MOHAN BABU UNIVERSITY

Sree Sainath Nagar, Tirupati – 517 102

SCHOOL OF ENGINEERING

M.Tech - CONSTRUCTION TECHNOLOGY AND MANAGEMENT

CURRICULUM AND SYLLABUS

(From 2025-26 Admitted Batches)

FULLY FLEXIBLE CHOICE BASED CREDIT SYSTEM (FFCBCS)

MOHAN BABU UNIVERSITY

Vision

To be a globally respected institution with an innovative and entrepreneurial culture that offers transformative education to advance sustainability and societal good.

Mission

❖ Develop industry-focused professionals with a global perspective.

❖ Offer academic programs that provide transformative learning experience founded on the spirit of curiosity, innovation, and integrity.

❖ Create confluence of research, innovation, and ideation to bring about sustainable and socially relevant enterprises.

❖ Uphold high standards of professional ethics leading to harmonious relationship with environment and society.

SCHOOL OF ENGINEERING
Vision

To be the sought-after destination for engineering education recognised for excellence, innovation and the societal relevance and impact of its pursuits.

Mission

❖ Instil within our students fundamental engineering knowledge, a broad set of skills, and an inquisitive attitude to create innovative solutions to serve industry and community.

❖ Provide an experience par excellence with our state-of-the-art research, innovation, and incubation ecosystem to realise our learners' fullest potential.

❖ Impart continued education and research support to working professionals in engineering fields to enhance their domain expertise in the cutting-edge technologies.

❖ Inculcate among the engineers of tomorrow with a spirit to solve societal challenges.

DEPARTMENT OF CIVIL ENGINEERING

Vision

To become a leading centre of excellence in the country in Civil Engineering education through teaching, research, innovation, incubation, consultancy and public service for technical development in a knowledge society.

Mission

- ❖ Inspire the civil engineers of tomorrow to take on the challenges of creating and sustaining the built environment that support our society.

- ❖ Nurture these civil engineers with fundamental engineering knowledge, a broad set of skills, and an inquisitive attitude for creating innovative solutions to serve industry and community through contemporary curriculum, congenial learning environment, pertinent research, innovation and incubation ecosystem, industry-institute interaction, mentoring, training and placement activities, student clubs, co-curricular and extra-curricular activities.

- ❖ Encourage faculty and staff to excel in their respective fields and demonstrate the best of their abilities by way of continuing education, research and consultancy.

M.Tech. Construction Technology and Management

PROGRAM EDUCATIONAL OBJECTIVES

After few years of graduation, the graduates of M.Tech. (CTM) will:

PEO 1. Pursue higher education in construction technology and management or other fields of engineering or management or other areas of interest

PEO 2. Address the contemporary issues in construction technology and management or related field and provide appropriate solutions through professional career in industry/teaching/research.

PEO 3. Engage in 'technology innovation and deployment' and engineering system implementation, as an entrepreneur.

PEO 4. Exhibit leadership qualities, participate in continuing education programs for lifelong learning and contribute individually and as a member in multidisciplinary teams to meet social and ethical constraints.

PROGRAM OUTCOMES

On successful completion of the Program, the graduates of M.Tech. (CTM) program will be able to:

PO1. **Competency-Knowledge, Analysis, Design, Problem Solving, Usage of Modern Tools:** Demonstrate a degree of mastery over the construction technology and management in order to construct, inspect, valuate, manage, maintain, retrofit and rehabilitate civil engineering systems and processes by applying suitable materials, tools and techniques at a level higher than the requirements in the appropriate bachelor program in the field of civil engineering.

PO2. **Research Skill:** Independently carry out research/investigation and development work to solve practical problems in the field of construction technology and management.

PO3. **Communication**: Write and present a substantial technical report/document in the field of construction technology and management.

PO4. **Collaborative and Multidisciplinary Work:** Demonstrate a capacity for self-management and teamwork to contribute positively to collaborative-multidisciplinary scientific research in the field of construction technology and management in order to achieve common goals and further the learning of themselves as well as others.

PO5. **Ethical Practices and Social Responsibility**: Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices in the field of construction technology and management and an understanding of responsibility to contribute to the community for sustainable development of society.

PO6. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously in the field of construction technology and management.

Basket Wise - Credit Allotment

Sl. No.	Baskets	Credit Contribution
1	SCHOOL CORE	31-34
2	PROGRAM CORE	21-24
3	PROGRAM ELECTIVE	12-18
4	UNIVERSITY ELECTIVE	6
TOTAL CREDITS		**Min. 70**

School Core (31-34 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	**T**	**P**	**S**	**C**	
25EE201001	Research Methodology	3	-	-	-	3	-
25EE201002	Innovation and Intellectual Property Rights	2	-	-	-	2	-
25CE211001	Internship	-	-	-	-	2	-
25CE209001	Project Work Phase -I	-	-	-	-	10	-
25CE210001	Project Work Phase -II	-	-	-	-	14	-
Mandatory Courses (Min. 4 Credits) Earned Credits will not be considered for CGPA							
25CB207601	Essentials of Cyber Security *	2	-	-	-	2	-
25AI207601	Statistics with R	2	-	-	-	2	-
25MG207601	Project Management	2	-	-	-	2	-
25MG207602	Essentials of Business Etiquette	2	-	-	-	2	-
25LG207601	Technical Report Writing	2	-	-	-	2	-

* Compulsory Course

Program Core (21-24 Credits)

S.No.	Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	**T**	**P**	**S**	**C**	
1.	25CE201001	Construction Planning, Scheduling and Control	3	-	-	-	3	-
2.	25CE201002	Project Formulation and Appraisal	2	-	-	-	2	Applied Statistics and Queuing Theory
3.	25CE201003	Construction and Contract Laws and Regulations	3	-	-	-	3	-
4.	25CE204001	Estimation and Quantity Surveying	3	-	2	2	5	-
5.	25CE203001	Construction Practices, Equipment, and Automation	3	-	-	4	4	-
6.	25CE201004	Modern Construction Materials	3	-	-	-	3	-
7.	25CE201005	Construction Resource Management	2	-	-	-	2	-
8.	25CE201006	Rehabilitation and Retrofitting of Structures	3	-	-	-	3	-
9.	25CE205001	Building Information Modeling (BIM)	-	-	2	-	1	-
10.	25CE205002	Advanced Concrete Technology Lab	-	-	3	-	1.5	-
11.	25CE205003	Computer Applications in Construction Project Management	-	-	3	-	1.5	-

Program Elective (12-18 Credits)

S.No.	Course Code	Title of the Course	Lecture L	Tutorial T	Practical P	Project based Learning S	Credits C	Pre-requisite
1.	25CE201007	Smart Materials and Structures	3	-	-	-	3	Modern Construction Materials
2.	25CE203002	Infrastructure Development and Management	2	-	-	4	3	-
3.	25CE201008	Real Estate and Facilities Management	3	-	-	-	3	Construction and Contract Laws and Regulations
4.	25CE201009	Environmental Management System	3	-	-	-	3	-
5.	25CE201010	Construction Economics and Finance	3	-	-	-	3	-
6.	25CE203003	Urban Planning and Design	3	-	-	4	4	-
7.	25CE202001	Supply Chain Management	3	-	2	-	4	-
8.	25CE201011	Quality Control and Safety	3	-	-	-	3	-
9.	25CE203004	Lean Construction Practices	2	-	-	4	3	Construction Practices, Equipment and Automation
10.	25CE202002	Energy Efficiency and Conservation in Buildings	2	-	2	-	3	-
11.	25CE201012	Offshore Construction	3	-	-	-	3	-
12.	25CE203005	Formwork, Shoring and Scaffolding	2	-	-	4	3	-
13.	25CE203006	GIS in Construction Engineering and Management	2	-	-	4	3	Construction Practices, Equipment and Automation
14.	25CE201013	Highway Construction Management	3	-	-	-	3	-
15.	25CE201014	Operations Research	3	-	-	-	3	-
16.	25CE201015	Building Services	3	-	-	-	3	-
17.	25CE202003	Structural Health Monitoring	3	-	2	-	4	-
18.	25CE201016	Sustainable Materials and Green Buildings	3	-	-	-	3	Modern Construction Materials
19.	25CE203007	Occupational Health and Safety in Construction	2	-	-	4	3	-
20.	25CE204002	AI and IoT in Construction	2	-	2	4	4	-

S.No.	Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	T	P	S	C	
21.	25CE204003	Data Science for Civil Engineers	2	-	2	4	4	-
22.	25CE201017	Strategic Management in Construction	3	-	-	-	3	-
23.	25CE201018	Acoustics and Noise Control in Buildings	3	-	-	-	3	-

University Elective (6 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits
		L	T	P	S	C
25AI201701	Business Analytics	3	-	-	-	3
25AI201702	Ethics for AI	3	-	-	-	3
25CM201701	Cost Management of Engineering Projects	3	-	-	-	3
25CE201701	Disaster Management	3	-	-	-	3
25SS201701	Value Education	3	-	-	-	3
25SS201702	Pedagogy Studies	3	-	-	-	3
25LG201701	Personality Development through Essential Life Skills	3	-	-	-	3
25ME201701	Entrepreneurship and Innovation Management	3	-	-	-	3

Note:

1. If any student has chosen a course or equivalent course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s under University Elective.

2. The student can choose courses from other disciplines offered across the schools of MBU satisfying the pre-requisite other than the above list.

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25EE201001	**RESEARCH METHODOLOGY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The course is developed for the students' to understand the underlying concepts of research methodology and a systematic approach for carrying out research in the domain of interest. The course is emphasised on developing skills to recognise and reflect the strength and limitation of different types of research; formulation of the research hypothesis and its systematic testing methods. The course also emphasises on interpreting the findings and research articulating skills along with the ethics of research.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the underlying concepts of research methodology, types of research and the systematic research process.

CO2. Demonstrate the philosophy of research design, types of research design and develop skills for a good research design.

CO3. Demonstrate the philosophy of formulation of research problem, methods of data collection, review of literature and formulation of working hypothesis.

CO4. Analyse the data and parametric tests for testing the hypothesis.

CO5. Interpret the findings and research articulating skills along with the ethics of research.

CO-PO- Mapping Table:

Learning Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	-	3	-	-
CO2	-	-	-	3	-	-
CO3	-	-	-	3	-	-
CO4	-	-	-	3	-	-
CO5	-	-	-	3	3	-
Course Correlation Mapping	-	-	**-**	**3**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

MODULE 1: INTRODUCTION TO RESEARCH METHODOLOGY (08 Periods)

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, and Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research.

MODULE 2: RESEARCH DESIGN (08 Periods)

Research design—Basic Principles, Need of research design, Features of good design, Important concepts relating to research design, Different research designs, Basic principles of experimental designs, Developing a research plan.

MODULE 3: RESEARCH FORMULATION (08 Periods)

Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Data collection – Primary and secondary sources; Critical literature review – Identifying gap areas from literature review; Hypothesis— Types of hypothesis, Development of working hypothesis.

MODULE 4: ANALYSIS OF DATA AND HYPOTHESIS TESTING (14 Periods)

Quantitative Tools: Testing and Significance of Measures of Central Tendency, Dispersion; correlation, Principles of least squares—Regression; Errors-Mean Square error, Mean absolute error, Mena absolute percentage errors. Testing of Hypothesis: Hypothesis Testing Procedure, Types of errors, Parametric testing (t, z and F), Chi-Square Test as a Test of Goodness of Fit; Normal Distribution- Properties of Normal Distribution; Analysis of Variance.

MODULE 5: INTERPRETATION AND REPORT WRITING (07 Periods)

Interpretation: Meaning of interpretation; Techniques of interpretation; Precautions in Interpretation.
Report Writing –Significance, Different Steps, Layout, Types of reports, Mechanics of Writing a Research Report, Precautions in Writing Reports; Research ethics—Plagiarism, Citation and acknowledgement.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Should conduct a survey based on a hypothesis, analyze the data collected and draw the inferences from the data.
2. Should review the literature on the given topic and should identify the scope/gaps in the literature and develop a research hypothesis.
3. Should study a case, formulate the hypothesis and identify an appropriate testing technique for the hypothesis.
4. Study an article and submit a report on the inferences and should interpret the findings of the article.

RESOURCES

TEXT BOOKS:

1. C.R. Kothari, Research Methodology: Methods and Techniques, New Age International Publishers, 2nd revised edition, New Delhi, 2004.

