGD)	3
Self-directed learning (SDL) / Tutorial	12
Problem Based Learning (PBL)	3
Case/Project Based Learning (CBL)	--
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination

Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		
Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	3. Student's Feedback
Students Feedback is taken through various steps 3. Regular feedback through Mentor Mentee system **4.** Feedback between the semester through google forms	
References:	(List of books)
	TEXT BOOKS 1. Anil K. Chopra, (2011), Dynamics of Structures - Theory and Applications to Earthquake Engineering, Second Edition, Ingram International Inc., ISBN-13: 9780132858038. **REFERENCE BOOKS** 1. Pankaj Agarwal and Manish Shrikhande, (2007), Earthquake Resistant Design of Structures, First Edition, Prentice-Hall India Pvt Ltd, ISBN-13: 9788120328921. 2. Gupta B. L., (2010), Principles of Earthquake Resistant Design of Structures & Tsunami, Standard Publishers & Distributors, ISBN-13: 9788180141485.

s

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160239
Course Title	**Finite Element Analysis Lab**
Academic Year	I
Semester	II
Number of Credits	3
Course Prerequisite	Structural Analysis
Course Synopsis	Basics of finite element analysis, study of different methods linear equations and matrix method, study by displacement models, analysis of structure such as frame and truss by finite element analysis, Basic study of Iso-parametric elements.

Course Outcomes:
At the end of the course students will be able to:

CO1	Calculate strain-displacement matrix and stress-strain matrix.
CO2	Know the analysis procedure and the matrix operations.
CO3	Know the concepts of isoperimetric elements.
CO4	Know the analysis procedure by Finite element analysis

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO4	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
0	**0**	**2**	**2**

Experiment No.	**Content**
1	Analysis of three-span continuous beams (C4, Analyze)
2	Analysis of propped cantilever beam (C4, Analyze)
3	Analysis of statically determinate plane truss (C4, Analyze)
4	Analysis of statically indeterminate plane truss (C4, Analyze)
5	Analysis of one bay – one storey plane frame (C4, Analyze)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	18
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	12
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	30

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4		
Quiz						
VIVA	✓	✓	✓	✓		
Unit test						
Practical Log Book/ Record Book	✓	✓	✓	✓		
Demonstration	✓	✓	✓	✓		
Mid Semester Examination 1						
Mid Semester Examination 2						
University Examination(External Practical)	✓	✓	✓	✓	✓	
Feedback Process	2. Student's Feedback					
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system						

2. Feedback between the semester through google forms

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160218
Course Title	**Structural Engineering Laboratory**
Academic Year	I
Semester	II
Number of Credits	2
Course Prerequisite	Concrete Technology
Course Synopsis	The aim of the course is to present to the students fundamental concepts of current seismic codes and technical seismology as well as the technical skills for the seismic design of structures and the evaluation of their seismic response.

Course Outcomes:
At the end of the course students will be able to:

CO1	Design concrete mix for particular grade of concrete
CO2	Test concrete beams for various loading conditions
CO3	Perform non-destructive testing.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**1**	**1**	**3**	**3**	**3**	**3**	**1**	**1**	**3**	**3**
CO2	**1**	**1**	**3**	**3**	**3**	**3**	**1**	**1**	**3**	**3**
CO3	**1**	**1**	**3**	**3**	**3**	**3**	**1**	**1**	**3**	**3**
Average	**1**	**1**	**3**	**3**	**3**	**3**	**1**	**1**	**3**	**3**

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
0	**0**	**2**	**2**

Experiment No.	**Content**
1.	To test the compressive strength of fibre reinforced concrete by testing cube specimens (C4, Analyze)
2.	Casting and testing of simply supported RCC beams for flexural failure (C4, Analyze)
3.	Casting and testing of simply supported RCC beams for shear failure (C4, Analyze)
4.	To test tensile strength on a steel reinforcement bar (C4, Analyze)
5.	To test shear strength of steel bar under double shear (C4, Analyze)

6.	To test bending test of I-section steel beam (C4, Analyze)
7.	To conduct bending test of steel channel section (C4, Analyze)
8.	To test rebound hammer test on concrete blocks (C4, Analyze)
9.	To test ultrasonic pulse velocity test (C4, Analyze)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	11
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	8
Case/Project Based Learning (CBL)	11
Revision	--
Others If any:	--
Total Number of Contact Hours	30

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**			
Quiz						
VIVA	✓	✓	✓			
Assignment / Presentation						
Unit test						
Practical Log Book/ Record Book/Drawing	✓	✓	✓			
Mid Semester Examination 1						
Mid Semester Examination 2						

University Examination (External Practical)	✓	✓	✓			
Feedback Process	1. Student's Feedback					
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through google forms						

SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

NAAC A+

Master of Technology in Civil Engineering (Remote Sensing and GIS) 2nd Semester

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160240
Course Title	**Geospatial Data Processing and Modelling**
Academic Year	I
Semester	II
Number of Credits	4
Course Prerequisite	NIL
Course Synopsis	Interpolation, Geo- statistical Method, DTM application, GIS models, programming tools

Course Outcomes:
At the end of the course students will be able to:

CO1	Apply advanced GIS tools
CO2	Prepare GIS data for various elevation models
CO3	Solve geospatial problems using programming tools
CO4	Analyze GIS data using complex geospatial models

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	-	-	-	-	1	1
CO2	3	3	1	2	-	-	-	-	1	1
CO3	3	3	1	2	-	-	-	-	1	1
CO4	3	2	1	2	-	-	-	-	1	1
Average	3	1.75	1	2	-	-	-	-	1	1

Course Content:

L (Hours/ Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week

3	**-**	**-**	**3**	**3**

Unit	**Content and Competency**
1	Local and Global methods of Interpolation C1 (Remember). Explain method of undetermined coefficients and method of variation of parameters. C2 (Understand)
2	Slope and aspect and site selection studies C2 (Understand) view shed and watershed analysis. C1 (Remember) Working with Open Source DEM's. C6 (Create)
3	Modelling Process. C2 (Understand) Classification; Model builder tools. C6 (Create) Python, R programming and MATLAB concepts for geo-processing tools. C6 (Create)
4	Components, Data Sources Free and open source GIS software and applications

Teaching Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	16
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	60

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	1. Student's Feedback			

References:	**Textbooks:** 1. Principles of GIS for Land Resource Assessment, Burrough, P.A., Oxford Pub., 2005. 2. Concepts and Techniques of Geographic Information Systems, C.P .Lo & Albert K.W. Yeung, second Edition, Prentice Hall India Pvt. Ltd,2016. 3. Remote Sensing and Image Interpretation, Lilles T. Mand Kiefer R.W., John Wiley, 2015
	Reference Books: 1. Remote Sensing Imagery, Florence Tupin, Jordi Inglada and Jean-Marie Nicolas, ISTE and Wiley, 2014 2. Principles of GIS for Land Resource Assessment, Burrough, P.A., Oxford Publications, 2005.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160241
Course Title	**Satellite Image Processing**
Academic Year	I
Semester	I
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	Data products, digital image formation, enhancement, and processing, segmentation, image classification techniques

Course Outcomes:
At the end of the course students will be able to:

CO1	Analyze remote sensing data using image processing techniques.
CO2	Classify the remote sensing data
CO3	Evaluate the accuracy of image classification
CO4	Apply advanced processing methods to map geographical features

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	-	1	-	-	-	-	2
CO2	3	1	-	-	1	-	-	-	-	2
CO3	3	1	-	-	1	-	-	-	-	2
CO4	1	-	1	-	-	-	-	-	-	2
Average	1.75	-	0.25	-	0.75	0.75	-	-	-	2

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	CL (Hours/Week)	Total Hour/Week
3	**0**	**0**	**0**	**3**

Unit	Content	Competency
1	Explain Data Products and Their Characteristics C2 (Understand) Digital image formation, digital image display mechanism, image histograms and look up table data. C1 (Remember) Pre-processing – Atmospheric, Radiometric, Implement Geometric Corrections - Basic Principles of Visual Interpretation, Ground Truth, Ortho rectification, Applications. C2 (Understand)	
2	Explain Linear and non-linear Contrast enhancement techniques, density slicing, pseudo colour images, spatial enhancement techniques (convolution filtering). C2 (Understand) Describe spectral enhancement techniques.C2 (Understand) Implement Image algebra, PCA, data fusion techniques. C6 (Create) Explain Segmentation - Methods, MDL, Watershed, Mean-shift, Edge detection. C2 (Understand) Explain Spectral indices - Vegetation indices, water related indices, indices related to cloud properties. C2 (Understand) Describe Google Earth Engine platform for satellite data processing. C2 (Understand)	
3	Explain Supervised Classification.C2 (Understand) Training set - Statistical computation, understanding feature space & scatter plots, signature purity & separability.C2 (Understand) Signature Baye's decision rule. C2 (Understand) Implement Parallelepiped algorithm, maximum like-hood method, unsupervised and hybrid classification techniques, classification analysis. C6 (Create) Describe confusion matrix, error analysis & kappa coefficient. C2 (Understand) Analysis of Multi-Temporal series and change detection. C2 (Understand)	
4	Explain Object based Fuzzy, ANN and SVM classification techniques. C2 (Understand) Implement sub-pixel mixture analysis. C6 (Create) Define Object Oriented Image Classification. C1 (Remember)	

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	2. Student's Feedback
References:	**TEXTBOOKS:** 1. Digital Image Processing, John R J, Introductory Prentice Hall,New Jersey,2016. 2. Remote Sensing Imagery, Florence Tupin, Jordi Inglada and Jean-Marie Nicolas, ISTE and Wiley, 2014. 3. Remote Sensing and Digital Image Processing, Jarocińska, Anna, vander Meer, Freek D., Springer, 2016
	REFERENCE BOOKS: 1. An Introduction to Support Vector Machines, Nello Cristiani and John Shawe Taylor., Cambridge University Press, 2013 2. Remote Sensing and Image Interpretation, Lilles and,T.M., Kiefer, R.W. and Chapman, J.W., Fifth Edition, John Wiley &Sons,2007. 3. Digital Image Processing, Gonzalez, Rafael C. and Richard E. Woods, Third Edition, Pearson Education, London.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160242
Course Title	**Advanced GIS**
Academic Year	I
Semester	II
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	Data quality, error in GIS database, project evaluation, web mapping, application of internet service to GIS, Spatial and network analysis

Course Outcomes:

At the end of the course, students will be able to:

CO1	Conduct advanced spatial analyses using GIS tools
CO2	Study GIS data with complex geospatial models.
CO3	Solve the geospatial error using GIS tools.
CO4	Develop models in GIS using Open source and Web GIS.