2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.

REFERENCE BOOKS:

1. R. Panneerselvam, Research Methodology, PHI learning Pvt. Ltd., 2009.

2. Singh, Yogesh Kumar. Fundamental of research methodology and statistics. New Age International, 2006.

VIDEO LECTURES:

1. NPTEL

2. Research Methodology - Course (nptel.ac.in)

3. Intro to Hypothesis Testing in Statistics - Hypothesis Testing Statistics Problems & Examples - YouTube

WEB RESOURCES:

1. Research Methods | Definitions, Types, Examples (scribbr.com)
2. Types of Research Design: Process and Elements (leverageedu.com)
3. How to formulate a research problem: effective ways (prothesiswriter.com)
4. Hypothesis Testing: Definition, Uses, Limitations + Examples (formpl.us)
5. What Is Data Interpretation? Meaning, Methods & Examples (datapine.com)
6. Report Writing: Format, Tips, Topics & Examples I Leverage Edu

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25EE201002	**INNOVATION AND INTELLECTUAL PROPERTY RIGHTS**	2	-	-	-	2

Pre-Requisite   -

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION

The course is designed to provide comprehensive knowledge to the students regarding the general principles of innovation and intellectual property rights, significance of innovation and steps for innovation, Concept and Theories, Criticisms of Intellectual Property Rights, International Regime Relating to IPR. The course provides an awareness on how to protect ones unique creation, claim ownership, knowledge of what falls under the purview of someone's rights and what doesn't, and safeguard their creations and gain a competitive edge over the peers.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the significance of innovation and steps for innovative thinking, and the concepts of intellectual property right and avenues for filling intellectual property rights.

CO2. Understand the legislative practices and protocols for acquisition of trademark and the judicial consequences for violating laws of trademark protection.

CO3. Understand the legislative practices and protocols for acquisition of copyrights and the judicial consequences for violating laws of copyrights protection.

CO4. Understand the fundamentals of patent laws, legislative practices and protocols for acquisition of trade secrets and the judicial consequences for violating laws of trade secrets protection.

CO5. Understand the latest developments and amendments in protection and filling of intellectual rights at international level.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	-	-	-	-	3
CO2	-	-	-	-	-	3
CO3	-	-	-	-	-	3
CO4	-	-	-	-	-	3
CO5	-	-	-	-	-	3
Course Correlation Mapping	**-**	**-**	**-**	**-**	**-**	**3**

Correlation Levels: 3: High;   2: Medium;   1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO INNOVATION AND IPR   **(06 Periods)**

Innovation: Difference between Creativity and Innovation – Examples of innovation; Being innovative; Identify Blocks for creativity and innovation – overcoming obstacles; Steps for Innovation

Intellectual property rights: Need for intellectual property rights (IPR); types of intellectual property- Design, Geographical Indication; International organizations, agencies and treaties.

Module 2: TRADEMARKS   **(06 Periods)**

Introduction to trademark, Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

Module 3: LAW OF COPYRIGHTS   **(06 Periods)**

Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Module 4: TRADE SECRETS   **(06 Periods)**

Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

Module 5: NEW DEVELOPMENT OF INTELLECTUAL PROPERTY   **(06 Periods)**

New developments in: trade mark law, copy right law, patent law, intellectual property audits. International overview on intellectual property; international - trade mark law, copy right law, international patent law, international development in trade secrets law.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Should conduct a survey based on the real scenario, where IPR is misused or unethically used and present an article.
2. Prepare an article on the registration processes of IPR practically (copy right/trade mark/ patents).
3. Should study a case of conflict on trademarks/patents and should produce an article mentioning the circumstances and remedial measures.
4. Prepare an article on the latest development in the international intellectual property rights.
5. Refining the project, based on the review report and uploading the text

RESOURCES

TEXT BOOKS:

1. Deborah, E. Bouchoux, Intellectual property: The law of Trademarks, Copyright, Patents, and Trade Secrets, Cengage learning, 4th Edition, 2013.

2. Prabuddha Ganguli, Intellectual property right - Unleashing the knowledge economy, McGraw Hill Education, 1st Edition, 2017.

3. Tom Kelley & Jonathan Littman, The Art of Innovation, Profile Books Ltd, UK, 2008

REFERENCE BOOKS:

1. Neeraj P., & Khusdeep D, Intellectual Property Rights, PHI learning Private Limited, 1st Edition, 2019.

2. Nithyananda, K V. Intellectual Property Rights: Protection and Management, Cengage Learning India Private Limited, 2019

3. Edward debone, How to have Creative Ideas, Vermilon publication, UK, 2007.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/110105139

2. https://www.youtube.com/watch?v=bEusrD8g-dM

3. https://www.youtube.com/watch?v=LS7TTb23nzU

WEB RESOURCES:

1. http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf

2. https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

3. Official website of Cell for IPR Promotion and Management (CIPAM), Ministry of Commerce and Industries, Government of India

4. What is Intellectual Property? (wipo.int)

5. Official website of Intellectual Property India (ipindia.gov.in)

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25CE211001	**INTERNSHIP**	-	-	-	-	2

Pre-Requisite   -

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: This course is provides through grounding in project management principles and techniques, including project life cycle, stakeholder management, contingency planning, project monitoring and reporting.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the nature of civil engineering works and construction activities using different methods and technologies by following code of ethics with lifelong learning.

CO2. Identify risk factors in the construction projects and develop the skills to overcome with the solutions by following code of ethics with lifelong learning.

CO3. Develop an environment that facilitates team work and progress of work.

CO4. Develop presentation skills to deliver the experience of work at the industry.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
Course Correlation Mapping	**3**	**3**	**3**	**3**	**3**	**3**

Correlation Levels: **3: High;   2: Medium;**   **1: Low**

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25CE209001	**PROJECT WORK PHASE - I**	-	-	-	-	10

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is provides through grounding in project management principles and techniques, including project life cycle, stakeholder management, contingency planning, project monitoring and reporting.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the need for research and development in civil engineering industry.

CO2. Identify problems associated with different elements and overcome using different methods and technologies by following code of ethics with lifelong learning.

CO3. Develop an environment that facilitates team work and produce outcomes of the research activities by following code of ethics maintaining sustainability with lifelong learning.

CO4. Develop communication skills in solving complex problems using different tools and techniques by following code of ethics besides lifelong learning

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
Course Correlation Mapping	**3**	**3**	**3**	**3**	**3**	**3**

Correlation Levels: **3: High;   2: Medium;   1: Low**

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25CE210001	**PROJECT WORK PHASE - II**	-	-	-	-	14

Pre-Requisite   -

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: This course is provides through grounding in project management principles and techniques, including project life cycle, stakeholder management, contingency planning, project monitoring and reporting.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the need for research and development in civil engineering industry.

CO2. Identify problems associated with different elements and overcome using different methods and technologies by following code of ethics with lifelong learning.

CO3. Develop an environment that facilitates team work and produce outcomes of the research activities by following code of ethics maintaining sustainability with lifelong learning.

CO4. Develop communication skills in solving complex problems using different tools and techniques by following code of ethics besides lifelong learning

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
Course Correlation Mapping	**3**	**3**	**3**	**3**	**3**	**3**

Correlation Levels: **3: High;   2: Medium;**   **1: Low**

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25CB207601	**ESSENTIALS OF CYBER SECURITY**	2	-	-	-	2

Pre-Requisite   -

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: This course provides a detailed discussion on Cyber Security Fundamentals, Cyber Security Fundamentals, Attacker techniques and motivations, Fraud techniques, Threat infrastructure, Exploitation, Malicious code, Defense and analysis techniques, Intrusion detection techniques

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understanding the fundamental concepts of cyber security concepts

CO2. Identify the pattern of launching attacker and fraud techniques to reduce risk and impact of cyber-attacks.

CO3. Identify the vulnerabilities using the SQL injection and web exploitation techniques in a system for securing data.

CO4. Apply code obfuscation techniques to prevent any unauthorized party from accessing logic of an application

CO5. Apply honey pots and malicious code-naming techniques to defend against attacks in memory.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	-
CO2	3	2	-	-	-	-
CO3	3	3	3	-	-	-
CO4	3	3	3	2	-	-
CO5	3	2	3	2	-	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**-**	**-**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1:   CYBER SECURITY FUNDAMENTALS   **(05 Periods)**

Network Security Concepts: Information assurance fundamentals, Basic cryptography, Symmetric encryption, Public key encryption, The Domain Name System (DNS), Firewalls, Virtualization, and Radio-Frequency Identification.

Module 2:   ATTACKER TECHNIQUES   **(07 Periods)**

Attacker techniques and motivations: Anti forensics, proxy usage, Tunneling techniques: HTTP, DNS, ICMP, Intermediaries, Steganography and other concepts, Detection and prevention.
Fraud techniques: Phishing, smishing, vishing and mobile malicious code, rogue antivirus, click fraud.
Threat infrastructure: Botnets, Fast Flux, Advanced Fast Flux.

Module 3:   EXPLOITATION   **(06 Periods)**

Shellcode, Integer overflow vulnerabilities, Stack based buffer overflows, Format string vulnerabilities, SQL injection, Malicious PDF files, Race conditions, Web exploit tools, DoS conditions, Brute force and dictionary attacks.

Module 4:   MALICOUS CODE   **(06 Periods)**

Worms, viruses, Evading detection and elevating privileges: obfuscation, Virtual Machine obfuscation Persistent software techniques, Token kidnapping, Virtual machine Detection, Rootkits, Spyware, Attacks against privileged user accounts and escalation of privileges, Stealing information and Exploitation.

Module 5:   DEFENSE AND ANALYSIS TECHNIQUES   **(06 Periods)**

Importance of memory forensics, Capabilities of memory forensics, Memory analysis frameworks, Dumping physical memory, Installing and using volatility, Finding hidden processes, Volatality analyst pack.
Honeypots, Malicious code naming, Automated malicious code analysis systems, Intrusion detection techniques

Total Periods:30

EXPERIENTIAL LEARNING

1. Observe the firewall settings on your personal computer or smartphone.
   - What configurations are enabled?
   - How does this firewall protect your device from threats?

2. Compare phishing, smishing, and vishing using real-life examples. Which of these do you think people are most vulnerable to, and why?

3. Research a recent DoS attack in the news.
   - What services were affected?
   - What preventive measures could have reduced the impact?

4. Explore your antivirus software logs.
   - What types of threats were blocked recently?
   - Were any of them worms, viruses, or spyware?

5. Reflect on the importance of intrusion detection systems (IDS).
   - How does an IDS differ from a firewall?
   - Why are both needed in an organisation's security framework?

RESOURCES

TEXT BOOKS:

1. James Graham, Richard Howard, Ryan Olson, "Cyber Security Essentials", CRC Press, 2011.
2. Chwan-Hwa(john) Wu,J. David Irwin, "Introduction to Cyber Security", CRC Press T&F Group.

REFERENCE BOOKS:

1. Nina Godbole and SunitBelpure, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley publications.
2. B.B.Gupta, D.P.Agrawal, HaoxiangWang, "Computer and Cyber Security: Principle s, Algorithm, Applications, and Perspectives", CRC Press, ISBN 9780815371335, 2018.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106129

2. https://www.coursera.org/professional-certificates/ibm-cybersecurity-analyst

WEB RESOURCES:

1. https://www.interpol.int/en/Crimes/Cybercrime

2. https://www.geeksforgeeks.org/ethical-hacking/cyber-security-tutorial/

3. https://owasp.org/www-project-top-ten/

4. https://www.netacad.com/courses/cybersecurity-essentials?courseLang=en-US

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25AI207601	**STATISTICS WITH R**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course introduces the basic concepts of statistics using R language. The course also deals with various types of sampling methods and its impact in the scope of inference through the computation of confidence intervals. The topics covered in the course also includes descriptive statistics, marginal and conditional distribution, statistical transformations, chi-squared test and ANOVA.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Import, manage, manipulate, structure data files and visualize data using R programming.

CO2. Identify trends and patterns in data using Marginal, Conditional distributions and Statistical transformations.

CO3. Analyse data using sampling and probability distribution methods and compute confidence intervals for statistical inference.

CO4. Apply chi-squared goodness-of-fit test, Pearson's □ 2-statistic and ANOVA to investigate the distribution of data.

CO-PO Mapping Table:

Learning Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	-	-	-	-
CO2	3	2	-	-	-	-
CO3	2	2	-	-	-	-
CO4	3	2	-	-	-	-
Course Correlation Mapping	**3**	**2**	**-**	**-**	**-**	**-**

Correlation Levels: 3: High;   2: Medium;   1: Low

COURSE CONTENT

Module 1:   INTRODUCTION   (05 Periods)

Data, R's command line, Variables, Functions, The workspace, External packages, Data sets, Data vectors, Functions, Numeric summaries, Categorical data.

Module 2:   BIVARIATE AND MULTIVARIATE DATA   (07 Periods)

Lists, Data frames, Paired data, Correlation, Trends, Transformations, Bivariate categorical data, Measures of association, Two-way tables, Marginal distributions, Conditional distributions, Graphical summaries, Multivariate data - Data frames, Applying a function over a collection, Using external data, Lattice graphics, Grouping, Statistical transformations.

Module 3:   POPULATIONS   (06 Periods)

Populations, Discrete random variables, Random values generation, Sampling, Families of distributions, Central limit theorem, Statistical Inference - Significance tests, Estimation, Confidence intervals, Bayesian analysis.

Module 4:   CONFIDENCE INTERVALS   (06 Periods)

Confidence intervals for a population proportion, p - population mean, other confidence intervals, Confidence intervals for differences, Confidence intervals for the median, Significance test - Significance test for a population proportion, Significance test for the mean (t-tests), Significance tests and confidence intervals, Significance tests for the median.

Module 5:   GOODNESS OF FIT   (06 Periods)

The chi-squared goodness-of-fit test, The multinomial distribution, Pearson's □ 2-statistic, chi-squared test of independence and homogeneity, Goodness-of-fit tests for continuous distributions, ANOVA - One-way ANOVA, Using lm for ANOVA.

Total Periods: 30

EXPERIENTIAL LEARNING

1. The data set baby boom (Using R) contains data on the births of 44 children in a one-day period at a Brisbane, Australia, and hospital. Compute the skew of the wt variable, which records birth weight. Is this variable reasonably symmetric or skewed? The variable running. Time records the time after midnight of each birth. The command diff (running. Time) records the differences or inter-arrival times. Is thisvariable skewed?

2. An elevator can safely hold 3, 500 pounds. A sign in the elevator limits the passenger count to 15. If the adult population has a mean weight of 180 pounds with a 25-pound standard deviation, how unusual would it be, if the central limit theorem applied, that an elevator holding 15 people would be carrying more than 3, 500 pounds?

3. The data set MLB Attend (Using R) contains attendance data for Major League Baseballbetween the years 1969 and 2000. Use lm to perform a t-test on attendance for the two levels of league. Is the difference in mean attendance significant? Compare your results to those provided by T.test.

RESOURCES

TEXT BOOKS:

1. John Verzani, Using R for Introductory Statistics, CRC Press, 2nd Edition, 2014.
2. Sudha G Purohit, Sharad D Gore, Shailaja R Deshmukh, Statistics Using R, Narosa Publishing house, 2nd Edition, 2021.

REFERENCE BOOKS:

1. Francisco Juretig, R Statistics Cookbook, Packet Publishing, 1st Edition, 2019.
2. Prabhanjan N. Tattar, Suresh Ramaiah, B. G. Manjunath, A Course in Statistics with R, Wiley, 2018.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_ma76/preview
2. https://onlinecourses.nptel.ac.in/noc19_ma33/preview
3. https://youtu.be/WbKiJe5OkUU?list=PLFW6lRTa1g83jjpIOte7RuEYCwOJa-6Gz
4. https://youtu.be/svDAkvh6utM?list=PLFW6lRTa1g83jjpIOte7RuEYCwOJa-6Gz
5. https://nptel.ac.in/courses/111104120

WEB RESOURCES:

1. https://www.geeksforgeeks.org/r-statistics/
2. https://www.geeksforgeeks.org/r-programming-exercises-practice-questions-and-solutions/
3. https://www.w3schools.com/r/r_stat_intro.asp
4. https://www.w3schools.com/r/r_stat_intro.asp
5. https://statsandr.com/blog/descriptive-statistics-in-r/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25MG207601	**PROJECT MANAGEMENT**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: To understand the importance of decision-making while implementing any project and interpret and discuss the results of qualitative and quantitative analysis

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic introduction to project management

CO2. Apply the methods of project identification and selection.

CO3. Understand project allocation methods and evaluation.

CO4. Analyse the techniques for project time, review, and cost

CO5. Understand the factors of risk and quality of a project.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	2	1	-	-
CO2	1	1	2	2	-	-
CO3	2	2	1	2	1	-
CO4	3	1	2	2	1	-
CO5	2	2	1	2	1	1
Course Correlation Mapping	**2**	**2**	**2**	**2**	**1**	**1**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION   **(05 Periods)**
Concept of project management, project definition and key features of projects, project life cycle phases, typical project management issues, basic project activities

Module 2: PROJECT IDENTIFICATION AND SELECTION   **(06 Periods)**
Identification and screening (brainstorming, strength and weakness in the system, environmental opportunities and threats), Project evaluation methods- Payback period, Net present value, Internal rate of return and project evaluation under uncertainty.

Module 3: PROJECT RESOURCE MANAGEMENT   **(07 Periods)**
Scheduling resources, resource allocation methods, project crashing and resource leveling, working of systems, design of systems, project work system design, project execution plan, project procedure manual project control system, planning scheduling and monitoring

Module 4: TIME AND COST MANAGEMENT   **(05 Periods)**
Time Management-Network diagram, forward and backward pass, critical path, PERT and CPM, AOA and AON methods, tools for project network, Cost management-earned value method

Module 5: RISK AND QUALITY MANAGEMENT   **(07 Periods)**
Risk identification, types of risk, risk checklist, risk management tactics, risk mitigation and contingency planning, risk register, communication management, Quality assurance and quality control, quality audit, methods of enhancing quality

Total Periods: 30

EXPERIENTIAL LEARNING

1. Refer to any video lecture on project evaluation methods and give a brief seminar using PPT

2. Select any company wherein you will get the details of activities and time and draw the project network diagram and submit a report.

3.

Activity	Predecessor Activity	Normal Time (Weeks)	Crash Time (Weeks)	Normal Cost (Rs.)	Crash Cost (Rs.)
A	-	4	3	8,000	9,000
B	A	5	3	16,000	20,000
C	A	4	3	12,000	13,000
D	B	6	5	34,000	35,000
E	C	6	4	42,000	44,000
F	D	5	4	16,000	16,500
G	E	7	4	66,000	72,000
H	G	4	3	2,000	5,000

Determine a crashing scheme for the above project so that the total project time is reduced by 3 weeks

4. Collect any case study that discusses the process of probability calculation of success of the project and submit a report

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. R.Panneerselvam and P.Senthil Kumar (2013), Project Management, PHI Learning Private Limited.
2. Prasanna Chandra (2014), Projects: Planning, Analysis, Selection, Financing, implementation, and Review.

REFERENCE BOOKS:

1. A Guide to the Project Management Body of Knowledge: (PMBOK Guide) by Project Management Institute, 2013.
2. Gopala Krishnan & Rama Murthy, A Text book of Project Management, McMillan India.
3. S. Choudhary (2004), Project Management, Tata McGraw Hill Publication.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_mg30/preview

2. https://archive.nptel.ac.in/courses/110/104/110104073/

WEB RESOURCES:

1. https://www.pmi.org/about/learn-about-pmi/what-is-project-management

2. https://www.manage.gov.in/studymaterial/PM.pdf

3. https://imada.sdu.dk/u/jbj/DM85/lec7.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25MG207602	**ESSENTIALS OF BUSINESS ETIQUETTE**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course develops the concept of business etiquette and the proper etiquette practices for different business scenarios. It builds student awareness of professional conduct and cultural sensitivity, preparing them to navigate diverse global environments with confidence, respect, and appropriate etiquette for every scenario.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. To understand the concept of Etiquette.

CO2. Develop life skills or etiquette in order to succeed in corporate culture.

CO3. Present oneself with finesse and making others comfortable in a business

CO4. Adopt behaviors consistent with standard workplace expectations

CO5. Demonstrate an understanding of professionalism in terms of workplace behaviors and workplace relationships.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	1	-	-	-	1
CO2	1	1	2	1	-	1
CO3	2	-	2	-	1	-
CO4	1	2	-	1	-	-
CO5	1	2	1	-	-	-
Course Correlation Mapping	**2**	**2**	**2**	**1**	**1**	**1**

Correlation Levels: **3: High; 2: Medium; 1: Low**

COURSE CONTENT

Module 1: **BUSINESS ETIQUETTES- AN OVERVIEW**   **(06 Periods)**

Significance of Business Etiquettes in 21st Century- Professional Advantage; Need and Importance of Professionalism; Workplace Etiquette: Etiquette for Personal Contact- Personal Appearance, Gestures, Postures, Facial Expressions, Eye-contact, Space distancing

Module 2: **COMMUNICATION SKILLS**   **(06 Periods)**

Understanding Human Communication, Constitutive Processes of Communication, Language as a tool of communication, Barriers to Effective communication, and Strategies to Overcome the Barriers.

Module 3: **TEAMWORK AND LEADERSHIP SKILLS**   **(06 Periods)**

Concept of Teams; Building effective teams; Concept of Leadership and honing Leadership skills. Personality: Meaning & Definition, Determinants of Personality, Personality Traits, Personality and Organizational Behavior Motivation: Nature & Importance, Herzberg's Two Factor theory, Maslow's Need Hierarchy theory, Alderfer's ERG theory

Module 4: **INTERVIEW SKILLS**   **(06 Periods)**

Interview Skills: in-depth perspectives, Interviewer and Interviewee, Before, During and After the Interview, Tips for Success. Meeting Etiquette: Managing a Meeting-Meeting agenda, Minute taking,; Duties of the chairperson and secretary; Effective Meeting Strategies - Preparing for the meeting, Conducting the meeting, Evaluating the meeting

Module 5: **DECISION-MAKING AND PROBLEM - SOLVING SKILLS**   **(06 Periods)**

Decision-Making and Problem-Solving Skills: Meaning, Types and Models, Group and Ethical Decision-Making, Problems and Dilemmas in application of these skills. Conflict Management: Conflict - Definition, Nature, Types and Causes; Methods of Conflict Resolution.

Total Periods:30

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Collect the case studies related to successful leaders and their traits.
2. Conduct a mock interview showcasing interview skills.
3. The case studies will be collected as Assignments and the same will be evaluated.

RESOURCES

TEXT BOOKS:

1. Barbara Pachter, Marjorie Brody. Complete Business Etiquette Handbook. Prentice Hall, 2015.

2. Mahanand, Anand. English for Academic and Professional Skills. Delhi: McGraw, 2013. Print.

REFERENCE BOOKS:

1. Pease, Allan and Barbara Pease. The Definitive Book of Body Language. New Delhi: Manjul Publishing House, 2005.

2. Rani, D Sudha, TVS Reddy, D Ravi, and AS Jyotsna. A Workbook on English Grammar and Composition. Delhi: McGraw, 2016.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=NqlfZOPMqjA

2. http://www.nitttrc.edu.in/nptel/courses/video/109104107/L24.html

WEB RESOURCES:

1. http://elibrary.gci.edu.np/bitstream/123456789/685/1/BM-783%20The%20Essential%20Guide%20to%20Business%20Etiquette%20by%20Lillian%20H.%20Chaney%2C%20Jeanette%20S.%20Martin.pdf

2. The Essentials of Business Etiquette: How to Greet, Eat, and Tweet Your Way to Success by Barbara Pachter (EBook) - Read free for 30 days (everand.com)

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
25LG207601	**TECHNICAL REPORT WRITING**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with preparing effective technical documents for both written and digital media, with particular emphasis on technical memos, problem-solving and decision-making reports, and organizational, product-support, and technical-information webs.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge of Technical Report Writing and structures with a scientific attitude.
CO2. Analyze the process of writing in preparing effective reports.
CO3. Demonstrate styles of writing for Publication in a Scientific Journal.
CO4. Apply the process of referencing and editing techniques for effective communication in written documents.
CO5. Analyze the strategies in the technical report presentation.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	-	-	-	3	-
CO2	-	-	-	-	3	-
CO3	-	-	-	-	3	-
CO4	-	-	-	-	3	-
CO5	-	-	-	-	3	-
Course Correlation Mapping	**-**	**-**	**-**	**-**	**3**	**-**

Correlation Levels: **3: High;** **2: Medium; 1: Low**

COURSE CONTENT

Module 1:   INTRODUCTION TO TECHNICAL REPORT WRITING   **(06 Periods)**

Concepts of Technical Report, Types of Reports, Planning Technical Report Writing, Components of a Technical Report, Report Writing in Science and Technology, Selecting and Preparing a Title, Language Use in Report Writing.