Mapping of Course Outcomes (COs) to Program Outcomes (POs)& Program Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	-	1	0	3	-	-	-	3	2
CO2	2	1	1	1	3	-	-	-	3	2
CO3	2	1	1	1	3	-	-	-	3	2
CO4	2	1	1	1	3	-	-	-	3	2
Average	2	0.75	1	0.75	3	-	-	-	3.0	2.0

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week

1	0	0	1

Unit	Content & Competencies
1	Discuss the nature of geographic data (C2, Understand), Explain sources of errors in GIS database (C2, Understand), Describe the data quality parameters (C2, Understand), Define Handling error in GIS (C1, Remember), Demonstrate the Error propagation in GIS (C3, Apply). Examine Human and Organizational issues: The issue of GIS applications and users (C4, Analyze), Justifying the investment in GIS (C4, Analyze). Choosing and implementation of GIS (C4, Analyze), Organizational changes due to GIS (C4, Analyze). Discuss GIS project design and management: Problem identification (C2, Understand), designing a data model (C6, Create), Define Project management (C1, Remember), Identify Implementation problem (C2, Understand), Investigate Project evaluation (C6, Create).
2	Define the Principles of computer network (C1, Remember), Discuss Network type (C2, Understand), Discuss Client server computing concept (C2, Understand), Demonstrate the Application of internet services to GIS software (C3, Apply). Describe the Issues in GIS and trends (C2, Understand): Discuss the Development of computer method for handling spatial data (C2, Understand), Define Web Page Basics (C1, Remember), Discuss Web Mapping (C2, Understand), Describe Geospatial Web Services (C2, Understand), Demonstrate the Application of Internet services to GIS (C3, Apply), Examine Internet GIS software (C4, Analyze).
3	Demonstrate Digital Terrain Modeling and other raster analysis (C3, Apply), Examine Vector overlay analysis (C4, Analyze), Define TIN (C1, Remember). Demonstrate the Viewshed analysis and its application (C3, Apply). Demonstrate the Watershed analysis and its application (C3, Apply).
4	Describe Link and link impedance (C2, Understand), Discuss Node and turn impedance (C2, Understand), Explain Overpass and underpass (C2, Understand). Demonstrate the Network applications (C3, Apply): Examine Shortest path analysis (C4, Analyze), Examine closest facility allocation (C4, Analyze), Examine Location allocation (C4, Analyze).

Teaching Learning Strategies and Contact Hours

Learning Strategies	Contact Hours
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2

Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz	✓	✓	✓	✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback 2. Course Exit Survey
Students Feedback is taken through various steps 1. Regular feedback through the Mentor Mentee system. 2. Feedback between the semester through Google forms. 3. Course Exit Survey will be taken at the end of the semester.	
References:	
	1. Principles of GIS: P.A. Burrough and Rachel A.M. McDonnel, Oxford. 2. Concepts and Techniques of GIS by C.P. Lo and A.K.W. Yeung, Prentice Hall.

	3. An Introduction to GIS by Heywood, Cornelius and Carver, Pearson Education 4. Pinde Fu and Jiulin Sun, Web GIS: "Principles and Applications", ISBN:9781589482456,ESRI, 2010.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160243
Course Title	**GPS & Surveying**
Academic Year	1
Semester	II
Number of Credits	3
Course Prerequisite	Surveying, Remote Sensing
Course Synopsis	In this course, the students will know the importance of GPS, Factor affecting GPS & Applications of GPS.

Course Outcomes:

At the end of the course, students will be able to:

CO1	Students will learn how to take observation and collect data from GPS.
CO2	Students will be able to understand the application of GPS
CO3	Students will be able to understand different types of GPS and its technical description.
CO4	Understand the concept of MS Access.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	0	3	-	-	2	3	1
CO2	2	1	1	1	3	-	-	2	3	1
CO3	2	1	1	1	3	-	-	2	3	1
CO4	2	1	1	1	3	-	-	2	3	1
Average	2	1	1	0.75	3	-	-	2	3	1

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
0	**0**	**4**	**4**

Content & Competencies		
Unit	**Content**	
1	Discuss Maps & their numbering (C2, Understand), Describe Map projection and co-ordinate system (C2, Understand), Define Geo referencing and data (C1, Remember), Define Basic concepts of GPS (C1, Remember): History and timeline, overview. pseudo range and carrier phase measurements (C2, Understand); Describe Signal structure (C2, Understand); Explain GPS coordinate systems (C2, Understand): WGS-84, GPS time; GPS Errors and biases; GPS orbital Geometry and Navigational solution (C2, Understand).	
2	Explain System Segmentation – Space segment (C2, Understand); Describe control segment (C2, Understand), Discuss user segment (C2, Understand)- Differentiate the types of receivers (C4, Analyze); Discuss GPS satellite signals (C2, Understand), Define GPS data, position and time from GPS (C1, Remember), Explain code phase tracking, pseudo range navigation, receiver position, time and velocity, carrier phase tracking (C2, Understand), Demonstrate GPS positioning types – absolute positioning, differential positioning (C3, Apply); Define Navigation signals -GPS frequencies (C1, Remember); Calculating positions using C/A code using P(Y) code, code phase v/s carrier phase, augmented GPS, local augmentation (C6, Create); Describe Accuracy and error sources – atmospheric effects, multipath effects, ephemeris and clock errors; selective availability, relativity, sagnac distortion (C2, Understand)	
3	Explain the factors that affect GPS (C2, Understand) - Discuss the number of satellites, multipath, ionosphere, troposphere, satellite geometry, satellite health, signal strength, distance from the reference receiver, RF interference, loss of radio transmission (C2, Understand); Demonstrate other satellite based navigational systems: GLONASS, GALILEO (C3, Apply). Explain GPS interference and jamming – natural sources, artificial sources (C2, Understand); Discuss the techniques to improve accuracy - augmentation, precise monitoring, GPS time and data, GPS modernization (C2, Understand).	
4	Define Military – airborne, marine and land based navigation (C1, Remember), and Discuss civilian – surveying and mapping (C2, Understand), Explain control surveys,	

	cadastral surveying (C2, Understand), navigation, RS, GIS and Photogrammetry (C4, Analyze), geodesy, location, navigation, tracking, mapping and timing, Engineering and Monitoring (C4, Analyze); Special applications of GPS, etc. (C3, Apply).

Teaching Learning Strategies and Contact Hours

Learning Strategies	**Contact Hours**
Lecture	32
Practical	
Seminar/Journal Club	2
Small group discussion (SGD)	2
Self-directed learning (SDL) / Tutorial	1
Problem Based Learning (PBL)	2
Case/Project Based Learning (CBL)	2
Revision	4
Others If any:	
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Quiz	Mid Semester Examination 2
Seminars	University Examination
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz	✓	✓	✓	✓

Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback 2. Course Exit Survey
References:	1 Understanding GPS: Principles and Applications Elliott Kaplan, Christopher Hearty 2. Introduction to GPS: The Global Positioning System Ahmed El-Rabbany

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160244
Course Title	**Advanced GIS Lab**
Academic Year	I
Semester	II
Number of Credits	2
Course Prerequisite	NIL
Course Synopsis	To design electrical systems. To analyze a given network by applying various network theorems. To know the response of electrical circuits for different excitations. To study various electrical measuring instruments and transducers. To summarize the performance characteristics of electrical machines

Course Outcomes:

At the end of the course, students will be able to:

CO1	Understand the basic concepts and terminology of electrical quantities
CO2	Analyze the DC circuit using various network theorems
CO3	Understand the response of different types of electrical circuits to different excitations
CO4	Understand the measurement, calculation and relation between the basic electrical parameter.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO1	PSO2	PSO3	PSO4
CO1	2	-	1	-	3	-	-	2	3	1
CO2	2	1	1	1	3	-	-	2	3	1
CO3	2	1	1	1	3	-	-	2	3	1
CO4	2	1	1	1	3	-	-	2	3	1
Average	2	1	1	1	3	-	-	2	3	1

Course Content:			
L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
0	**0**	**4**	**4**

Content & Competencies

Unit	Title
1	Familiarization of electrical Elements, sources, measuring devices and transducers related to electrical circuits. C1 (Remember)
2	Verification of KVL and KCL. C6 (Create)
3	Verification of Thevenin's and Norton's theorems. C6 (Create)
4	Verification of superposition theorem. C6 (Create)
5	Verification of maximum power transfer theorem. C6 (Create)
6	Calculations and Verification of Impedance and Current of RL, RC and RLC series circuits. C6 (Create)
7	Verification of relation between phase and line quantities in a 3-phase balanced star and delta connected systems. C6 (Create)
8	Measurement of Active and Reactive Power in a balanced Three-phase circuit. C6 (Create)
9	Torque-Speed Characteristics of a Separately/Self Excited DC Shunt/Compound Motor. C1 (Remember)
10	Load test on single phase transformer. C1 (Remember)
11	Demonstration of measurement of electrical quantities in DC and AC systems. C6 (Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	30
Seminar/Journal Club	--
Small group discussion (SGD)	20
Self-directed learning (SDL) / Tutorial	--

Problem Based Learning (PBL)	10
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1,2, End term
Viva-voce	--
Objective Structured Practical Examination (OSPE)	University Examination
Quiz	Multiple Choice Questions (MCQ)
Seminars	Multiple Choice Questions (MCQ)
Problem-Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination (OSPE)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
VIVA	✓	✓	✓	✓
Practical Log Book/ Record Book	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	1. Student's Feedback 2. Course Exit Survey			
References:	Spatial Analysis Methods and Practice: Describe – Explore – Explain through GIS, Cambridge University Press (11 June 2020).			

Faculty of Engineering & Technology	
Name of the Department	**Civil Engineering**
Name of the Program	**Master of Technology in Civil Engineering (Remote Sensing and GIS) Structural Engineering**
Course Code	
Course Title	**Satellite Image Processing Lab**
Academic Year	I
Semester	II
Number of Credits	1
Course Prerequisite	**Image processing lab**
Course Synopsis	This course mainly deals with data products, digital image formation, enhancement, and processing, segmentation, image classification techniques

Course Outcomes:
At the end of the course students will be able to:

CO1	Analyze remote sensing data using image processing techniques.
CO2	Classify the remote sensing data
CO3	Evaluate the accuracy of image classification
CO4	Apply advanced processing methods to map geographical features

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	-	-	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**
CO3	-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**
CO4	-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**
Average	-	-	**3**	**3**	**3**	**3**	**3**	**3**	**2.5**	**2.5**

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
0	**0**	**2**	**2**

Experiment No.	**Content**
1.	Image Display & Color Theory (C1, Knowledge)
2.	Analysis LandSat Image and Make Maps from Satellite Imagery (C1, Knowledge)
3.	Polynomial Rectification (C4, Analysis)
4.	Enhancing Imagery (C3, Apply)
5.	Data fusion: multi-sensor sharpening (C4, Analysis)
6.	Classification of images (C2, Understand)
7.	Advanced Classification and Accuracy Assessment (C2, Understand)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	--
Practical	13
Seminar/Journal Club	--
Small group discussion (SGD)	04
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	13
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	30

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3			
Quiz						
VIVA	✓	✓	✓			
Assignment / Presentation						
Unit test						
Practical Log Book/ Record Book	✓	✓	✓			
Mid Semester Examination 1						
Mid Semester Examination 2						
University Examination (External Practical)	✓	✓	✓			
Feedback Process	3. Student's Feedback					
Students Feedback is taken through various steps						

3. Regular feedback through Mentor Mentee system
4. Feedback between the semester through google forms

SEMESTER - III

Course Code	Course Title
13160367	Dissertation Phase-I
Transportation Engineering (Choose these subjects for specialization)	
13160357	Intelligent Transportation Systems
Program Elective-I Pool (Choose One from the pool)	
13160355	Construction Project Management & BOT
13160368	Traffic Management and Road Safety
13160359	Highway Construction Practices
Program Elective-II Pool (Choose One from the pool)	
13160369	Pavement evaluation, Rehabilitation & Maintenance
13160363	Environment Impact Assessment
13160365	Bridge Engineering
Structural Engineering (Choose these subjects for specialization)	
13160305	Theory & Design of Plate and Shell
Program Elective-I Pool (Choose One from the pool)	
13160325	Pre-Fabricated Structures
13160327	Design of Industrial Structures
13160329	Maintenance & Rehabilitation of Structures
Program Elective-II Pool (Choose One from the pool)	
13160331	Design of Bridges
13160333	Composite Structures
13160335	Design of Tall Buildings
Remote Sensing and GIS (Choose these subjects for specialization)	
13160370	Digital Image Processing
Program Elective-I Pool (Choose One from the pool)	
13160371	Web and Mobile GIS
13160372	Argo Remote Sensing
13160373	Remote Sensing Geology
Program Elective-II Pool (Choose One from the pool)	
13160374	Global Navigation Satellite System
13160375	Advanced Surveying and Cartography
13160376	Pattern Recognition and Machine Learning

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160367
Course Title	**Dissertation Phase-I**
Academic Year	II
Semester	III
Number of Credits	6
Course Prerequisite	Research methodology
Course Synopsis	In this course, student will finalize the research problem and will complete the literature review for Thesis.