Module 2:   PROCESSOF WRITING   **(06 Periods)**

Writing the 'Introduction', Writing the 'Materials and Methods, Writing the Findings/Results, Writing the 'Discussion', Preparing and using "Tables".

Module 3:   STYLE OF WRITING   **(06 Periods)**

Preparing and using Effective 'Graphs', Citing and Arranging References-I, Citing and Arranging References –II, Writing for Publication in a Scientific Journal.

Module 4:   REFERENCING   **(06 Periods)**

Literature citations, Introductory remarks on literature citations, Reasons for literature citations, Bibliographical data according to ISO standards, Citations in the text, Copyright, and copyright laws, the text of the Technical Report, Using a word processing and desktop publishing (DTP) systems, Document or page layout, hints on editing Typographic details, Cross-references.

Module 5:   PRESENTATION   **(06 Periods)**

Presentation with appropriate pointing, Dealing with intermediate questions, Review and analysis of the presentation, Rhetoric tips from A to Z.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare a report on technologies of modern times that enriched the originality of research works and their impacts on society concerning plagiarism.

2. Make PowerPoint presentations on the various style of writing academic reports.

3. Error-free Reports are so important for successful communication and sharing of information. Prepare a detailed chart on proofreading techniques to make a report effective and error-free.

4. Design a logo for a company and write down the copy-right laws for that.

5. Read research articles from any international journal of science and technology and differentiate research writing from other academic and non-academic writings.

6. Write an organizational memo Include a heading, introduction, and summary at the beginning of your memo, and present the details of your discussion in a logical order. Use headings and topic or main-idea sentences to clarify the organization.

7. Prepare an appraisal report on the staff performance of your company.

8. Prepare a PowerPoint presentation on the annual performance report of a company.

9. Critically review and write a report on any one of the recently released products.

10. Read the newspaper and write a detailed report about the content coverage and analyse the factors for the popularity of the newspaper.

RESOURCES

TEXTBOOK:

1. RC Sharma and Krishna Mohan, "Business Correspondence and Report Writing", McGraw-Hill Publishing, 3rd Edition, 2005 (reprint).

2. Patrick Forsyth, "How to Write Reports and Proposals", The Sunday Times, Kogan Page, New Delhi, Revised 2nd Edition, 2010.

REFERENCE BOOKS:

1. John Seely, "The Oxford Writing & Speaking", Oxford University Press, Indian Edition

2. Anne Eisenberg, "A Beginner's Guide to Technical Communication", McGraw-Hill Education (India) Private Limited, New Delhi, 2013.

VIDEO LECTURES:

1. https://vimeo.com/143714818

2. https://digitalmedia.sheffield.ac.uk/media/002.+The+Anatomy+of+a+Technical+Report/1_u8wntcge

WEB RESOURCES:

1. http://www.resumania.com/arcindex.html

2. http://www.aresearchguide.com/writing-a-technical-report.htm

3. http://www.sussex.ac.uk/ei/internal/forstudents/engineeringdesign/studyguides/tec report writing

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25CE201001	CONSTRUCTION PLANNING, SCHEDULING AND CONTROL	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed brief on construction planning, scheduling procedures and techniques, cost control, monitoring and accounting the construction problems, quality control, safety precautions during construction, organization and project information.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the importance of construction planning, organizing, demand and role of human resources and estimate the resource and organizational requirements for various type of constructions work activities.

CO2. Apply appropriate techniques for scheduling activity-on-node with leads, lags and windows with resource constraints and precedence

CO3. Apply the knowledge on selecting suitable techniques and methods for resource management, project monitoring, target schedule, cost control and understand the risk management strategies and risk mitigation techniques for safety in construction.

CO4. Demonstrate knowledge and understanding the various types of project Information using Database Management Systems and other conceptual models of databases applications for information transfer and flow.

CO5. Apply knowledge on selection of materials, labours, safety precautions to maintain quality control and on sampling the statistical quality control by attributes and variables.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	3
CO3	3	3	3	2	3	2
CO4	3	3	3	2	3	2
CO5	3	3	3	2	2	3
Course Correlation Mapping	3	3	3	2	3	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

MODULE 1:   CONSTRUCTION PLANNING   (09 Periods)

Construction Planning - Organizing, staffing, directing, and controlling; Factors influence supply and demand of human resources; Role of HR manager; Personnel Principles; case studies; Requirement of Organization; Organization structure; Organization charts; Staffing Plan; Development and Operation of human resources.

MODULE 2:   SCHEDULING PROCEDURES AND TECHNIQUES   (09 Periods)

Work Breakdown Structure (WBS); Time Management and Scheduling -Bar chart and Gantt chart; Network methods, Network diagram; Critical Path Method; Calculation critical path; Floats/slacks; PERT – Three time estimates; Precedence Network Analysis fundamentals.

MODULE 3:   CONSTRUCTION RESOURCES   (09 Periods)

Precedence Diagram Method (PDM), Project monitoring, updating; Target Schedule; Optimum cost and time; Scheduling with uncertain durations; Calculations for Monte Carlo Schedule Simulations; Crashing and Time-Cost Trade off; Risk Management, Risk Assessment Approach, Risk mitigation and allocation.

MODULE 4:   PROJECT INFORMATION   (09 Periods)

Types of project information, Accuracy and use of information, Computerized organization and use of information; Organizing information in databases, Relational model of databases,
Other conceptual models of databases; Centralized database management systems; Databases and applications programs; Information transfer and flow; PMIS-Framework, information communication using IT applications; Project document management.

MODULE 5:   QUALITY CONTROL AND SAFETY DURING CONSTRUCTION   (09 Periods)

Quality and safety concerns in construction; Organizing for quality and safety, Work and material specifications; Total quality control; Quality control by statistical methods, Statistical quality control with sampling by attributes, Statistical quality control with sampling by variables; Safety.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Create a schedule for the G+10 residential building using advanced scheduling technique.

2. Prepare a budget and work chart for the G+3 commercial building and forecast the cost control.

3. Visit the nearby construction sites and take a survey about the safety precautions followed in that site and report your suggestions

4. Frame the system of operations to maintain the quality in construction site.

5. Visit the nearby construction sites and collect the project information and give the detail report.

RESOURCES

TEXT BOOKS:

1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 1998.

2. Calin M. Popescu, Chotchai Charoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications, Wiley, New York, 1995.

3. Hendrickson, C. and Au, T., Project Management for Construction – Fundamentals Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pitsburgh, Version 2.2, 2008.

4. P.S. Gahlot, B. M. Dhir, Construction Planning and Management, New Age International Publishers, 1st edition, 2018.

REFERENCE BOOKS:

1. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.

2. Wills, E.M., Scheduling Construction Projects, John Wiley & Sons, 1986.

3. Halpin, D.W., Financial and Cost Concepts for Construction Management, John Wiley & Sons, New York, 1985.

4. Calin M. Popescu, Chotchai Charoenngam, Project Planning, Scheduling, and Control in Construction, Wiley, 1995.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105106149

2. https://nptel.ac.in/courses/105103093

3. https://www.digimat.in/nptel/courses/video/105104161/L14.html

4. https://www.digimat.in/nptel/courses/video/105106149/L01.html

WEB RESOURCES:

1. https://esub.com/blog/construction-project-planning-and-scheduling-guide/

2. https://www.cmu.edu/cee/projects/PMbook/09_Construction_Planning.html

3. https://www.letsbuild.com/blog/construction-planning-and-scheduling-guide

4. https://www.projectmanager.com/blog/make-a-construction-schedule

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25CE201002	**PROJECT FORMULATION AND APPRAISAL**	2	-	-	-	2

Pre-Requisite   Applied Statistics and Queuing Theory

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: This course provides a detailed discussion on Project Initiation and Capital Investments; Time Value of Money; Project Costing; Project Financing and Appraisal and Infrastructure projects and Private Sector Participation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze project and capital investment to solve complex project management problems following latest developments by using appropriate tools and techniques considering safety, environment, sustainability, relevant code of practice, communicating and manage effectively.

CO2. Analyze time value of money to solve complex project management problems following latest developments by using appropriate tools and techniques considering safety, relevant code of practice, perform team work besides communicating and manage effectively.

CO3. Analyze project costing to solve complex project management problems following latest developments by using appropriate tools and techniques considering safety, communicating and manage effectively.

CO4. Analyze project financing & appraisal to solve complex project management problems following latest developments by using appropriate tools and techniques considering safety, communicating and manage effectively.

CO5. Analyze project costing to solve complex project management problems following latest developments by using appropriate tools and techniques considering safety, environment, sustainability, relevant code of practice, communicating and manage effectively.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	1	3	2	1
CO2	2	3	2	3	2	2
CO3	2	3	3	3	2	3
CO4	2	3	2	3	2	3
CO5	2	3	1	3	2	3
Course Correlation Mapping	**2**	**3**	**2**	**3**	**2**	**3**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1:   PROJECT INITIATION AND CAPITAL INVESTMENT   (05 Periods)

Capital Initiation: Generation and screening of project ideas; Project identification, evaluation and overview; The project cycle, Planning selection and appraisal, Project quality factors and basic needs the measurement of project performance.
Capital Investment: Capital Budgeting; feasibility study; preliminary analysis; market, technical, financial, economic and ecological; Market and demand analysis; Detailed technical analysis.

Module 2:   TIME VALUE OF MONEY   (05 Periods)

Value of Money: Time lines and notations, Future Value of single amount, present value of single amount, future value of an annuity, present value of an annuity; Simple interest; Compound interest; project cash flows; principles of cash flow estimation.

Module 3:   PROJECT COSTING   (07 Periods)

Project Costing: Investment; Discounting; Net present value (NPV), Benefit cost ratio (BCR), internal rate of return (IRR); Non-Discounting criteria; Payback period, accounting rate of return (ARR), Urgency; Investment analysis in practice.

Module 4:   PROJECT FINANCING & APPRAISAL   (08 Periods)

Project Financing: Means of finance; Equity and Debt; Special Schemes; Key financial indicators; Ratios
Project Appraisal: Investment appraisal; International practice of appraisal; analysis of risk; different methods; risk analysis, sources and measures of risk; methods of risk analysis; analysis of standalone risk; analysis of contextual risk.

Module 5:   INFRASTRUCTURAL   PROJECTS   &   PRIVATE   SECTOR (05 Periods)
**   PARTICIPATION**

Infrastructural Projects: Infrastructure, types of infrastructure, various infrastructure sectors; A review on Indian Infrastructure.
Private sector participation: concept of Public Private Partnership (PPP); Types of PPP's; Development of infrastructure through Build operate own transfer (BOOT), Build operate transfer (BOT), Built operate lease transfer (BOLT) and Design Built operate transfer (DBOT); Technology transfer and foreign collaboration; case study.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare a report on detailing the project investment.

2. Write a report on stakeholder analysis, problem trees, and objectives analysis relate to construction project.

3. Give a detail report on ledger for construction project.

4. Prepare a report on investment analysis for a construction firm.

5. Write a special report on public private partnership for national highways.

RESOURCES

TEXT BOOKS:

1. Prasanna Chandra, "Projects -Planning Analysis Selection Implementation & Review", 4th Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.2005.

2. Joy P.K. "Total Project Management - The Indian Context (Chapters 3 7)", New Delhi, Macmillan India Ltd., 2002.

REFERENCE BOOKS:

1. "United Nations Industrial Development Organization (UNIDO) Manual for the preparation of Industrial Feasibility Studies", (IDSI Reproduction) Bombay, 2007.