Course Outcomes:
At the end of the course students will be able to:

CO1	Identify civil engineering problems by reviewing available literature.
CO2	Identify appropriate techniques to analyze complex problems related to civil engineering
CO3	Investigate and development of solution

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
0	**0**	**12**	**12**

Experiment No.	**Content**
1	Identify the problem (C2, Understand), Implement the suitable solution (C3, Apply), Experiments and tests (C4, Analyze), Investigate and develop the solution (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	90

Case/Project Based Learning (CBL)	90
Revision	--
Others If any:	--
Total Number of Contact Hours	180

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**			
Quiz						
VIVA	✓	✓	✓			
Assignment / Presentation	✓	✓	✓			
Unit test						
Practical Log Book/ Record Book	✓	✓	✓			
Demonstration	✓	✓	✓			
Mid Semester Examination 1						
Mid Semester Examination 2						
University Examination (External Practical)	✓	✓	✓			

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through Google forms	

SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

NAAC A+

Master of Technology in Civil Engineering (Transportation Engineering) 3rd Semester

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160357
Course Title	**Intelligent Transportation Systems**
Academic Year	II
Semester	III
Number of Credits	4
Course Prerequisite	Highway Engineering
Course Synopsis	Introduction to ITS and overview, Its applications and Highway Safety, Advance traffic management system, Interactive voice recognition and its applications, ITS components and standards

Course Outcomes:
At the end of the course students will be able to:

CO1	Identify and differentiate ITS user services and their components.
CO2	Propose appropriate ITS technology to solve real-life traffic problems.
CO3	Estimate traffic congestion by the acquisition of big data using advanced devices.
CO4	Design and implement suitable ITS and services for effective transportation.
CO5	Select suitable standards for effective implementation of ITS

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**3**
CO2	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**3**
CO3	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**3**
CO4	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**3**
CO5	**3**	***2***	***2***	***2***	**1**	**1**	**2**	**2**	**3**	**3**
Average	**2.8**	**2.4**	**2**	**2**	**1.4**	**1.2**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**1**	**0**	**4**

Unit	Content
1.	Overview and history of ITS (C1, Remember), ITS Applications (C3, Apply); Federal ITS Programs, Improving Highway Safety with ITS (C4, Analyze)
2.	Advanced Traveler Information Systems A Case Study (C2, Understand); VA DOT Active Traffic Management Concept (C4, Analyze);ITS Telecommunications Technologies Connected - Vehicle Technology Connected Vehicle Technology and Applications (C3, Apply)

3.	Understand Interactive Voice Recognition (IVR) Technologies (C2, Understand); ITS Mobile Applications (C3, Apply)
4.	Understand analyze Economics of ITS Congestion and Pricing Revenue Generation Models (C2, Understand, C4, Analyze)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	35
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	15
Problem Based Learning (PBL)	4
Case/Project Based Learning (CBL)	4
Revision	2
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Quiz	Mid Semester Examination 1
Seminars	Mid Semester Examination 2
Problem Based Learning (PBL)	University Examination
	Short Answer Questions (SAQ)
	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Quiz	✓	✓	✓	✓	✓
VIVA					
Assignment / Presentation	✓	✓	✓	✓	✓
Unit test	✓	✓	✓	✓	✓
Practical Log Book/ Record Book					
Mid Semester Examination 1	✓	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓	✓
University Examination	✓	✓	✓	✓	✓
Feedback Process	1. Student's Feedback				
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through google forms					
References:					

	Text Books 1. Rangawala , Building Construction (2010) ISBN No. 978-93-80358-15-4,Charotar Publications Pvt. Ltd. 28th Edition **Referance books** 1. P.C.Varghese, Engineering Materials, 1st edition, PHI Learning. 2. S.K.Duggal, Building Materials, 3rd Edition, New Age International Publishers. 3. Sushil Kumar, Building Construction, Standard Publishers Distributors. 4. M.S.Shetty, Concrete Technology: Theory and Practice, S. Chand Publishers. 5. A.R.Santhakumar, Concrete Technology, Oxford University Press.

SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

Master of Technology in Civil Engineering (Transportation Engineering)

Departmental Electives

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160355
Course Title	**Construction Project Management & BOT**
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	PERT and CPM
Course Synopsis	Understanding the various stages of project, Economic and financial analysis of project, Project selection, Network scheduling, Use of Project Planning Software, Project bid, Project operation

Course Outcomes:
At the end of the course students will be able to:

CO1	Understand the importance of project management for any infrastructure project
CO2	Overall development of students in how to deal with different – different people involved in the project
CO3	Learn about the use of various software in flow less execution of any infrastructure project
CO4	Apply the concepts of failure theories for design of structures

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**3**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
CO2	**2**	**3**	**2**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
CO3	**2**	**3**	**2**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
CO4	**2**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**3**	**3**
Average	**2.5**	**2.75**	**2.5**	**3**	**2**	**2**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1.	Understand foundations of Project Management (C1,Remember), Understand Project Life Cycle(C2, Understand), Project Selection methodology (C3, Apply), Drafting Project Proposal (C3, Apply), Project Scope understanding (C1,Remember)
2.	Understand the Breakdown Structure (C1, Remember). Network Scheduling (C4, Analyze), Critical Path Method (C4, Analyze),

	Program Evaluation & Review Technique (C5, Evaluate), Planning and Scheduling of Activity Networks (C2, Understand), Assumptions in PERT (C1, Remember)
3.	Modeling - Time-cost Trade-offs, Linear Programming and Network Flow Formulations (C6, Create), PERT/COST Accounting (C5, Evaluate)
4.	Scheduling with limited resources (C3, Apply), Resource Planning and Resource Allocation (C3, Apply), Project Schedule Compression (C2, Understand), Project Scheduling Software, Precedence Diagrams, Decision CPM, Generalized Activity Networks, GERT (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	36
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	4
Case/Project Based Learning (CBL)	3
Revision	2
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Quiz	Mid Semester Examination 1
Seminars	Mid Semester Examination 2
Problem Based Learning (PBL)	University Examination
	Short Answer Questions (SAQ)
	Long Answer Question (LAQ)

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz	✓	✓	✓	✓
VIVA				
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through google forms	
References:	
	Text Books: 1. Projects: Planning, Analysis, Selection, Implementation & Review, Prasanna Chandra, 5th Ed., 2002. 2. Project Management: A systems approach to planning and controlling, Harold Kerzner, CBS Publisher, New Delhi, 2nd Ed., 2000. **Reference Books:** 1. Lock, D., 2003, Project Management, 8th edition, Gower Publishing Limited. 2. AMS REALTIME projects http://www.amsrealtime.com/products/project.htm

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160368
Course Title	**Traffic Management and Road Safety**
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	
Course Synopsis	Highway safety, Drivers behavior, Highway safety management system, Crash statistics and road safety audit

Course Outcomes:
At the end of the course students will be able to:

CO1	Provide students with a working knowledge of traffic safety concepts, covering the range from traffic planning, operations, and design
CO2	Gain an understanding of safety management systems, different safety countermeasures, statistical issues with countermeasures and their effectiveness, and crash investigation
CO3	Hotspot" identification and remediation
CO4	State of the practice analysis methods for evaluating counter measures

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
CO2	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
CO3	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
Average	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1.	Define Road user, vehicle, and roadway (C1,Remember);Understand Vehicle characteristics(C2,Understand); IRC standards for Design speed, and traffic volume(C3,Apply);Understand Highway capacity and levels of service determination for capacity of urban and rural roads(C2,Understand);Define and analyze PCU concept and its limitations(C1,Remember, C4,Analyzed).
2.	Define Road user facilities like Parking facilities, Cycle tracks and cycle-ways and Pedestrian facilities(C1,Remember); Understand and design Road user facilities like Parking facilities, Cycle tracks and

	cycle-ways and Pedestrian facilities(C2, Understand, C6,Create); Explain Road inventory(C2,Understand); Discuss Accident studies(C2,Understand);
3.	Define Cross-sectional elements(C1,Remember); Define Stopping and passing sight distance(C1,Remember);Design of Horizontal and Vertical curves(C6,Create). Construction of Hill Roads(C6,Create);
4.	Differentiate between Signs and markings(C4,Analyzed); Describe Traffic System Management(C2,Understand); Define at-grade intersections and its type(C1,Remember); Understand Channelization of traffic(C2,Understand); Design of rotaries(C6,Create);Understand the function of Traffic signals - pre-timed and traffic actuated(C2,Understand); Design of signal setting - phase diagrams, timing diagram(C6,Create);developing Signal co-ordination(C6,Create);

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	35
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	4
Case/Project Based Learning (CBL)	4
Revision	2
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz				
VIVA		✓		✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	1. Student's Feedback			
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through google forms				

References:	
	Text Books 1. KW Ogden, Safer Roads: A Guide to Road Safety Engineering, Averbury Technical Press, Ash gate Publishers, 1996. 2. Rune Elvik and TrulsVaa, the Handbook of Road Safety Measures, Elsevier, 2004. **Reference books** 1. Leonard Evans, Traffic Safety, Science Serving Society, 2004. 2. Ezra Hauer, Observational Before-After Studies in Road Safety, Pergamon Press, 1997 (reprinted 2002). 3. Highway Safety Manual (HSM).

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160359
Course Title	**Highway Construction Practices**
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	
Course Synopsis	Embankment construction, WBM & WMM, Dry lean concrete and cement treated base, Concrete road construction, Road construction in mountainous region

Course Outcomes:
At the end of the course students will be able to:

CO1	Develop construction procedures for subgrade, unbound, and bound granular layers.
CO2	Formulate strategies to produce optimal bituminous mixes.
CO3	Propose appropriate construction procedures for bituminous and concrete layers.
CO4	Choose appropriate pavement quality control test, and quantify construction variability

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1		**1**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**3**
CO2		**1**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**3**
CO3		**1**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**3**
CO4		**1**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**3**
Average		**1**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1.	Describe the formation cutting in Soil and hard rock (C2, Understand), Investigate the preparation of Sub-grade (C6, Create), Explain ground improvement, Retaining and Breast walls on hill roads (C2, Understand)
2.	Describe the Sub – base / base (C2, Understand), compare the Water Bound Macadam (WBM), Wet Mix Macadam (WMM), and Cement treated bases, Dry Lean Concrete (DLC) (C4, Analyze).

3.	Differentiate the different types of Bituminous Constructions (C4, Analyze), Interface Treatments, Examine the Bituminous Surfacing and wearing Courses for roads and bridge deck slabs (C4, Analyze), Selection of wearing Course under different Climatic and Traffic conditions as per IRC specifications (C5, Evaluate), Compare the different construction techniques and Quality Control (C4, Analyze)
4.	Test on Concrete mixes (C4, Analyze), Classify the construction equipment (C2, Understand), Compare the different methods of construction of joints in concrete pavements (C4, Analyze), Investigate the quality Control in Construction of Concrete pavements (C6, Create), Describe Overlay Construction (C2, Understand).

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	35
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	4
Case/Project Based Learning (CBL)	4
Revision	2
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz				
VIVA				
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓

Feedback Process	3. Student's Feedback
Students Feedback is taken through various steps 3. Regular feedback through Mentor Mentee system 4. Feedback between the semester through google forms	
References:	
	Text Books: 1. Principles & practice of Highway Engg.-Dr. L. R. Kadiyali& Dr. N. B. Lal - Khanna Publishers. 2. MOST, Specifications for Road and Bridge Work (4th Revision), Ministry of Road Transport and Highways, 2001. **Reference Books:** 1. C. A. O' Flaherty, Highways – The Location, Design, Construction, & Maintenance of Pavements, Butterwsorth Heinemann, 2002. 2. R. N. Hunter, Bituminous Mixtures in Road Construction, Thomas Telford Services Ltd., 1995.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160369
Course Title	**Pavement Evaluation, Rehabilitation & Maintenance**
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	
Course Synopsis	Pavement distresses, Pavement rehabilitation techniques, Overlay design, Pavement maintenance

Course Outcomes:
At the end of the course students will be able to:

CO1	Evaluate pavement based on surface conditions.
CO2	Assess structural strength of pavements.
CO3	Select appropriate pavement rehabilitation options.
CO4	Prioritize pavement maintenance strategies.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**1**	**3**	**3**	**3**	**2**	**2**	**3**	**3**
CO2	**2**	**1**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**3**
CO4	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**3**
Average	**2.75**	**2**	**2**	**2.25**	**2.5**	**2.25**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1.	Define various pavement distresses and its types (C1,Remember); Evaluate and understand techniques for functional and structural evaluation of pavements (network survey vehicle, FWD, Retro reflecto-meter) and bridge (mobile bridge inspection unit)(C2,Understand, C4,Analyzed, C5,Evaluate);
2.	Network and project survey and evaluation (C5,Evaluate, C6,Create), Understand and analyze various pavement rehabilitation techniques(C2,Understand, C4,Analyzed).
3.	Understand Overlay design procedures(C2,Understand);feasibility study of recycling flexible and rigid pavements(C4,Analyzed, C5,Evaluate);
4.	Maintenance of paved and unpaved roads(C3,Apply); Pavement

	management systems(C2,Understand);

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	35
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	4
Case/Project Based Learning (CBL)	4
Revision	2
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA		✓		✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	2. Student's Feedback			
Students Feedback is taken through various steps				

3. Regular feedback through Mentor Mentee system **4.** Feedback between the semester through google forms	
References:	
	Text/Reference Books 1. Flexible Pavement Rehabilitation and Maintenance, Prithvi S. Kandhal, Mary Stoup Gardiner, American Society for Testing & Materials publication. 2. Construction and Rehabilitation of Concrete Pavements Under Traffic, ShreenathRao, Deepak Raghunathan, TRB. 3. STP1348; Flexible Pavement Rehabilitation and Maintenance.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160363
Course Title	**Environment Impact Assessment**
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	
Course Synopsis	Understanding the importance of environmental effect of any infrastructure project and evaluating the socio-economic cost of that project, Understanding the various legal guideline to ensure proper evaluation and smooth execution of any project, Use of mathematical Models, Environmental Impact Assessment, Carbon trading

Course Outcomes:
At the end of the course students will be able to:

CO1	Recognizing the growing need of civil engineering professionals to be acquainted with the potential environmental risks of infrastructure projects
CO2	Their nature, methods of qualitative and quantitative assessments, environmental risk evaluation, risk management and remediation techniques and development of predictive model
CO3	The emerging aspects of environmental management including techniques of ecological foot printing and carbon trading will be illustrated
CO4	learn about the various legal guidelines for environment safety

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**
CO2	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**
CO3	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**
CO4	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**
Average	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1.	Understand Technical and procedural aspects of Environmental Impact assessment (C1, Remember, C2, Understand); Understand, Guidelines and

	legal aspects of environmental protection (C1, Remember, C2, Understand)
2.	General Framework for characterizing environmental dislocation and disruption due to pollution (C4, Analyze)
3.	Theory and application of mathematical models:- Mathematical modelling for water quality systems, Stream and Estuarine models for pollution control (C4, Analyze, C6, Create)
4.	Examine Socio economic aspects (C4, Analyze), Evaluate various Measures of effectiveness of pollution control activities (C5, Evaluate), understand effect of Inter-sector pollutant transfers (C2, Understand), determine total impact assessment (C5, Evaluate)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	35
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	4
Case/Project Based Learning (CBL)	4
Revision	2
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**
Quiz				
VIVA				
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	4. Student's Feedback			
Students Feedback is taken through various steps 5. Regular feedback through Mentor Mentee system 6. Feedback between the semester through google forms				

References:	
	Text Books: 1. L. W. Canter, Environmental Impact Assessment, 2nd Ed., McGraw-Hill, 1997. 2. P. Judith and G. Eduljee, Environmental Impact Assessment for Waste Treatment and Disposal Facilities, John Wiley & Sons, 1994. **Reference Books:** 1. G. Burke, B. R. Singh and L. Theodore, Handbook of Environmental Management and Technology, 2nd Ed., John Wiley & Sons, 2000. 2. K. Whitelaw and Butterworth, ISO 14001: Environmental System Handbook, 1997. 3. R. Welford, Corporate Environmental Management - Systems and Strategies, Universities Press, 1996.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Transportation Engineering)
Course Code	13160365
Course Title	**Bridge Engineering**
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	Bridge Aesthetics, Analyzing techniques, Pre-stress concrete, Steel bridge, Bridge in service

Course Outcomes:
At the end of the course students will be able to:

CO1	Understanding the importance of bridge aesthetics
CO2	Understanding the various components and there importance in bridge
CO3	Understanding the various kind of loading on bridge
CO4	Use of concrete and steel bridge and their maintenance

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**
CO2	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**
CO3	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**
CO4	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**
Average	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content	Competencies
1	Introduction, Planning, Aesthetics and Bridge, Road bridges, Loading and IRC codes	C1 C2 C3 C4
2	Slab Bridges and RCC T Beam Bridges, Different analysis techniques-finite element, finite strip, finite difference. Grillage analysis	C1 C2 C3
3	Pre-stressed Concrete I Girder Bridges, Box Girder Bridges and Segmental Box Girder Bridges, Substructures including Abutments	C1 C2 C3
4	Railway Bridges and IRS codes , Steel bridges:	C1

	Truss Bridges and Plate Girder Bridges	C2 C3

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	28
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	6
Case/Project Based Learning (CBL)	6
Revision	2
Others If any:	--
Total Number of Contact Hours	42

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4
Quiz				
VIVA		✓		✓
Assignment / Presentation	✓	✓	✓	✓
Unit test	✓	✓	✓	✓
Practical Log Book/ Record Book				
Mid Semester Examination 1	✓	✓	✓	✓
Mid Semester Examination 2	✓	✓	✓	✓
University Examination	✓	✓	✓	✓
Feedback Process	3. Student's Feedback			

Students Feedback is taken through various steps 5. Regular feedback through Mentor Mentee system **6.** Feedback between the semester through google forms	
References:	
	Text/Reference Books 1. Relevant IRC & IRS codes. 2. N. Krishna Raju, "Design of Bridge", Oxford &Ibh. (ISBN 8120417984). 3. Johnson Victor," Essentials Of Bridge Engineering", Oxford &Ibh, 2016. 4. Krishna Raju, "Prestressed Concrete", McGraw Hill Education; Sixth edition.

SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

NAAC A+

Master of Technology in Civil Engineering (Structural Engineering) 3rd Semester

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160305
Course Title	**Theory and Design of Plates & Shells**
Academic Year	II
Semester	III
Number of Credits	4
Course Prerequisite	Structure Mechanics
Course Synopsis	In this course, student will learn about Thin plates its equation and boundary condition, Plate bending and design of shells, curve shell etc. design and detailing of folded plate structure.

Course Outcomes:
At the end of the course students will be able to:

CO1	Analyze the plates using Navier's and Levy's method.
CO2	Analyze the circular, rectangular and square plates by finite difference method.
CO3	Design the curved shells and roofs.
CO4	Design the various folded plate structures

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO4	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**1**	**0**	**4**

Unit	Content
1	Define thin plate and shells (C1, Remember), describe Laterally loaded thin plates (C2, Understand), Formulate the differentiate equation and boundary conditions (C6, Create)
2	Explain Bending of plates (C2, Understand), Compare the Navier's solution and Levy's method (C4, Analyze), Describe Rectangular plates with various edge conditions and Symmetrical bending of circular plates (C2, Understand), Compare the Finite difference method for analysis of

	square and rectangular plates (C6, Create)
3	Classify the shells (C2, Understand), Interpret the structural action of shells (C3, Apply), Beam method of analysis (C4, Analyze)
4	Analysis and design of doubly curved shells and Elliptic parabolic (C4, Analyze), Compare Conoid and hyperbolic paraboloid roofs (C4, Analyze)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	28
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	25
Problem Based Learning (PBL)	--
Case/Project Based Learning (CBL)	--
Revision	07
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		
Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	2. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through google forms	
References:	
	Text Books 1. G. S. Ramaswamy, (1996), Design and Construction of Concrete Shell Roofs, First Edition, CBS Publishers and distributors. ISBN-13: 9780812390995. **Reference Books** 1. Timoshenko and Krieger, (2010), Theory of Plates and Shells, Second Edition, Tata McGraw Hill Education Pvt. Ltd., ISBN-13: 9780070701250. 2. K. Bhaskar, (2013), Plates: Theories and Applications, First Edition, Ane Books Pvt. Ltd., ISBN-13: 9789382127024.

SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

NAAC A+

Master of Technology in Civil Engineering (Structural Engineering)

Departmental Electives

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160325
Course Title	**Prefabricated Structures**
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	Concrete technology
Course Synopsis	In this course, student will learn about types of foundation, Prefabrication systems and structural schemes, Handling and erection stresses, Dimensioning and detailing of joints, Design of pre fabricated Modules.