2. Barcus. S.W and Wilkinson.J.V. "Hand Book of Management Consulting Services", McGraw Hill, New York, 2006.

VIDEO LECTURES:

1. Project Formulation & Appraisal | ESE 2020 | Basics of Project Management | Grade up - YouTube

2. Project Appraisal and Project Formulation || CHAP 2 || Project Engineering || IOE || 7th sem - YouTube

WEB RESOURCES:

1. NPTEL

2. (PDF) Built Environment Projects Formulation and Appraisal-New Paradigm (researchgate.net)

3. project-formulation.pdf (csjmu.ac.in)

4. Construction Project Formulation & Appraisal | CEPT Winter Exhibition 2021

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25CE201003	**CONSTRUCTION CONTRACT LAWS AND REGULATIONS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Construction contracts; Tenders; Arbitration; Legal requirements; Labour regulations.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Develop construction contracts to solve complex contract related problems by following laws and regulations considering project schedule, cost, quality and risk.

CO2. Prepare tenders as per the specifications by following latest developments, laws and regulations to solve complex tender problems considering project schedule, cost, quality and risk.

CO3. Analyze arbitration problems to address the contract disputes following the laws and regulations in the context of society.

CO4. Analyze legal issues pertaining to contracts and tenders considering society.

CO5. Analyze labour regulations to address labour safety issues.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	3	2	3
CO2	3	3	3	3	2	3
CO3	2	2	2	3	2	3
CO4	2	2	2	3	2	3
CO5	2	2	3	2	1	3
Course Correlation Mapping	**3**	**3**	**3**	**3**	**2**	**3**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: CONSTRUCTION CONTRACTS   (09 Periods)

Indian contracts act, Elements of contracts, Types of contracts, Features, Indian Contract Act 1872, Suitability, Design of contract documents, FIDIC, international contract document and laws, Standard contract document, Law of torts.

Module 2: TENDERS   (09 Periods)

Prequalification, Bidding, Accepting; Evaluation of tender from technical, contractual and financial points of view; Two cover system, Preparation of the documentation, Contract formation and interpretation, Potential contractual problems, Price variation clause, Comparison of actions and laws, Subject matter, Violations, Latest developments in tendering.

Module 3: ARBITRATION   (09 Periods)

Arbitration, Comparison of actions and laws, Agreements, Arbitration and Conciliation Act 1996, Appointment of arbitrators, Conditions of arbitration, Powers and duties of arbitrators, Rules of evidence, Enforcement of awards, Arbitration disputes, Dispute review boards, Arbitration case studies.

Module 4: LEGAL REQUIREMENTS   (09 Periods)

Legal requirements for planning, Property law, Agency law, Tax laws – Income tax, Sales tax, Excise and custom duties, Local government approval, Statutory regulations, Insurance and bonding, Laws governing purchase and sale, Use of urban and rural land, Land revenue codes, EMD, Security deposits, Liquidated damages.

Module 5: LABOUR REGULATIONS   (09 Periods)

Social security, Welfare legislation; Laws relating to wages, bonus and industrial disputes; Labour administration, Insurance and safety regulations, Workmen's compensation act, Maternity benefit act, Child labour act, Other labour laws.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Submit the comparison report about the international construction contracts and laws of two different foreign countries.

2. Take field survey with the construction labourers and suggest the modifications required for revising the acts.

3. Visit any municipality/Corporation/Panchayat to know about the legal documents requirement to get approval from the state government to build a house as per regulation and report the same.

4. Prepare a tender for constructing deck slab in your locality. Tender should be in format given by the state government.

5. Take a survey about child labourers and submit the report on modifications required in Child Labour Act for reducing child labour.

RESOURCES

TEXT BOOKS:

1. Subba Rao, G.C.V., Law of Contracts I & II, S. Gogia& Co., 11th Edition, 2011.

2. Jimmie Hinze, Construction Contracts, McGraw Hill, 3nd Edition, 2011.

3. Will Hughes, Ronan Champion, John Murdoch, Construction Contracts Law and Management, Routledge, 5th edition, 2015.

4. John Adriaanse, Construction Contract Law, Palgrave, 3rd edition, 2010.

REFERENCE BOOKS:

1. Kishore Gajaria, GT Gajaria's Law Relating to Building and Engineering Contracts in India, Lexis Nexis Butter worth's India, 4th Edition, 2000.

2. Patil, B. S., Civil Engineering Contracts and Estimates, University Press (India) Private Ltd., 4th Edition, 2015.

3. Joseph T. Bockrath, Contracts and the Legal Environment for Engineers and Architects, McGraw Hill Education, 7th Edition, 2010.

4. Akhileshwar Pathak, Contract Law, Oxford University Press, 2011.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105102206

2. https://onlinecourses.nptel.ac.in/noc22_mg52/

3. https://freevideolectures.com/course/4619/nptel-principles-construction-management/35

4. https://freevideolectures.com/course/4619/nptel-principles-construction-management/32

WEB RESOURCES:

1. https://blog.ipleaders.in/list-20-notable-cases-contract-law/

2. https://www.lgmadvisors.com.au/contract-law-case-studies/

3. https://www.legalserviceindia.com/laws/contracts.htm#:~:text=The%20general%20law%20of%20contract,against%20the%20party%20in%20default.

4. https://libguides.law.uiowa.edu/c.php?g=103056&p=668671

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25CE204001	**ESTIMATION AND QUANTITY SURVEYING**	3	-	2	2	5

Pre-Requisite   -

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: This course provides a detailed discussion on Estimation of residential buildings; Estimation of other structures; Specifications and rate analysis; Road estimates, culverts, bridges and wells; Valuation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1.   Estimate various components of residential buildings to solve complex problems of estimation using appropriate techniques by following relevant standards and codes besides communicating effectively in graphical form.

CO2.   timate other structures to solve complex problems of estimation using appropriate techniques by following relevant standards and codes besides communicating effectively in graphical form.

CO3.   Analyse specifications and rates for different items of building construction to solve complex problems of estimation using appropriate techniques by following relevant standards, codes and latest developments considering society.

CO4.   Prepare contracts and tenders to solve the complex problems using appropriate techniques by following relevant standards and latest developments considering society, legal issues, environment, sustainability, project management and financial besides communicating effectively in graphical form.

CO5.   Prepare valuation reports to solve the complex problems using appropriate techniques by following relevant standards and latest developments considering society, legal issues, project management and financial besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	2	1	1	2
CO2	2	2	2	1	1	2
CO3	2	2	-	1	1	2
CO4	2	2	3	1	1	2
CO5	2	2	-	1	1	2
Course Correlation Mapping	**2**	**2**	**3**	**1**	**1**	**2**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1: ESTIMATION OF RESIDENTIAL BUILDINGS   **(10 Periods)**
Types of estimation, Methods of estimation, Load bearing and framed structures – Calculation of quantities of earth work excavation, Brick work, RCC, PCC, Plastering, White washing, Color washing and painting/varnishing for shops, rooms; Residential building with flat and pitched roof, Various types of arches, Calculation of brick work and RCC works in arches; Estimate of joineries for paneled and glazed doors, windows, ventilators etc.

Module 2: ESTIMATION OF OTHER STRUCTURES   **(10 Periods)**
Estimating different structures - Septic tank, Soak pit, Sanitary and water supply installations, Water supply pipe line, Sewer line, Tube well, Open well, Roads, Retaining walls, Culverts.

Module 3: ROAD ESTIMATES, CULVERTS, BRIDGES AND WELLS   **(10 Periods)**
Road Estimates: Estimate of earthwork by three methods, Estimate of pitching of slopes, Estimate of earthwork of road from L-Sections, Estimate of earthwork in hill road, Estimate of metalled road, Estimate of C.C. trackway.
Culverts, Bridges and Wells: Culverts – Methods of estimating, Estimates of R.C.C slab culvert, 2-span arched culvert, 3-span arched culvert, R.C.C T-beam decking, Pier, Pipe culvert, Well foundations, R.C.C T-beam bridge.

Module 4: SPECIFICATION AND RATE ANALYSIS   **(08 Periods)**
Purpose and method of writing specifications, General and detailed specification for different items of building construction, Lead statement, Data, Schedule of rates, Rate analysis -Concrete, Brick work, Plastering, Flooring and Painting.

Module 5: VALUATION   **(07 Periods)**
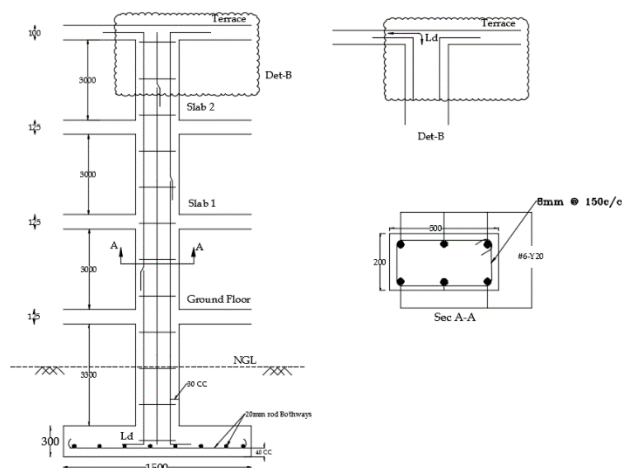Necessity, Basics of value engineering, Capitalized value, Depreciation, Escalation, Value of building, Calculation of standard rent, Mortgage, Lease.

                                                        Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:
1. Estimate the quantities of different items of work for residential building with a minimum of 2BHK considering the setbacks, compound wall and necessary requirements as per NBC.
2. Estimate the total reinforcement detailing for the following column.

3. Prepare a review report on detailed and abstract estimation for residential buildings in different locations.
4. Identify and prepare a detailed report on possible factors that affect the cost variation in abstract estimation.

5. Survey a proposed road for 1km and estimate the earthwork quantities and side slopes for the proposed road.

    A Canal work to a branch of river Swarna Mukhi at A.Rangampet to facilitate the water service to the green lands of the village. The canal of length of 3km length and with a maximum discharge of 30m³/sec.

6. Prepare a valuation report for M-Plaza in Mohan Babu University.

PROJECT BASED LEARNING:

1. Projects relevant to the contents of the course will be provided by the course instructor at the beginning.

RESOURCES

TEXT BOOKS:

1. Dutta. B.N., Estimating and Costing in Civil Engineering, UBS Publishers & Distributors Pvt. Ltd., 28th Edition, 2003.

2. Kohli, D.D. and Kohli, R.C., A Text Book of Estimating and Costing (Civil), S. Chand & Company Ltd., 13th Edition, 2013.

REFERENCE BOOKS:

1. Chakraborthi, M., Estimating Costing Specification and Valuation in Civil Engineering, Laxmi Publications, New Delhi, 23rd Edition, 2010.

2. Frank R. Dagastino and Steven J. Peterson, Estimating in Building Construction, 1989 Pearson Education, Inc., 7th Edition, 2011.

3. Rangawala, Estimation, Costing and Valuation, Charotar Publishing House Pvt. Ltd., 17th Edition, 2020.

4. Dieter Jacob and Clemens Muller, Estimating in Heavy Constructions, Wilhem Ernst and Sohn Publisher, Berlin, Germany, 2017.

ADDITIONAL LEARNING RESOURCES:

1. National Building Code of India, BIS, Government of India, New Delhi, 2005

2. Standard Schedule of Rates and Standard Data Book, Public Works Department.

CODES:

1. IS 1200 (Part I to XXV) – 1974: Method of Measurement of Building and Civil Engineering Works.

VIDEO LECTURES:

1. NPTEL :: Management - NOC:Cost Accounting

2. Estimation and Costing - 1 | SSC JE 2021 | STATE AE 2022 | Jaspal Singh - YouTube

3. Estimation || Building Estimation and Costing || Estimation and Costing || cost estimation 2023 - YouTube

WEB RESOURCES:

1. Using Intelligent Techniques in Construction Project Cost Estimation: 10-Year Survey (hindawi.com)

2. Construction Cost Estimating: A Step-By-Step Guide | Procore

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25CE203001	**CONSTRUCTION PRACTICES, EQUIPMENT AND AUTOMATION**	3	-	-	4	4

Pre-Requisite   -

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: This course provides a detailed discussion on Construction practices; Highway construction practices, Dams and harbour construction and Advanced practices; Equipment management and earthwork equipment; Concrete plants and other construction equipment; Building automation and robotics in construction.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1.   Analyze various construction practices to solve construction problems by using appropriate tools and techniques considering health, safety, environment, sustainability, besides communicating effectively in graphical form.

CO2.   Analyze advanced practices to solve construction problems in highway construction, dams and harbour construction following latest developments by using appropriate tools and techniques considering health, safety, and environment, sustain ability, besides communicating effectively in graphical form.

CO3.   Analyze equipment management and earthwork equipment to solve construction problems following latest developments by using appropriate tools and techniques considering health, safety, environment, sustainability, manage effectively in construction and besides communicating effectively in graphical form.

CO4.   Analyze Concrete plants and other construction equipments to solve construction problems following latest developments by using appropriate tools and techniques considering health, safety, environment and sustainability and besides communicating effectively in graphical form.

CO5.   Analyze building automation and robotics in construction to solve construction problems using appropriate techniques following latest developments considering society, relevant codes of practice, project management and finance besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	1	2	2	2
CO2	3	3	2	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	3	2	2	2
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**2**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1:   CONSTRUCTION PRACTICES   (08 Periods)

Concepts of construction practices, comparison to older and newer practices in construction, underground open excavation, dewatering, tunnelling techniques, piling techniques, launching girders, bridge decks, offshore platforms, erection of light weight components on tall structures, erection articulated structures, fabrication and erection of steel trusses and frames.

Module 2:   HIGHWAY CONSTRUCTION, DAMS AND HARBOUR (10 Periods)
              CONSTRUCTION AND ADVANCES PRACTICES

Highway Construction Practices: Embankment construction, ground improvement techniques, retaining and breast wall on hill road, bituminous and concrete road constructions, methods of construction joints in concrete pavements.
Dams and Harbour Construction: Construction methods for dams, harbours, river works and pipelines, water breakdown structures at shores.
Advanced Practices: Techniques for Box Jacking – purpose, concept, functioning and advantages; Pipe Jacking – Technique, factors, applications, advantages; underwater construction of diaphragm walls for basement, Coffer dam – purpose, types, techniques; cable anchoring – Screw anchor, necessity and applications

Module 3:   EQUIPMENT   MANAGEMENT   AND   EARTHWORK (10 Periods)
              EQUIPMENT

Equipment Management: Identification, Selection of Equipment, Equipment Productivity, Maintenance Management, Equipment cost, Operating cost, Cost Control of Equipment, Depreciation Analysis, Replacement of Equipment, and Replacement Analysis.
Earthwork Equipment: Fundamentals of Earth Work Operations, Earth Moving Operations, Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers; Front end Waders – Dozer, Excavators, Rippers, Loaders, Compacting Equipment, Finishing equipment.

Module 4:   CONCRETE   PLANTS   AND   OTHER   CONSTRUCTION (09 Periods)
              EQUIPMENT

Concrete Plants: Batching and Mixing Equipment, Pumping Equipment, Ready mix concrete equipment, Concrete pouring equipment. Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment
Other Construction Equipment: Equipment for Dredging, Trenching, Drag line and clamshells, Tunnelling, Equipment for Drilling and Blasting, Pile driving Equipment, Erection Equipment, Crane, Mobile crane, Types of pumps used in Construction, Equipment for Dewatering and Grouting, Equipment for Demolition

Module 5:   BUILDING   AUTOMATION   AND   ROBOTICS   IN (08 Periods)
              CONSTRUCTION

Building Automation: Building Automation System (BAS) **-** Concept, Applications, Requirements, Design considerations, Effect on functional efficiency, Architecture and Components of BAS.
Robotics in Construction: Tele-operated robots, Programmed Robots and Cognitive Robots - Use of robots for repetitive activities; Challenges in construction robotics, Robotics in concrete works, Concrete surface finishing robot, Transformable welding robot.

Total Periods: 45

PROJECT BASED LEARNING

1. Prepare a Detailed report on selection of methods used in above ground level construction.
2. Prepare a Detailed report on selection of methods used in under water construction.
3. Study the Levels in the construction and select suitable equipment at different levels of construction.
4. Visit and Prepare a detailed report on working process of RMC Plant and equipment involved in.
5. Consider a existing building and identify the possibilities in implementing Building Automation System (BAS).
6. Identify various construction automated equipment for the excavation and laying a RCC bed in canal construction project.

RESOURCES

TEXT BOOKS:

1. Roy Chudley, Roder Geeno, "Advanced Construction Technology" 4th edition, Pearson education limited, 2006.
2. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 1988.

REFERENCE BOOKS:

1. Patrick Powers. J, "Construction Dewatering: New Methods and Applications", John Wiley & Sons, 2002
2. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning, Equipment and Methods", McGraw Hill, Singapore, 2006.
3. Sharma S.C. "Construction Equipment and Management", Khanna Publishers, New Delhi, 1988
4. Mikell P. Groover "Automation, Production system and computer – integrated manufacturing", Pearson Higher Education, Inc., 4th edition, 2015.
5. Bimal Kumar "A Practical guide to adopting BIM in Construction Projects", Whittles Publishing, Dun breath, Scotland, 2015.

VIDEO LECTURES:

1. Construction methods and equipment management - Course (nptel.ac.in)

WEB RESOURCES:

1. Sustainable Construction Practices : All you need to know - GreenSutra®
2. 8 Popular Piling Methods in Building Construction - Powered by Orange
3. Piling equipment and installation (slideshare.net)
4. 1.1 box jacking (slideshare.net)
5. Pipe Jacking (slideshare.net)
6. tunnels and underground excavations - Tunneling techniques | Britannica

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25CE201004	**MODERN CONSTRUCTION MATERIALS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on special concrete, metals, composite, other materials and smart and intelligent materials

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the behavior of special concrete to solve problems associated with conventional concrete for ensuring safety and sustainability using appropriate tools and techniques in buildings besides lifelong learning.

CO2. Analyze the characteristics and coatings of new metals to solve problems associated with the old metals used in construction ensuring safety and sustainability using appropriate tools and techniques besides lifelong learning.

CO3. Analyze the composition of composite materials to solve problems associated with existing composite materials for ensuring safety and sustainability using appropriate tools and techniques in buildings besides lifelong learning.

CO4. Evaluate the various new materials for repair and rehabilitation of building to solve problems associated with already existing materials for ensuring safety and sustainability using appropriate tools and techniques in buildings besides lifelong learning.

CO5. Evaluate the smart and intelligent materials used in smart buildings to solve problems associated with normal buildings for ensuring safety and sustainability using appropriate tools and techniques in buildings besides lifelong learning.

CO-PO- Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	2	3	3	2
CO2	2	3	2	3	3	2
CO3	2	3	2	3	3	2
CO4	2	3	2	3	3	2
CO5	2	3	2	3	3	2
Course Correlation Mapping	**2**	**3**	**2**	**3**	**3**	**2**

Correlation Levels: **3: High; 2: Medium; 1: Low**

COURSE CONTENT

Module 1:   BUILDING AND ARCHITECTURAL MATERIALS   **(09 Periods)**

Building Materials: Cement- types - properties and testing – Aggregate – types - properties and Testing, Reinforcement – Types - Manufacturing Process - Properties – Types of Coatings & Coatings to reinforcement.
Architectural Materials: Wood and Wood Product – Glass - Floor Finishes – Paints – Tiles - Thermal insulation and acoustic absorption materials - decorative panels and laminates - architectural glass and ceramics - ferrocement.

Module 2:   METALS AND POLYMERS   **(09 Periods)**

Metals: Metals and Special Alloys of Steel - Water Jet Cut Stainless Steel, Mill Slab Steel, Tension Rods Assemblies and Cast Iron - Heat Treatment – Tendons - GI sheets, tubes and lightweight roofing materials - Aluminum and its products.
Polymers: Polymers- Structural Plastics and Composites- Polymer Membranes- Coatings-Adhesives, Non-Weathering Materials-Flooring and Facade Materials- Glazed Brick - Photo Catalytic Cement - Acid Etched Copper and Composite Fibers

Module 3:   SPECIAL CONCRETES   **(09 Periods)**

Concretes, Behavior of concretes – Fiber Reinforced Concrete – Self-Compacting Concrete – Lightweight concrete – Self dynamic concrete – Self Healing Concrete – Nanotube concrete – High density concrete – High Performance Concrete – Ready mix Concrete – Geopolymer Concrete - Vacuum concrete – Bacterial concrete, Alternate Materials to concrete.

Module 4:   CHEMICAL AND MINERAL ADMIXTURES   **(09 Periods)**

Chemical Admixtures: Types and properties of Chemical Admixtures - Water Proofing Compounds– sealants, engineering grouts, various types of finishes & treatments.
Mineral Admixtures: Fly ash – silica fume – GGBFS - metakaolin - rice husk ash - properties and its application in concrete under special environment.

Module 5:   SMART MATERIALS   **(09 Periods)**

Neoprene, Bridge pads, thermo Cole, Smart and Intelligent Materials – Special features – Case studies showing the applications of smart and Intelligent Materials. Petroleum products, Fiber Reinforced Polymers, Bituminous Materials

Total Periods: 45

EXPERIENTIAL LEARNING

1. Study on properties of building, composite and architectural materials

2. Prepare a report on applications of polymers in construction industry for types of constructions.

3. Experimental study on strength and durability of special concretes

4. Study the properties of chemical and mineral admixtures

5. Applications of smart and intelligent materials

RESOURCES

TEXT BOOKS:

1. Kumar Mehta, P. and Paulo, J. M. Monteiro., Concrete: Microstructure, Properties and Materials, 4th Edition, McGraw-Hill, New Delhi, 2014.

2. Ashby, M.F. and Jones, D.R.H.H., Engineering Materials 1: An introduction to Properties, Applications and designs, Elsevier Publications, 2005.

3. Mamlouk, M.S. and Zaniewski, J.P., Materials for Civil and Construction Engineers, Prentice HallInc., 1999.

REFERENCE BOOKS:

1. Deucher, K.N, Korfiatis, G.P and Ezeldin, A.S., Materials for civil and Highway Engineers, PrenticeHall Inc., 1998.

2. Santhakumar.A.R., Concrete Technology, Oxford University press, New Delhi.

3. Shan Somayaji., Civil Engineering Materials, Prentice Hall Inc., 2001

4. Shetty M.S., Concrete Technology: Theory and Practice, S.Chand & Company Ltd., 2005.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105106053

2. https://www.youtube.com/watch?v=_KDzJ_VN7d0

3. https://www.youtube.com/watch?v=Z_JVSnmgzjw

4. https://www.youtube.com/watch?v=lma2C5D3CJU

5. https://www.youtube.com/watch?v=GN03dj47UIg

6. https://www.youtube.com/watch?v=H-TkT6fsKFI

7. https://www.youtube.com/channel/UC0porMN7noGOGq8liCYIsAA/videos

WEB RESOURCES:

1. Modern methods of construction – Details and application: https://theconstructor.org/construction/modern-methods-of-construction/17487/

2. Modern Building Materials: https://pb.edu.pl/oficyna-wydawnicza/wp-content/uploads/sites/4/2018/12/Buildings-2020-part1-20.12-rozdz-3.pdf

3. Modern Construction Materials: https://pb.edu.pl/oficyna-wydawnicza/wp-content/uploads/sites/4/2018/12/Buildings-2020-part1-20.12-rozdz-3.pdf

4. Construction Materials: https://www.brainkart.com/subject/Construction-Materials_29/

5. Building Materials: https://skyupsmediablog.files.wordpress.com/2016/04/bmcp-unit-1-image-marked.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25CE201005	**CONSTRUCTION RESOURCE MANAGEMENT**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on resource planning, labour management, materials and equipment, time management and resource allocation and levelling

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the resource planning to solve problems associated with labour, time schedule and cost for ensuring safety and sustainability using appropriate tools and techniques in construction besides lifelong learning.

CO2. Analyze the labour management to solve problems associated with Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour ensuring safety and sustainability using appropriate tools and techniques besides lifelong learning.

CO3. Analyze the quality of materials and equipments to solve problems associated with Time of purchase, sources, Transportation, Delivery and handling for ensuring safety and sustainability using appropriate tools and techniques in construction besides lifelong learning.

CO4. Evaluate the time management to solve problems associated with critical path measuring for ensuring safety and sustainability using appropriate tools and techniques in construction besides lifelong learning.