Course Outcomes:
At the end of the course students will be able to:

CO1	Know the types of prefabrication systems.
CO2	Understand the behaviour of shell structures.
CO3	Design pre-fabricated Modules.
CO4	Do the detailing of pre-fabricated Modules.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO4	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1	Classify the foundation (C2, Understand), explain prefabricated structure, Economy of prefabrication and Modular co-ordination (C2, Understand), Demonstrate and interpret the Structural behavior of pre-cast structure and DisModuleing of structures (C3, Apply), Design consideration of prefabricated structures (C6, Create)
2	Explain handling and erection stresses (C2, Understand), Application of pre stressing of roof members - Floor systems (C3, Apply), Organize

	floor system, slab and wall panels (C4, Analyze), Investigate two way load bearing slabs and Wall panels (C6, Create)
3	Discuss Dimensioning and detailing of joints for different structural connections (C2, Understand), Differentiate Construction and expansion joints (C4, Analyze)
4	Discuss the erection of R.C. structures and equipment (C2, Understand), Organize the production, transportation, storing, shuttering and erection of structures (C4, Analyze), Investigate total prefabricated buildings (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	33
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	6
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	6
Case/Project Based Learning (CBL)	--
Revision	--
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4		
Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		

Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	2. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through google forms	
References:	
	Text Books: 1. Hass, A. M., Precast Concrete Design and Applications, Taylor & Francis Publishers, ISBN-13: 9780853341970. **Reference Books** 1. A. S. G. Bruggeling & G. F. Huyghe, (1991), Prefabrications with Concrete, CRC Press, ISBN-13: 9789061911838. Second Edition, Applied Science Publishers Ltd., ISBN-13: 9780415268462.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160327
Course Title	**Design of Industrial Structures**
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	Building and construction materials
Course Synopsis	The purpose of this course is to develop an in-depth knowledge in the area of design of industrial structure with the latest code of practice as per the Indian Standard. On completion of this course student gain good confidence in designing major industrial structures like bridge plate girders, industrial structures like gantry girders, water tanks, support structures, high rise chimneys and pre-engineered thin walled structures.

Course Outcomes:
At the end of the course students will be able to:

CO1	Know the requirements of various industries.
CO2	Get an idea about the materials used and planning.
CO3	Know the construction techniques.
CO4	Understand the functional requirements

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO4	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1	General - Specific requirements for industries like textile, sugar, cement, chemical, etc(C1, Remember); State site layout and external facilities(C1, Remember); Discuss Building Work, Standards for Structural materials including plastics – Polymers - Fiber glass - Pressed

	card boards, etc (C2,Understand); Understand concept of multi-storey buildings(C2,Understand); Define steel skeletal structures and Reinforced concrete frames(C1, Remember); Define Workshops, Ware houses - Single storey buildings(C1, Remember); Understand Sheds in steel and reinforced concrete and North-lights(C2,Understand); Single span spherical and other special constructions such as Cooling towers and chimneys, Bunkers and silos' prefabrication - Construction(C3, Apply);
2	Understand various construction techniques for Expansion joints, Machine foundations and Other foundations(C2, Understand); Analyze various waterproofing techniques like Roofs and roofing, Roof drainage(C4,Analyzed); learn about Floors and flooring joists, Curtain walling, Outer wall facing, Sound and shock proof mountings(C1,Remember); Use of modern hoisting and other construction equipments (C3,Apply).
3	Define Circulation, Communication and Transport(C1,Remember); understand Fixed points (central cores) Staircases and Grid floor sections(C2,Understand); Analyze Lifts refuse disposals and Utilization of waste materials(C5,Evaluate) ; learn use of Cranes, Continuous conveyors, Mobile cranes, Transporters, Doors and Sliding gates(C3,Apply).
4	Investigate Functional Requirements of Lighting like Natural lighting, Protection from the sun, sly lights and window cleaning installations Services(C6, Create); Use of Layout, wiring, fixtures, cable and pipe bridges(C3,Apply); Understand process of electrical installations and lighting substation(C2,Understand); Use of Effluent(C3, Apply). Explain Ventilation and fire protection functions (C2, Understand); Understand functions of Ventilation, Air-conditioning, Fire escapes and chutes, Fire alarms and Hydrants (C2,Understand).

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	28
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	06
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	--
Case/Project Based Learning (CBL)	11
Revision	--
Others If any:	--

Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4		
Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	4. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system 2. Feedback between the semester through Google forms	
References:	
	Text Books 1. El Reedy, (2010), Construction Management and Design of Industrial Concrete and Steel Structures, Taylor & Francis Group, ISBN-13: 9781439815991. REFERENCE BOOKS 1. Nelson G. L., (1988), Light Agricultural and Industrial Structures: Analysis and Design Kluwer Academic Publisher,

	ISBN-13: 9780442267773. 2. Dr. Raja Rizwan Hussain, (2011), Pre-Cast Concrete for Multi-Storey Structures, Create space Publisher, ISBN: 9781467918220.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160329
Course Title	**Maintenance & Rehabilitation of Structures**
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	Concrete Technology
Course Synopsis	In this course, student will learn Maintenance & Rehabilitation of Structures by learning different properties of concrete, repairing materials and different repairing techniques.

Course Outcomes:
At the end of the course students will be able to:

CO1	Understand the properties of fresh and hardened concrete.
CO2	Know the strategies of maintenance and repairing.
CO3	Get an idea of repairing techniques.
CO4	Understand the properties of repairing materials.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO4	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO5	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1	Discuss Serviceability and Durability of Structures (C2, Understand) - Examine Quality Assurance for concrete construction (C4, Analyze) - Define Fresh concrete properties (C1, Remember) – Explain Strength – Permeability - Cracking (C2, Understand) - Discuss the Effects due to climate – Temperature – chemicals - Wear and erosion - (C2, Understand), Design and construction errors (C6, Create) - Describe

	Corrosion mechanism (C2, Understand) - Examine the Effects of cover thickness and cracking (C4, Analyze)- Distinguish the Methods of corrosion protection (C4, Analyze) – Explain Inhibitors - Resistant steels – Coatings - Catholic protection (C2, Understand), Define Construction Scan (C1, Remember).
2	Define Chemical admixtures (C1, Remember), Describe the function of repairing materials: Patching materials, resurfacing, sealing, waterproofing, bonding materials (C2, Understand) Examine the Special types of repair materials (C4, Analyze), Explain the Selection and evaluation of repairing materials (C2, Understand) Define Expansive cement (C1, Remember)- Define Polymer concrete (C1, Remember) – Define Ferro cement (C1, Remember), Define Fiber reinforced concrete (C1, Remember) - Describe Fiber reinforced plastics (C2, Understand).
3	Define Diagnosis and Assessment of Distress (C1, Remember) - Explain Visual inspection (C2, Understand) – Describe Non destructive tests (C2, Understand), Classify semi destructive and destructive tests (C2, Understand) Discuss Rust eliminators and polymers coatings for rebars during repair (C2, Understand), Explain Shotcrete - Epoxy injection (C2, Understand) - Explain Mortar repair for cracks (C2, Understand) - Describe Shoring and underpinning (C2, Understand). Design Small crack and large crack repair (C6, Create)
4	Describe the Techniques for Repair and strengthening of structures (C2, Understand), Discuss structural concrete strengthening (C2, Understand), Examine Strengthening by SIMCON (C4, Analyze), Design Retrofit using FRP composites and base isolation techniques (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	33
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	--
Problem Based Learning (PBL)	6
Case/Project Based Learning (CBL)	6
Revision	--
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5	
Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓	✓	
Unit test	✓	✓	✓	✓	✓	
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓	✓	
Mid Semester Examination 2	✓	✓	✓	✓	✓	
University Examination	✓	✓	✓	✓	✓	

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1.Regular feedback through Mentor Mentee system 2.Feedback between the semester through google forms	
References:	
	Text Books 1. Shetty M. S., (2008), Concrete Technology, Seventh Edition, S. Chand & Company Ltd.*ISBN-13: 9788121900034.* **Reference books** 1. Ravindra K. Dhir, M. Roderick Jones & Li Zheng, (2005), Repair and Renovation of Concrete Structures, American Society of Civil Engineers, *ISBN-13: 9780727734051.* 2. A. R. Santha Kumar, (2006), Concrete Technology, First Edition, Oxford University Press, ISBN-13: 9780195671537.

Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160331
Course Title	**Design of Bridges**
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	Reinforced Concrete Structures
Course Synopsis	Design of reinforced concrete bridges is normally done on the basis of a structural analysis. The purpose of the analysis is to find a distribution of sectional forces which fulfils equilibrium and is suitable for design.

Course Outcomes:
At the end of the course students will be able to:

CO1	Understand the load distribution and IRC standards
CO2	Design the slab bridges
CO3	Design the Arch bridges
CO4	Design the bridge bearings, hinges and expansion joints.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO4	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
3	**0**	**0**	**3**

Unit	**Content**
1	Explain Load Distribution Theory as per I.R.C(C2, Understand); Define loading standards for Bridge slabs(C1, Remember); Understand Effective width method as per I.R.C(C2, Understand); Explain Pigeaud's and Courbon's method(C2, Understand); State Assumptions and analysis of a typical bridge floor as per Hendry-Jaeger method - Morice – Little version of Guyon and Massonet method(C1, Remember, C4, Analyzed)
2	Understand and analyze Slab Bridges, Straight and skew slab bridges, T beam bridges and Balanced cantilever bridges(C2,Understand, C4,Analyzed); Design of articulation and Continuous girder

	bridges(C6,Create);
3	Define Arch Bridges(C1,Remember); Understand and analyze Single span closed and open spandrel symmetrical type (structural arrangements and functions only)(C2,Understand, C4,Analyzed); Design of bow string girder bridges(C6,Create);
4	Define various types of bridges, including box culvert, single span rigid frame bridges, and pre stressed composite T beam bridges(C1, Remember); Identify the structural components of bridges, such as slab base, gusset base, and grillage foundation(C1, Remember);Demonstrate the ability to design slab base and gusset base for different bridge configurations(C3, Apply); Analyze the structural integrity of various bridge components, including slab base, gusset base, and grillage foundation(C4, Analyzed)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	26
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	10
Problem Based Learning (PBL)	5
Case/Project Based Learning (CBL)	--
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		

Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1.Regular feedback through Mentor Mentee system 2.Feedback between the semester through Google forms	
References:	
	Text Books 1. Johnson Victor, (2007), Essentials of Bridge Engineering, Sixth Edition, Oxford & IBH Publishing Co. Ltd., ISBN-13: 9788120417175. **Reference books** 1. Wilbur Jay Watson, (2910), General Specifications for Concrete Bridges, Nabu Press, ISBN-13: 9781177206587. 2. Portland Cement Association, (2010), Continuous Concrete Bridges, Cambridge Scholars Publishing, ISBN-13: 978115337241.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160333
Course Title	**Composite Structures**
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	NIL
Course Synopsis	Stress Strain relationship of composite materials, methods of analysis, finite element analysis of plates with Laminated plates.

Course Outcomes:
At the end of the course students will be able to:

CO1	Analyze composite structures
CO2	Do microscopic and macroscopic analysis
CO3	Analyze sandwich and laminated plates
CO4	Understand the failure criteria for composites.
CO5	Know the fabrication techniques

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO4	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO5	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
3	**0**	**0**	**3**

Unit	**Content**
1	Define composite materials and its applications (C1, Remember), State Hook's law (C1, Remember), Classify materials (C2, Understand), Differentiate elastic constant for anisotropic, orthotropic and isotropic materials. (C4, Analyze)

2	Describe the concept of mesh in FEM and displacement function (C2, Understand), Compare the matrix for plate elements (C4, Analyze), Design and analysis of plates using FEM (C6, Create), Drive Stress-Strain Matrix – Stiffness matrix of plate element (C6, Create)
3	Classify the mechanics of materials approach (C2, Understand), Compare Micro mechanics, Mechanics of materials approach, elasticity approach to determine material properties, Macro Mechanics (C4, Analyze), Interpret the Stress-strain relations with respect to natural axis, arbitrary axis (C3, Apply), Examine the material properties and Experimental characterization of lamina (C4, Analyze)
4	Discuss failure criteria for composites (C2, Understand), Differentiate the Governing differential equation for a general laminate, angle ply and cross ply laminates (C4, Analyze), Formulate and derive differential equation for laminated plates (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	28
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	8
Problem Based Learning (PBL)	--
Case/Project Based Learning (CBL)	5
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	

Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓	✓	
Unit test	✓	✓	✓	✓	✓	
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓	✓	
Mid Semester Examination 2	✓	✓	✓	✓	✓	
University Examination	✓	✓	✓	✓	✓	

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1.Regular feedback through Mentor Mentee system 2.Feedback between the semester through google forms	
References:	
	Text Books 1. Madhujit Mukhopadhyay, (2010), Mechanics of Composite Materials and Structures, First Edition, Orient Blackswan Pvt. Ltd., ISBN-13: 9788173714771. **Reference books** 1. Jones, R.M., (1998), Mechanics of Composite Materials, Second Edition, Taylor and Francis Publisher, Isbn-13: 9781560327127. 2. Atul K. Kaw, (2005), Mechanics of Composite Materials, Second Edition, CRC Press, ISBN-13: 9780849313431.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160335
Course Title	**Design of Tall Buildings**
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	Structural Analysis
Course Synopsis	Classification of buildings, Three dimensional analysis, Shear wall system, In-filled frame system, Plane frame system.