CO5. Evaluate the resource allocation and levelling to solve problems associated with time-cost and value management for ensuring safety and sustainability using appropriate tools and techniques in construction besides lifelong learning.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	1	3	3	2
CO2	2	3	2	3	3	2
CO3	2	3	3	3	3	2
CO4	2	3	2	3	3	2
CO5	2	3	3	3	3	2
Course Correlation Mapping	**2**	**3**	**3**	**3**	**3**	**2**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1:   RESOURCE PLANNING   (06 Periods)

Definition - Principles - Characteristics of resources; Types of resources, Men, Machinery, Material, Money and Time, Resource Planning, Utilization, Tools for measurement of resources, Procurement, Identification, Planning for material, Labour, time schedule and cost control.

Module 2:   LABOUR MANAGEMENT   (06 Periods)

Labour Characteristics, Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour, Labour Productivity, Job-Site Productivity, Non-Productive Activities, Project Work Conditions, Labour Relations in Construction.

Module 3:   MATERIALS AND EQUIPMENT   (06 Periods)

Material: Time of purchase, quantity of material, sources, Transportation, Delivery and Distribution. Equipment: Planning and selecting by optimistic choice with respect to cost, Time, Source and handling.

Module 4:   TIME MANAGEMENT   (06 Periods)

Time management, tracking of time for resources and activities; time management strategies, setting goals, organize, plan ahead, maximize time, prioritize and eliminate distractions. Personnel time, Management and planning, forecasting the future.

Module 5:   RESOURCE ALLOCATION, LEVELLING AND   (06 Periods)
SMOOTHENING

Time-cost trades off, Computer application - resource list, Resource loading, resource allocation, Resource optimization techniques, applications, factors affecting, resource leveling, resource smoothening, examples, problems in resource leveling and smoothening, Cumulative cost - Value Management.

Total Periods: 30

EXPERIENTIAL LEARNING

1.   Write a study report on resources in construction industry.

2.   Prepare a detailed field report on labour management in construction industry for apartment building.

3.   Write a detail report on stock management and inventory analysis.

4.   Write a report on time management in resources for construction project.

5.   Prepare a detail report on Resource levelling and smoothening techniques with a construction site.

RESOURCES

TEXT BOOKS:

1. James.A.,Adrain., Quantitative Methods in Construction Management, American Elsevier Publishing Co., Inc., 1973.

REFERENCE BOOKS:

1. Andrew,D., Szilagg, Hand Book of Engineering Management, 2nd Edition, 2001.

2. Harvey, A., Levine., Project Management using Micro Computers, Obsorne-McGrawHill, C.A.Publishing Co., Inc. 1988.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=kuCHsNXeNMc

2. Resource management in construction projects - YouTube

WEB RESOURCES:

1. Resource management in construction project:
   https://www.researchgate.net/publication/341903981_Resource_Management_In_Construction_Project

2. Resource management in construction projects:
   https://www.globalscientificjournal.com/researchpaper/RESOURCE_MANAGEMENT_IN_CONSTRUCTION_PROJECTS_.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25CE201006	**REHABILITATION AND RETROFITTING OF STRUCTURES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Maintenance and repair strategies; Serviceability and durability of concrete; Materials and techniques for repair; Repairs, Rehabilitation and Retrofitting of structures; Demolition techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze maintenance and repair strategies to solve rehabilitation and retrofitting problems of structures using various tools and techniques following relevant codes and standards considering safety, serviceability, environment and sustainability

CO2. Analyze the serviceability and durability of concrete to solve complex rehabilitation and retrofitting problems of structures using various tools and techniques following relevant codes and standards considering safety, serviceability, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze materials for repair to solve complex rehabilitation and retrofitting problems of structures using tools and techniques to following relevant codes and standards considering safety, serviceability, environment and sustainability.

CO4. Analyze various techniques for repair to solve complex rehabilitation and retrofitting problems of structures to following relevant codes, standards and latest development considering safety, serviceability, environment and sustainability.

CO5. Analyze various rehabilitation, retrofitting and demolition procedures for repair to solve complex rehabilitation and retrofitting problems of structures to following relevant codes, standards and latest developments considering safety, serviceability, environment and sustainability besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	-	-	3	1
CO2	2	3	2	3	3	1
CO3	2	3	1	3	3	1
CO4	2	3	3	3	3	2
CO5	2	3	3	3	3	2
Course Correlation Mapping	**2**	**3**	**3**	**3**	**3**	**2**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1:   MAINTENANCE AND REPAIR STRATEGIES   **(08 Periods)**

Maintenance, Repair and rehabilitation, Facets of maintenance, Importance of maintenance, various aspects of inspection, Assessment procedure for evaluating a damaged structure, Causes of deterioration.

Module 2:   SERVICEABILITY AND DURABILITY OF CONCRETE   **(09 Periods)**

Quality assurance for concrete construction, Concrete properties – Strength, Permeability, Thermal properties; Cracks – Causes and effects due to climate, temperature, chemicals, and corrosion; Design and construction errors – Effects of cover thickness and cracking.

Module 3:   MATERIALS FOR REPAIR   **(10 Periods)**

Special concretes and mortar, Concrete chemicals, Special elements for accelerated strength gain, Expansive cement, Polymer concrete, Sulphur infiltrated concrete, Ferrocement, Fiber reinforced concrete, Rust eliminators and polymers coating for rebars during repair, Foamed concrete, Mortar and dry pack, Vacuum concrete.

Module 4:   TECHNIQUES FOR REPAIR   **(09 Periods)**

Load test for stability, Gunite and shotcrete, Epoxy injection, Mortar repair for cracks, Shoring and underpinning, Methods of corrosion protection, Corrosion inhibitors, Corrosion resistant steels, Coating to reinforcement and cathodic protection; Repairs to overcome low member strength, deflection, chemical disruption, weathering, corrosion, wear, fire, leakage and marine exposure; Latest developments.

Module 5:   REHABILITATION, RETROFITTING AND DEMOLITION OF   **(09 Periods)**
STRUCTURES

Rehabilitation, Retrofitting of Structures: Introduction to beam-shear capacity strengthening, Flexural strengthening, Column strengthening, Failure mode of masonry building, Retrofitting strategies for RC members global level and local level retrofitting; Retrofitting of historical buildings, strengthening and case studies; Latest developments.
Demolition of Structures: Engineered demolition techniques for dilapidated structures – Case studies.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Critically review the article Case study of demolition costs of residential buildings, construction, Construction Management and Economics (24) (2006) https://doi.org/10.1080/01446190500512024

2. Retrofit a three story damaged school building which has developed multiple cracks in floor slabs. Identify the load paths and possible damages and suggest the retrofitting measures.

RESOURCES

TEXT BOOKS:

1. Vidivelli, B., Rehabilitation of Concrete Structures, Standard Publishers Distributors, 2008.

2. Bhattacharjee. J., Concrete Structures Repair, Rehabilitation and Retrofitting, CBS Publishers and Distributors (P). Ltd., New Delhi, 2019.

REFERENCE BOOKS:

1. Shetty, M. S., Concrete Technology, S. Chand and Company Ltd., New Delhi, 2003.

2. Zongjinli, Advanced Concrete Technology, John Wiley and Sons, 2011.

3. Alexander, M. G., Beushausen, H. D., Dehn, F. and Moyo, P., Concrete Repair, Rehabilitation and Retrofitting III, CRC Press, Balkama, 2012.

4. Guha, P. K., Maintenance and Repairs of Buildings, New Central Book Agency (P) Ltd., 2006.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/105/105/105105213/

WEB RESOURCES:

1. Rehabilitation and Retrofitting of Structures:
   https://akanksha.iare.ac.in/index?route=course/details&course_id=754

2. Rehabilitation and Retrofitting of Structures:
   https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_RRS_Lecture_Notes_0.pdf

3. Types and Causes of Concrete Deterioration: https://www.cement.org/docs/default-source/th-paving-pdfs/concrete/types-and-causes-of-concrete-deterioration-is536.pdf

4. Deterioration of Structures: https://www.yashkrishi.com/deterioration-of-structures

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25CE205001	**BUILDING INFORMATION MODELLING (BIM)**	-	-	2	-	1

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Building Information Modelling (BIM), terminology associated with buildings, the theory and evolution of BIM, develop BIM models using Autodesk Revit, BIM and clash detection, its use and application for small- and large-scale building construction projects, prepare or feed into key project items such as cost estimation, Scheduling, Interference checking, Construction safety, and modelling of energy consumption.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand, demonstrate and apply the fundamental concepts of building information modelling (BIM) in an initial planning and program validation of buildings.

CO2. Analyse, design and integrates construction planning, scheduling & management processes through Building Information Modelling (BIM) in the construction of buildings.

CO3. Analyse and design a system to meet desired needs within realistic constraints such as economic, environmental, social, safety, and manufacturability.

CO4. Demonstrate and apply building information modelling for particular requirements of coordination & clash detection.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	2	3	1
CO2	2	3	3	1	3	2
CO3	2	3	1	1	3	2
CO4	-	3	3	2	3	3
Course Correlation Mapping	**2**	**3**	**3**	**2**	**3**	**2**

Correlation Levels: 3: High;   2: Medium; 1: Low

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Introduction to BIM- tools and uses.
2. Basic modelling and project navigation.
3. BIM tools and new workflows of construction planning & management.
4. Model-based quantity take off and cost estimating.
5. Scheduling and planning with 4D BIM.
6. Construction safety planning using BIM.
7. Cloud-BIM for design/construction coordination & clash detection.
8. Point cloud data for as-built modelling.
9. Rule-based model checking.
10. Term project plan presentation.
11. Case study: BIM for construction management.
12. Mini project.

RESOURCES

REFERENCES:

1. Manual…
2. Chuck Eastman, Paul Teicholz, Rafael Sacks, and Kathleen Liston, BIM Handbook: A guide to building information modelling for owners, managers, designers, engineers and contractors, 2nd Edition, John Wiley & Sons, 2011.
3. Karen Kensek, Building Information Modelling: BIM in Current and Future Practice, Wiley, 2014.

SOFTWARE/TOOLS:

1. Autodesk Revit

VIDEO LECTURES:

1. https://www.coursera.org/learn/bim-fundamentals
2. https://www.tuvsud.com/en-in/services/training/e-learning-courses/building-information-modeling-bim-basics

WEB RESOURCES:

1. http://help.autodesk.com/view/RVT/2016/ENU/
2. https://www.coursera.org/learn/bim-fundamentals
3. https://facilities.fiu.edu/Documents/Forms_Standards/FIU_BIM_Standard_120814.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25CE205002	**ADVANCED CONCRETE TECHNOLOGY LAB**	-	-	3	-	1.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience testing of hardened concrete, non-destructive testing of concrete, testing of beams.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Evaluate the properties of concrete using various tools and techniques to solve complex problems related to concrete technology by following relevant IS codes and latest developments ensuring cost effectiveness, safety, environment and sustainability.

CO2. Evaluate properties of beams using various tools and techniques to solve complex problems related to concrete technology by following relevant IS codes and latest developments ensuring cost effectiveness, safety, environment and sustainability.

CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on concrete technology.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	2	3	3	1
CO2	2	3	2	3	3	1
CO3	2	2	2	2	2	2
Course Correlation Mapping	**2**	**3**	**2**	**3**	**3**	**1**

Correlation Levels: 3: High;   2: Medium; 1: Low

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Determination of Workability Properties of fibre reinforced concrete (FRC).
2. Determine and correlate the compressive strength of control concrete to FRC.
3. Stress strain curve for concrete.
4. Correlation between cube strength and cylinder strength.
5. Determination of modulus of rupture concrete.
6. Correlation between compressive strength and Split Tensile strength.
7. Non-destructive testing of existing concrete members.
8. Behaviour of beams under flexure.
9. Behaviour of beams under shear.
10. Behaviour of beams under torsion.

RESOURCES

REFERENCES:

1. Advanced Concrete Technology Manual, Department of Civil Engineering, Sree Vidyanikethan Engineering College, Tirupati.
2. Duggal, S. K., Building Materials, New Age International Publishers, 4th Edition, 2012.
3. Neville,A. M.,Properties of Concrete, John Wiley and Sons, New Delhi, 5th Edition, 2011.

VIDEO LECTURES:

1. https://www.digimat.in/nptel/courses/video/105106176/L01.html
2. https://nptel.ac.in/courses/105102012

WEB RESOURCES:

1. https://www.sciencedirect.com/book/9780750656863/advanced-concrete-technology
2. https://www.hindawi.com/journals/ace/si/818751/
3. https://www.slideshare.net/selvaprakash549/advanced-concrete-technology-71802015
4. https://www.slideshare.net/selvaprakash549/advanced-concrete-technology-3

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
25CE205003	**COMPUTER APPLICATIONS IN CONSTRUCTION PROJECT MANAGEMENT**	-	-	3	-	1.5

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on project planning, scheduling, control and estimation in small and major construction projects using different software.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze project planning and scheduling for various construction projects using various tools and techniques to solve complex construction problems by following relevant codes and latest developments ensuring cost effectiveness and safety.