Course Outcomes:
At the end of the course students will be able to:

CO1	Know the types of tall buildings.
CO2	Analyze the plane frame systems by different methods.
CO3	Design the shear wall systems and in filled frame systems.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO2	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
CO3	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
Average	**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	**0**	**0**	**3**

Unit	Content
1	Describe the importance of tall buildings (C2, Understand) - Classify the buildings according to NBC (C2, Understand) – Explain the types of load wind load, Seismic load, Quasi static approach (C2, Understand).
2	Discuss the plane frame system (C2, Understand)- Describe the method of Calculation of wind load (C2, Understand) – Explain approximate method (C2, Understand) – Appraise the significance of cantilever and factor methods (C5, Evaluate) – Explain Kani's method (C2, Understand) – Discuss the substitute frame method for dead load and live loads (C2, Understand).
3	Explain Shear Wall System (C2, Understand), Describe Rosman's

	analysis, Design aspect, RC frame and shear wall interaction – Equivalent frame method (C2, Understand), Compare the different methods of analysis (C4, Analyze), Design of shear wall system (C6, Create)
4	Discuss In-filled Frame Systems: Importance – Methods of analysis (C2, Understand), Compare Equivalent truss and frame method, Force-displacement method (C4, Analyze), Design and analysis of in filled frame system (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	32
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	8
Problem Based Learning (PBL)	--
Case/Project Based Learning (CBL)	5
Revision	--
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**			
Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓			
Unit test	✓	✓	✓			

Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓			
Mid Semester Examination 2	✓	✓	✓			
University Examination	✓	✓	✓			

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1.Regular feedback through Mentor Mentee system 2.Feedback between the semester through google forms	
References:	
	Text Books 1. Bryan Stafford Smith and Alex Coull, (2011), Tall Building Structures: Analysis and Design, Wiley India, ISBN-13: 9788126529896. **Reference books** 1. Sarwar Alam Raz, (2002), Structural Design in Steel, Second Edition, New Age International, ISBN-13: 9788122432282.

SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

Master of Technology in Civil Engineering (Remote Sensing and GIS) 3rd Semester

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160370
Course Title	Digital Image Processing
Academic Year	II
Semester	III
Number of Credits	4
Course Prerequisite	Image Processing
Course Synopsis	Digital image processing includes Introduction Image processing system, Image Analysis and Understanding and Multi temporal Data merging – Change detection procedures & Hyper-spectral Image Analysis and Radar image analysis.

Course Outcomes:
At the end of the course students will be able to:

CO1	Students will be able to understand use of image processing in Civil Engineering
CO2	Students will understand about GIS and image processing techniques
CO3	study and analyze the image processing
CO4	analyze the appropriate methods to improve data merging and image analysis

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	-	3	3	3	3	1	-	3	3
CO2	1	-	3	3	3	3	1	-	3	3
CO3	1	-	3	3	3	3	1	-	3	3
CO4	1	-	3	3	3	3	1	-	3	3
Average	1	-	3	3	3	3	1	-	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	1	0	4

Unit	Content
1	Image processing system; Satellite data acquisition –Storage and retrieval – Data Formats – Compression – Satellite System (C1, Remember); Data products – Image display system – Current Remote Sensing Systems. Preprocessing of remotely sensed data; (C2, Understand); Radiometric and Geometric distortions and corrections-Geometric correction Radiometric correction – Noise removal. Spectral Rationing –Principal and Canonical Components– Vegetative Components. (C1, Remember, C4, Analyzed)

2	Image Rectification and Restoration. Image enhancement- Contrast Manipulation – Gray-Level (C2, Understand, C4, Analyzed); Thresh holding- Level Slicing Contrast Stretching. Convolution – Edge Enhancement – Spatial feature manipulation. Image transformations; Pattern recognition, Image classification, Image fusion and change detection. Pattern recognition – Shape analysis- Textural and contextual analysis. (C6,Create);
3	Multi temporal Data merging – Change detection procedures- Multi sensor image merging – Merging of image data with Ancillary data Incorporating GIS Data in automated land cover classification. (C2,Understand, C4,Analyzed), (C6,Create);
4	Atmospheric correction – Hyper-spectral image analysis techniques.(C1, Remember), (C4, Analyzed)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	30
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	21
Problem Based Learning (PBL)	5
Case/Project Based Learning (CBL)	--
Revision	4
Others If any:	--
Total Number of Contact Hours	60

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		

Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1.Regular feedback through Mentor Mentee system 2.Feedback between the semester through google forms	
References:	
	Text Books: 1. John R Jenson „Introducing Digital Image Processing" Prantice Hall. New Jersy 1986. 2. R. A. Schowengergt, „Techniques for Image Processing and Classification in Remote Sensing'; 1983 **Reference Books:** 1. Remote Sensing & Image Interpretation Thomas M. Lillesand, Ralph W.Kiefer, 2. Image Interpretation in Geology Drury S.A. 3. Robert A Schowengergt, „Remote Sensing – Models and Methods for Image Processing¬ Academic Press 1997 Hord R M, Academic Press, 1982.

SGT UNIVERSITY
Shree Guru Gobind Singh Tricentenary University

NAAC A+

Master of Technology in Civil Engineering (Remote Sensing and GIS)

Departmental Electives

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160371
Course Title	Web and Mobile GIS
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	GIS
Course Synopsis	Web GIS, its function, web mapping, mobile GIS

Course Outcomes:
At the end of the course students will be able to:

CO1	Publish geospatial data in web environment.
CO2	Analyze the geospatial layers in web environment
CO3	Prepare and publish geospatial data in mobile applications
CO4	Develop applications in web and mobile platforms

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	-	3	3	3	3	1	-	3	3
CO2	1	-	3	3	3	3	1	-	3	3
CO3	1	-	3	3	3	3	1	-	3	3
CO4	1	-	3	3	3	3	1	-	3	3
Average	1	-	3	3	3	3	1	-	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	0	0	3

Unit	Content
1	Definition, concept of Web GIS, History of Web GIS, components of web GIS, internet, web GIS v/s Internet GIS, Distributed GIS, users and stake holders of web GIS, advantages and limitations of web GIS, overview of Web GIS.(C2, Understand); (C1, Remember, C4, Analyzed)
2	Static and interactive web mapping, Web-map services, open GIS web map server, Geographic Mark-up Language - principles and characteristics, commercial web mapping programs. (C2, Understand); (C1, Remember, C4, Analyzed)
3	Hosting and Display of general information for the public, display of planning information, interactive display of spatial information, sharing and distribution of spatial data as well as management of spatial data,

	Style Layer Description (SLD), Open layers, Geo-server applications. (C2,Understand, C4,Analyzed), (C6, Create);
4	Location based services, Case studies on Mobile Solutions; Mobile App Development Approaches, HTML5 Geolocation; Creating a Mobile App, jQuery Mobile - Components, Event Handling, Mobile Configuration Third-party APIs; Google Maps API; ArcGIS API; Leaflet API, Mobile App development in Android, IOS platforms (C4, Analyzed)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	26
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	10
Problem Based Learning (PBL)	5
Case/Project Based Learning (CBL)	--
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		
Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		

Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1.Regular feedback through Mentor Mentee system 2.Feedback between the semester through Google forms	
References:	
	TEXTBOOKS: • A. Web Cartography: Development and Prospects, Kraak, M. and Brown, Taylor and Francis, London, 2001. • Web GIS Application in Local Government, Tereshenkov, A.,VDMVerlag,2009. • GIS for Web Developers. Adding where to your web applications, Davis, S, First Edition, The Pragmatic Programmers LLC,2007. **REFERENCE BOOKS:** • Web GIS: Principles and Applications, Pinde Fuand Jiulin Sun,ESRI Press,2011 • Mobile:UpandRunning,MaximilianoFirtman.,jQuery,O'Reilly,2012 Dynamic and Mobile GIS, Drummond, J., & Group, F., First Edition, CRC Press Taylor and Francis Group,2007.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160372
Course Title	Argo Remote Sensing
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	Remote Sensing
Course Synopsis	Satellite sensors, Agro-Meteorological Applications of Optical, Microwave, Thermal and Hyper spectral Remote Sensing, crop informatics, Crop condition and cropping system analysis using different sensors

Course Outcomes:
At the end of the course students will be able to:

CO1	Acquire state of art sensor data to retrieve crop parameters.
CO2	Analyze the basic vegetation parameter and their interaction with different parts of the Electromagnetic Spectrum
CO3	Assess the role of sensor data to study the crop conditions during various stages of agricultural practices.
CO4	Apply different sensors to predict and forecast the variables affecting the agricultural production.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	-	3	3	3	3	1	-	3	3
CO2	1	-	3	3	3	3	1	-	3	3
CO3	1	-	3	3	3	3	1	-	3	3
CO4	1	-	3	3	3	3	1	-	3	3
Average	1	-	3	3	3	3	1	-	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	0	0	3

Unit	Content
1	Satellite sensors and their characteristics, Principles, instrumentation and approaches of estimating crop water requirement/crop ET, Remote sensing of water stress (thermal/optical approaches), various crop parameters: albedo, leaf area index, fAPAR and evapotranspiration. (C2, Understand); (C1, Remember, C4, Analyzed)
2	Surface and vadose zone soil moisture estimation using microwave

	optical and hyper spectral remote sensing techniques; Soil mapping large-scale high spatial resolution mapping of soil texture information; Assessment, Prediction and Monitoring of Droughts through satellite retrieved causal variable information; Flood mapping and monitoring; Water resources mapping; Real-time weather monitoring (C2, Understand); (C1, Remember, C4, Analyzed)
3	Crop classification and crop area estimation using digital analysis; Crop stress assessment using satellite data; Crop parameter retrieval, cropping pattern & cropping indices analysis, Crop yield modeling and estimation. Crop water requirements, Irrigation water requirements (C2, Understand); (C1, Remember, C4, Analyzed)
4	ICT application in agriculture at village/block scale, Demonstration on DSS in agriculture; Precision farming (C2, Understand); (C1, Remember, C4, Analyzed)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	26
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	10
Problem Based Learning (PBL)	5
Case/Project Based Learning (CBL)	--
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		

Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	2. Student's Feedback
Students Feedback is taken through various steps 1.Regular feedback through Mentor Mentee system 2.Feedback between the semester through google forms	
References:	

TEXTBOOKS:

- Applicationsofremotesensinginagriculture.,M.D.Steven,J.A.Clark,Butterworthpublisher,London,1990
- Manual of Remote Sensing, Ustin, S, Remote Sensing for Natural Resource Management and Environmental Monitoring, 3rd Edition,Volume4,Willey Publishing.2001
- Agro meteorology and sustainable agriculture. M. V. K. Sivakumar, R. Gommes, W.BaierAgriculturalandForestMeteorology103(2000)11–26
- Application radar in Agriculture, Holmes M.G., Remote sensing applications to agriculture, Butter worth publisher, London, 1990.

REFERENCE BOOKS:

- Introduction to Agro meteorology (1994), Second edition by H.S. Mavi, Oxford & IBH Publishing Co. Pvt. Ltd.

Remote Sensing for Agriculture, Ecosystems, and Hydrology, Manfred Owe; Guido D'Urso (2005).Proceedings of SPIE Volume: 5976.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160373
Course Title	Remote Sensing Geology
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	Remote Sensing
Course Synopsis	Radiation, concept of remote sensing, platforms, spacecraft, sensors, data acquisition and processing, Hydrogeology, Subsurface exploration techniques

Course Outcomes:
At the end of the course students will be able to:

CO1	Interpret the satellite imageries for geological features.
CO2	Identify and analyze geological structures from satellite images.
CO3	Apply geophysical principles for subsurface exploration.
CO4	Identifygroundwaterpotentialzones,landslidehazardzonesandmineral resources

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	-	3	3	3	3	1	-	3	3
CO2	1	-	3	3	3	3	1	-	3	3
CO3	1	-	3	3	3	3	1	-	3	3
CO4	1	-	3	3	3	3	1	-	3	3
Average	1	-	3	3	3	3	1	-	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	0	0	3

Unit	Content
1	Sources of Energy, Active and Passive Radiation, Electromagnetic Radiation-Reflectance, Transmission, Absorption, Thermal Emissions, Interaction with Atmosphere, Atmospheric windows, Spectral reflectance of Earth's surface features, and Multi concept of Remote Sensing. (C2, Understand); (C1, Remember, C4, Analyzed)
2	Various types of platforms, different types of aircraft, manned and unmanned spacecrafts used for data acquisition - characteristics of differenttypesofplatforms-airborneandspaceborne,IRSSatelliteSensors,LANDSAT,SPOT,IKONOS, Quickbird, Geoeye, Kompsat, Worldview II & III, Microwave, ALOS, Planet Data, Sentinel, SMAP, MODIS etc. (C2, Understand); (C1, Remember, C4,

	Analyzed)
3	Optical, Thermal and Microwave; Resolutions-spatial, spectral, radiometric and temporal, signal to noise ratio, LiDAR data acquisition and processing. (C2, Understand); (C1, Remember, C4, Analyzed)
4	Subsurface exploration techniques, geophysical investigations — electrical resistivity and seismic methods. Hydrogeology - principles of groundwater and ground water geology Ground water flow, surface and ground water interaction; controls of ground water occurrence and movement Ground water geology: Hydro geological properties of different rocks, structures and land form sand their detection from remotely sensed data, Ground water targeting and resource assessment Ground water targeting in different geologic terrains, rain water harvesting, artificial ground water recharge. (C2, Understand); (C1, Remember, C4, Analyzed)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	26
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	10
Problem Based Learning (PBL)	5
Case/Project Based Learning (CBL)	--
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4		
Quiz						

VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	3. Student's Feedback
Students Feedback is taken through various steps 1.Regular feedback through Mentor Mentee system 2.Feedback between the semester through Google forms	
References:	

TEXTBOOKS:

1. Remote Sensing Geology, Ravi P. Gupta, Springer Verlag Publications,2017.
2. Remote sensing: Principles and Interpretation, Floyd F. Sabins.,W.H. Freeman and Company,2020.
3. TextBookofEngineeringGeology,N.ChennaKesavulu.,MacMillanLtd.,NewDelhi. 2018

REFERENCE BOOKS:

4. Principles of Geomorphology, Thornbury, W.D., New Age International Publishers, 2018.
5. Image Interpretation in Geology, Druary, S.A., Allen and Unwin Ltd, 2004.
6. Remote Sensing and Image Interpretation, Thomas Lilles and, Ralph W. Kiefer, Jonathan Chipman, Wiley Publishers,2015
7. Fundamentals of Remote Sensing, George Joseph, C Jeganathan,UniversityPress,2015

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160374
Course Title	Global Navigation Satellite System
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	GIS & Satellite Image Processing
Course Synopsis	Introduction, GPS system, reference system, coordinate system, GNSS Survey , Satellite Orbits and signal

Course Outcomes:
At the end of the course students will be able to:

CO1	Identify GNSS components and their functions
CO2	Select GNSS survey method
CO3	Interpret navigation message and GNSS satellite signals
CO4	Identify error sources and apply corrections in GNSS observations

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	-	3	3	3	3	1	-	3	3
CO2	1	-	3	3	3	3	1	-	3	3
CO3	1	-	3	3	3	3	1	-	3	3
CO4	1	-	3	3	3	3	1	-	3	3
Average	1	-	3	3	3	3	1	-	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	0	0	3

Unit	Content
1	History of GNSS; GPS system - Services and Segments, GLONASS system- Services and Segments, Galileo System- Services and Segments, Regional Navigation Satellite Systems (RNSS), Augmentation Systems, GAGAN, IRNSS systems.(C2, Understand); (C1, Remember, C4, Analyzed)
2	Definition and scope of Geodesy, Earth, Geoid and Ellipsoid of rotation, Reference surfaces and coordinate systems in Geodesy, Indian Geodetic System and Everest Spheroid, WGS 84, Geodetic coordinate systems, Datum transformations, Height systems, Time systems.(C2, Understand); (C1, Remember, C4, Analyzed)
3	Orbit - Description, Determination and Dissemination.

	Structure of Signal, Navigation messages. Pseudo range measurements, Atmospheric effects, Antenna phase center offset and variation, Multipath, system accuracy characteristics, Data formats, Error budget.(C2, Understand); (C1, Remember, C4, Analyzed)
4	Planning a GNSS Survey, Positioning methods – point positioning, relative positioning, Static, Differential, RTK, and Field data collection. Ambiguity resolution, Post processing, real time processing, Accuracy measures, software modules, GIS and GNSS data integration, Applications of GNSS(C2, Understand); (C1, Remember, C4, Analyzed)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	Contact Hours
Lecture	26
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	10
Problem Based Learning (PBL)	5
Case/Project Based Learning (CBL)	--
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4		
Quiz						
VIVA						
Assignment / Presentation	✓	✓	✓	✓		

Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	4. Student's Feedback
Students Feedback is taken through various steps 1.Regular feedback through Mentor Mentee system 2.Feedback between the semester through Google forms	
References:	
	Text Books 1. Rangawala , Building Construction (2010) ISBN No. 978-93-80358-15-4,Charotar Publications Pvt. Ltd. 28th Edition **Reference books** 1. P.C.Varghese, Engineering Materials, 1st edition, PHI Learning. 2. S.K.Duggal, Building Materials, 3rd Edition, New Age International Publishers. 3. Sushil Kumar, Building Construction, Standard Publishers Distributors. 4. M. S. Shetty, Concrete Technology: Theory and Practice, S. Chand Publishers. 5. A. R. Santhakumar, Concrete Technology, Oxford University Press

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160375
Course Title	Advanced Surveying and Cartography
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	Advanced Surveying
Course Synopsis	Topographic survey and its allied electronic equipment, geodesy and cartographic principles

Course Outcomes:
At the end of the course students will be able to:

CO1	Identify the principles of topographical map preparation
CO2	Select electronic surveying
CO3	Carry out astronomical observations for accurate surveying
CO4	Apply projection and datum parameters for a map ,Map the features with GPS

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	-	3	3	3	3	1	-	3	3
CO2	1	-	3	3	3	3	1	-	3	3
CO3	1	-	3	3	3	3	1	-	3	3
CO4	1	-	3	3	3	3	1	-	3	3
Average	1	-	3	3	3	3	1	-	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	0	0	3

Unit	Content
1	Introduction to topographical mapping, scale of topographical maps, Indian topographical series and their numbering system, topographical survey methods. Precise level and Precise levelling (C2, Understand); (C1, Remember, C4, Analyzed)
2	Basic principles, classifications, applications, comparison with conventional surveying. electromagnetic wave theory – electromagnetic distance measuring system – principle of working and EDM instruments, application of Lasers in distance measurement. (C2, Understand); (C1, Remember, C4, Analyzed)
3	Introduction to Geodesy, Earth and its size and shape, coordinate systems, earth and its motions-annual, spin, precession, nutation, polar

	motion. Earth and its gravity field – anomaly, gravity potential, geoid and deflection to vertical. Celestial sphere, meridians and vertical circles, astronomical coordinate systems, astronomical triangle, determination of azimuth (C2, Understand); (C1, Remember, C4, Analyzed)
4	Definition, scope and content the spheroid, map scale, co-ordinate system, methods of mapping, relief maps, thematic maps, map projections, classification, principles of construction of common projections, cylindrical, conical, azimutal, and globular projections, properties and uses an choice of projections, plane co-ordinates, UTM system, projection used in Survey of India topographical sheets, map reproduction. (C2, Understand); (C1, Remember, C4, Analyzed)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	26
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	10
Problem Based Learning (PBL)	5
Case/Project Based Learning (CBL)	--
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		
Quiz						
VIVA						

Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1.Regular feedback through Mentor Mentee system 2.Feedback between the semester through google forms	
References:	
	Text Books 1. Gopi, "Advanced surveying: Total station, GIS and Remote Sensing", Pearson Education India, 2007. 2.Borden D. Dent, Jeffrey Troguson, Thomas W. Hodler, "Cartography: Thematic map Design", McGraw-Hill Higher Education, 2008.**Reference books** 3. Hoffman. B, H. Lichtenegga and J. Collins, "Global Positioning System – Theory and Practice", Springer – Verlag Publishers, 2001. 4. Wolfgang Torge, "Geodesy", Berlin: de Gruyter, 2001.

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Remote Sensing and GIS)
Course Code	13160376
Course Title	Pattern Recognition and Machine Learning
Academic Year	II
Semester	III
Number of Credits	3
Course Prerequisite	Advanced Surveying
Course Synopsis	This course aims to provide students with a comprehensive understanding of pattern recognition and machine learning techniques applied to Remote Sensing & GIS data. The course will cover fundamental concepts, algorithms, and practical applications in the context of civil engineering and environmental monitoring.

Course Outcomes:
At the end of the course students will be able to:

CO1	Understand problem framing, feature selection, and dimensionality reduction using methods like PCA.
CO2	Explore discriminative classifiers such as LDA, Multi-layer perceptron, back propagation, and SVM.
CO3	Study unsupervised learning techniques like clustering, Vector Quantization, Kohonen Map, and EM Algorithm.
CO4	Learn about generative models, probabilistic graphical models, and density estimation.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	-	3	3	3	3	1	-	3	3
CO2	1	-	3	3	3	3	1	-	3	3
CO3	1	-	3	3	3	3	1	-	3	3
CO4	1	-	3	3	3	3	1	-	3	3
Average	1	-	3	3	3	3	1	-	3	3

Course Content:

L (Hours/Week)	T (Hours/Week)	P (Hours/Week)	Total Hour/Week
3	0	0	3

Unit	Content
1	Definition and Scope of Pattern Recognition and Machine Learning Historical Overview and Evolution Applications in Civil Engineering with emphasis on Remote Sensing & GIS (C2, Understand); (C1, Remember, C4, Analyzed)

2	Types of Machine Learning: Supervised, Unsupervised, and Semi-supervised Feature Selection and Extraction in Geospatial Data Model Evaluation Metrics for Remote Sensing Applications. (C2, Understand); (C1, Remember, C4, Analyzed)
3	Linear Regression and its Applications, Decision Trees, Random Forests, and their use in Land Cover Classification, Support Vector Machines for Spatial Data Analysis, Introduction to Neural Networks in Remote Sensing (C2, Understand); (C1, Remember, C4, Analyzed)
4	Clustering Techniques (K-means, Hierarchical) for Unsupervised Learning, Principal Component Analysis (PCA) in Geospatial Analysis Spatial-Temporal Analysis using Machine Learning, Case Studies and Real-world Projects (C2, Understand); (C1, Remember, C4, Analyzed)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	26
Practical	--
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	10
Problem Based Learning (PBL)	5
Case/Project Based Learning (CBL)	--
Revision	4
Others If any:	--
Total Number of Contact Hours	45

Assessment Methods:

Formative	**Summative**
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	**CO1**	**CO2**	**CO3**	**CO4**		
Quiz						

VIVA						
Assignment / Presentation	✓	✓	✓	✓		
Unit test	✓	✓	✓	✓		
Practical Log Book/ Record Book						
Mid Semester Examination 1	✓	✓	✓	✓		
Mid Semester Examination 2	✓	✓	✓	✓		
University Examination	✓	✓	✓	✓		

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1.Regular feedback through Mentor Mentee system 2.Feedback between the semester through Google forms	
References:	
	Text Books S. Marsland, "Machine Learning: An Algorithmic Perspective," Chapman & Hall/CRC, 2009. R. O. Duda, P. E. Hart, and D. G. Stork, "Pattern Classification," 2nd Edn., Wiley India, 2007.. **Reference books** C. Bishop, "Pattern Recognition and Machine Learning," Springer, 2006. I. H. Witten, "Data Mining: Practical Machine Learning Tools And Techniques," 2nd Edn., Elsevier India, 2008.

SEMESTER - IV

Course Code	Course Title
13160432	Dissertation Phase-II

Faculty of Engineering & Technology	
Name of the Department	Civil Engineering
Name of the Program	Master of Technology in Civil Engineering (Structural Engineering)
Course Code	13160432
Course Title	**Dissertation Phase-II**
Academic Year	II
Semester	IV
Number of Credits	1
Course Prerequisite	NIL
Course Synopsis	In this course, student will complete the thesis work.

Course Outcomes:
At the end of the course students will be able to:

CO1	Identify civil engineering problems by reviewing available literature.
CO2	Identify appropriate techniques to analyze complex problems related to civil engineering
CO3	Investigate and development of solution

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
Average	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

Course Content:

L (Hours/Week)	**T (Hours/Week)**	**P (Hours/Week)**	**Total Hour/Week**
0	**0**	**2**	**1**

Experiment No.	**Content**
1.	Identify the problem (C2, Understand), Implement the suitable solution (C3, Apply), Experiments and tests (C4, Analyze), Investigate and develop the solution (C6, Create)

Teaching - Learning Strategies and Contact Hours

Teaching - Learning Strategies	**Contact Hours**
Lecture	--
Practical	-
Seminar/Journal Club	--
Small group discussion (SGD)	--
Self-directed learning (SDL) / Tutorial	-
Problem Based Learning (PBL)	-

Case/Project Based Learning (CBL)	-
Revision	--
Others If any:	--
Total Number of Contact Hours	-

Assessment Methods:

Formative	Summative
Multiple Choice Questions (MCQ)	Mid Semester Examination 1
Viva-voce	Mid Semester Examination 2
Objective Structured Practical Examination	University Examination
Quiz	Dissertation
Seminars	Multiple Choice Questions (MCQ)
Problem Based Learning (PBL)	Short Answer Questions (SAQ)
Journal Club	Long Answer Question (LAQ)
	Practical Examination & Viva-voce
	Objective Structured Practical Examination

Mapping of Assessment with COs

Nature of Assessment	CO1	CO2	CO3	CO4	CO5	
Quiz						
VIVA	✓	✓	✓	✓	✓	
Assignment / Presentation						
Unit test						
Practical Log Book/ Record Book	✓	✓	✓	✓	✓	
Demonstration	✓	✓	✓	✓	✓	
Mid Semester Examination 1						
Mid Semester Examination 2						
University Examination (External Practical)	✓	✓	✓	✓	✓	

Feedback Process	1. Student's Feedback
Students Feedback is taken through various steps 1. Regular feedback through Mentor Mentee system **2.** Feedback between the semester through Google forms	

9. MAPPING OF COURSE OUTCOMES, PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Sem.	Course Code	Course Title	C	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
I	13160138	Research Methodology & IPR	**3**	**3**	**3**	-	-	-	-	**3**	**3**	-	-
I	13160107	Seminar	**1**										
I	13160132	Pavement Materials	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**3**
I	13160133	Urban Transportation System Planning		**3**		**2**	**2.6**	**2.4**		**2**	**2**	**3**	**3**
I	13160134	Geometric Design of Transportation		**1.5**	**3**	**2.75**	**2.75**	**2.5**	**2**	**2**	**2**	**3**	**3**

		Facilities											
I	13160135	Ground Improvement		**2**	**3**	**3**	**3**	**2.5**	**2**	**2**	**2**	**3**	**3**
II	13160136	Pavement Materials Lab		**2.75**	**1.75**	**2**	**2.5**	**2.5**	**1.75**	**2**	**2**	**3**	**3**
I	13160137	Geometric Design Lab		**2.75**	**1.75**	**2**	**2.5**	**2.5**	**1.75**	**2**	**2**	**3**	**3**
I	13160114	Advance Pre-Stressed Concrete Design		-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
I	13160115	Structural Dynamics		-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
I	13160116	Matrix Methods of Structural		-	-	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

		Analysis											
I	131601 17	Design of Concrete Structural Systems		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
I	131601 18	Matrix Methods of Structural Analysis Lab (STAAD PRO)		**-**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
I	131601 19	Design of Concrete and Structural Systems Lab (STAAD PRO)		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
I	131601	Principl		**3**	**1.**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**

	43	es of Remote Sensing			**75**								
I	131601 08	Geograp hical Informat ion Systems		**1**	**1. 25**	**1**	**1**	**2**	**-**	**-**		**1**	**1**
I	131601 39	Photogr ammetr y		**3. 0**	**1. 8**	**2. 3**	**3**	**2**	**1**	**-**	**1. 3**	**2.5**	**2.0**
I	131601 40	Applicat ion of Remote Sensing		**2**	**3**	**2. 5**	**0. 8**	**1. 5**	**2. 5**	**-**	**2**	**3.0**	**1.5**
I	131601 41	Geograp hical Informat ion Systems Lab		**3. 0**	**1. 8**	**2. 3**	**0. 8**	**1. 0**	**0. 5**	**-**	**1. 3**	**2.5**	**0.5**
I	131601 42	Photogr ammetr y Lab		**3. 0**	**1. 8**	**2. 3**	**0. 8**	**1. 0**	**0. 5**	**-**	**1. 3**	**2.5**	**0.5**
II	131602 38	Minor Project		**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**3**

II	13160232	Analysis and Design of Pavement		**2**	**1**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**
II	13160233	Transport Economics		**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
II	13160234	Traffic Engineering and Management		**3**	**1**	**3**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
II	13160235	Airport Infrastructure, Planning and Design		**2.5**	**2.75**	**2.5**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
II	13160236	Pavement Design Lab		**2.75**	**1.75**	**2**	**2.5**	**2.5**	**1.75**	**2**	**2**	**3**	**3**
II	13160237	Traffic Lab		**2.75**	**2**	**2.25**	**2.5**	**2.5**	**2**	**2**	**2**	**3**	**3**

II	13160232	Analysis and Design of Pavement		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
II	13160233	Transport Economics		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
II	13160234	Traffic Engineering and Management		**3**	**1**	**3**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
II	13160235	Airport Infrastructure, Planning and Design		**2.5**	**2.75**	**2.5**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
II	13160236	Pavement Design Lab		**2.75**	**1.75**	**2**	**2.5**	**2.5**	**1.75**	**2**	**2**	**3**	**3**
II	13160237	Traffic Lab		**2.75**	**2**	**2.25**	**2.5**	**2.5**	**2**	**2**	**2**	**3**	**3**

II	13160214	Finite Element Analysis		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
II	13160215	Theory of Elasticity and Plasticity		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
II	13160216	Limit State Design of Steel Structures		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
II	13160217	Earthquake Resistant Design		**1**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
II	13160218	Structural Engineering lab (CASTING)		**1**	**1**	**3**	**3**	**3**	**3**	**1**	**1**	**3**	**3**
II	13160239	Finite Element Analysis		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

		Lab											
II	131602 40	Geospatial Data Processing and Modelling		**3**	**1.75**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**1**
II	131602 41	Satellite Image Processing		**1.75**	**-**	**0.25**	**-**	**0.75**	**0.75**	**-**	**-**	**-**	**2**
II	131602 42	Advanced GIS		**2**	**0.75**	**1**	**0.75**	**3**	**-**	**-**	**-**	**3.0**	**2.0**
II	131602 43	GPS & Surveying		**2**	**1**	**1**	**0.75**	**3**	**-**	**-**	**2**	**3**	**1**
II	131602 44	Advanced GIS Lab		**2**	**1**	**1**	**1**	**3**	**-**	**-**	**2**	**3**	**1**
II	131602 45	Satellite Image Processing Lab		**-**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**2.5**	**2.5**
III	131603 67	Dissertation Phase-I		**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

III	13160357	Intelligent Transportation Systems		**2.8**	**2.4**	**2**	**2**	**1.4**	**1.2**	**2**	**2**	**3**	**3**
III	13160355	Construction Project Management & BOT		**2.5**	**2.75**	**2.5**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
III	13160368	Traffic Management and Road safety		**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**
III	13160359	Highway Construction Practices		**1**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**3**	
III	13160369	Pavement Evaluation, Rehabili		**2.75**	**2**	**2**	**2.25**	**2.5**	**2.25**	**2**	**2**	**3**	**3**

		tation & Maintenance											
III	13160363	Environment Impact Assessment		**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**
III	13160365	Bridge Engineering		**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**3**
III	13160305	Theory & Design of Plate and Shell		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
III	13160325	Pre-Fabricated Structures		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
III	13160327	Design of Industrial Structur		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

		es											
III	13160329	Maintenance & Rehabilitation of Structures		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
III	13160331	Design of Bridges		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
III	13160333	Composite Structures		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
III	13160335	Design of Tall Buildings		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
III	13160370	Digital Image Processing		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
III	13160371	Web and Mobile GIS		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**

III	13160372	Argo Remote Sensing		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
III	13160373	Remote Sensing Geology		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
III	13160374	Global Navigation Satellite System		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
III	13160375	Advanced Surveying and Cartography		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
III	13160376	Pattern Recognition and Machine Learning		**1**	**-**	**3**	**3**	**3**	**3**	**1**	**-**	**3**	**3**
IV	13160432	Dissertation Phase-II		**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

Note: C-Credits