CO2. Estimate and analyze the project budget and rates using various tools and techniques to solve complex problems related to construction by following relevant codes and latest developments ensuring cost effectiveness and safety.

CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on project planning, scheduling, control and estimation in small and major construction projects.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	1	3	3	1
CO2	2	3	2	3	3	1
CO3	2	3	2	2	2	2
Course Correlation Mapping	**2**	**3**	**2**	**3**	**3**	**2**

Correlation Levels: 3: High;   2: Medium; 1: Low

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Estimate the detailed quantity and abstract for the given building plan using MS Excel
2. Prepare a scheduling report for a given project using MS Excel
3. Prepare a work breakdown structure (WBS) for small construction project in MS Project 2010 Software.
4. Execute project planning and scheduling for a given construction project using MS Project 2010 software.
5. Allocate the resources and update the activity status for the given construction project using MS Project 2010 software.
6. Track a project and prepare a report for cost analysis to the given construction project using MS Project 2010 software.
7. Execute project planning and scheduling for a given construction project using PRIMAVERA software
8. Allocate the resources and update the activity status for the given construction project and also track the project using PRIMAVERA software.
9. Prepare a detailed estimate report for a small construction project using Estimator 2.0 software.
10. Generate an abstract estimate report and the reports for rate analysis of different items of work in Estimator 2.0 software.

RESOURCES

REFERENCES:

1. Computer Applications In Construction Project Management Manual, Department of Civil Engineering, Sree Vidyanikethan Engineering College, Tirupati.
2. Step by Step Microsoft Project 2010, Carl Chatfield, PMP and Timothy Johnson, MCP, Microsoft Press, Redmond, Washington.
3. Oracle Primavera P6 User Guide, Version 21, December 2021.

SOFTWARE/TOOLS:
1. MS Project 2010 Software
2. PRIMAVERA software
3. Estimator 2.0 software

VIDEO LECTURES:

1. https://www.udemy.com/course/microsoft-project-tutorial/
2. https://www.udemy.com/course/project-management-with-primavera-p6/
3. https://www.youtube.com/playlist?list=PLuX_PtBw-QK1-c-B5D8SiJjfOttjxmHf6

WEB RESOURCES:
1. https://estimator.soft112.com/
2. http://www.asciutto.com/project2010/Project2010_eBook.pdf
3. https://docs.oracle.com/cd/F37125_01/English/User_Guides/p6_eppm_user/p6_eppm_user pdf.

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201007	**SMART MATERIALS AND STRUCTURES**	3	-	-	-	3

Pre-Requisite   Modern Construction Materials

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: This course provides a detailed discussion on Smart materials and structures; Measuring techniques and types; Sensing systems; Actuators; Data acquisition and processing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze smart materials and various components of smart structures to solve problems associated with smart structures for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

CO2. Analyze various strain measuring tools to solve problems associated with smart structures for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning

CO3. Analyze various sensing systems to solve problems associated with smart structures for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

CO4. Analyze various materials and techniques used in actuators to solve problems associated with smart structures for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

CO5. Analyze the signals from the smart structures and monitor the structural deficiencies prior to failure to solve problems associated with smart structures for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	2	3	3	2
CO2	2	3	1	3	3	2
CO3	2	3	3	3	3	2
CO4	2	3	3	3	3	2
CO5	2	3	3	3	3	2
Course Correlation Mapping	**2**	**3**	**3**	**3**	**3**	**2**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1: SMART MATERIALS AND STRUCTURES   **(08 Periods)**

Smart materials and structures, Instrumented structures functions and response Sensing systems, Self-diagnosis, Signal processing consideration, Actuation systems and effectors.

Module 2: MEASURING TECHNIQUES AND TYPES   **(08 Periods)**

Strain measuring techniques using electrical strain gauges- Types, Resistance, Capacitance, Inductance, Wheatstone bridges, Pressure transducers, Load cells, Temperature compensation, and Strain rosettes.

Module 3: SENSING SYSTEMS   **(11 Periods)**

Sensing technology, Types of sensors, Physical measurement using piezo electric strain measurement, Inductively read transducers, LVDT, Fiber optic techniques, Chemical and Bio-chemical sensing in structural assessment, Absorptive chemical sensors, Spectroscopes, Fibre optic chemical sensing systems and distributed measurement.

Module 4: ACTUATORS   **(09 Periods)**

Actuator techniques, Actuator and actuator materials, Piezoelectric and electro strictive material, Magneto structure material, Shape memory alloys, Electro rheological fluids, Electromagnetic actuation, Role of actuators and Actuator materials

Module 5: DATA ACQUISITION AND PROCESSING   **(09 Periods)**

Data acquisition and processing, Signal processing and control for smart structures, Sensors as geometrical processors, Signal processing, Control system- Linear and non-linear.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Modify a normal bridge in to smart bridge.

2. Design a smart home with major utilization of smart materials

3. Critically review the Bosch Singapore Campus: Smart building concept turned reality
    https://www.youtube.com/watch?v=n5aTeQkBBew&ab_channel=BoschIO

RESOURCES

TEXT BOOKS:

1. Brain Culshaw, Smart Structure and Materials, Artech House – Borton. London, 2004.

2. Srinivasan, A. V. and Michael McFarland, D., Smart Structures: Analysis and Design, Cambridge University Press, 2009.

REFERENCE BOOKS:

1. Gandhi, M.V. and Thompson, B.S., Smart Materials and Structures, Chapman and Hall, New York, 1992.

2. Mel. M Schwartz, Encyclopedia of Smart Materials, John Wiley and Sons Inc., 2002.

3. Srinath, L. S., Raghavan, M.R., Lingaiah, K., Gargesa. G., Pant. B., Ramachandra, K., Experimental Stress Analysis, Tata McGraw-Hill, 1984.

4. Dally, J. W. and Riley, W. F., Experimental Stress Analysis, Tata McGraw-Hill, 3rd Edition, 1991.

VIDEO LECTURES:

1. http://nptel.ac.in/courses/112104251

WEB RESOURCES:

1. Applications of smart materials in Structural Engineering:
    https://www.ltrc.lsu.edu/pdf/report_375.pdf

2. Role of Smart Materials in Civil Engineering:
    https://www.ltrc.lsu.edu/pdf/report_375.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE203002	**INFRASTRUCTURE DEVELOPMENT AND MANAGEMENT**	2	-	-	4	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on infrastructure development, overview of Indian infrastructure, tenders, contracts and specifications, policies on infrastructure development, construction and infrastructure, and infrastructure management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the impact of infrastructure development on society, economy and environment to solve infrastructure problems ensuring sustainability.

CO2. Analyze the Indian infrastructure to solve infrastructure problems following relevant government policies and regulations considering society, environment, sustainability and finance.

CO3. Analyze the policies on infrastructure development to solve complex infrastructure problems considering society, environment and sustainability.

CO4. Analyze the construction components of various infrastructure sectors to solve complex infrastructure problems following government policies and regulations considering society, environment and sustainability.

CO5. Analyze the infrastructure management in various sectors to solve infrastructure problems using appropriate tools and techniques following relevant guidelines, policies and regulations considering society, environment and sustainability.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	1	1	1	2
CO2	3	3	1	1	1	2
CO3	3	3	2	2	3	2
CO4	3	3	3	2	-	2
CO5	3	3	1	1	2	3
Course Correlation Mapping	**3**	**3**	**2**	**2**	**2**	**2**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1:   INFRASTRUCTURE DEVELOPMENT   (06 Periods)

Impact of infrastructure development on economic growth, standard of living and environment; Reasons for rise of public sector and government involvement in infrastructural activities, Changed socio-economic scenario and current problems and related issues.

Module 2:   OVERVIEW OF INDIAN INFRASTRUCTURE   (06 Periods)

Indian Infrastructure: Energy, Power, Water resources, Dams, Bridges, Canals, Rural Infrastructure, Urban Infrastructure, Housing, Roads, Railways, Ports, Airports, Social Infrastructure, Education, Health care, Infrastructure deficiencies.

Tenders, Contracts and Specifications: Public Private Partnership (PPP) contracts, Turnkey contracts, FIDIC clauses.

Module 3:   POLICIES ON INFRASTRUCTURE DEVELOPMENT   (06 Periods)

A historical review of the government policies on infrastructure; Current public policies on transportation, power and telecom sectors; Plans for infrastructure development; Legal framework for regulating private participation - Roads and highways, Ports and airports, Power and telecom.

Module 4:   CONSTRUCTION AND INFRASTRUCTURE   (06 Periods)

Construction component of various infrastructure sectors: Highways, Ports and aviation, Oil and gas, Power, Telecom, Railways, Irrigation; Current scenario, Future needs, Investment needed, Regulatory framework, Government policies and future plans, Technological and methodological demands on construction management in infrastructure development projects.

Module 5:   INFRASTRUCTURE MANAGEMENT   (06 Periods)

Importance, scope and role in different sectors of construction

- **Highway Sector:** Repayment of Funds, Toll Collection Strategy, Shadow tolling, and direct tolls, Maintenance strategy, Review of toll rates & structuring to suit the traffic demand.
- **Irrigation Projects:** Large / Small Dams, Instrumentation, Monitoring of water levels, Catchments area, Rainfall data management, Prediction, Land irrigation planning & policies, Processes Barrages, Canals.
- **Power Projects:** Power scenario in India, Estimated requirement, Generation of power distribution strategies, National grid, Load calculation & factors, Hydropower, Day to day operations, Management structures, Maintenance, Thermal Power, Nuclear Power.
- **Airports:** Requisites of domestic and International airports, Cargo and military airports, Facilities available, Terminal management, ATC.
- **Railways:** Mass Rapid Transport System MRTS, LRT, Multi–modal Transport System.

Total Periods: 30

PROJECT BASED LEARNING:

Projects relevant to the contents of the course will be provided by the course instructor at the beginning.

LIST OF PROJECTS:

1. Consider any one of the metropolitan cities in India and conduct studies on impact of infrastructural development on various sectors.

2. Conduct a detailed study on Indian infrastructure under various sectors and prepare a brief report on various infrastructural deficiencies in our country.

3. Investigate the future needs of infrastructure development in India and suggest some suitable policies and future plans to be implemented for attracting the investments.

4. Visit any nearby highway toll plaza and prepare a detailed report on how the toll collection management system works.

5. Conduct various studies in and around Tirupati and suggest suitable Mass Rapid Transit System to reduce the fuel consumption, environmental pollution and traffic congestion.

RESOURCES

TEXT BOOKS:

1. Narindar Jetli K. and Vishal Sethi, Infrastructure Development in India Post Liberalization Initiatives and Challenges, New Century Publications, 2007.

2. Raghuram G. and Jain R., Infrastructure Development and Financing towards a Public–Private Partnership, Macmillan India Ltd., 2002.

REFERENCE BOOKS:

1. Joshi R. N., Public Private Partnership in Infrastructure Perspectives, Principles, Practice, Vision Books, 2000.

2. Prasanna Chandra, Projects: Planning, Analysis, Selection, Financing, Implementation and Review, Mc. Graw Hill Education, 8th Edition, 2014.

3. Murty G. R. K., Infrastructure Projects: Current Financing Trends, ICFAI University Press, 2006.

4. Anup Chatterjee, Narinder Jetli, K. and Vishal Sethi, Industry and Infrastructure Development in India since 1947, New Century Publications, 2009.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105106188

2. https://nptel.ac.in/courses/105103133

WEB RESOURCES:

1. https://gh.copernicus.org/articles/66/100/2011/gh-66-100-2011.pdf

2. https://drive.google.com/file/d/1WDoWBuC8rvxUxpJyX9wrKNYaQe49ILWn/view

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201008	**REAL ESTATE AND FACILITIES MANAGEMENT**	3	-	-	-	3

Pre-Requisite   Construction and Contract Laws and Regulations

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: Introduction to Real Estate; Real Estate Considerations, Analysis, and Planning; Facility Management; Long-Range and Annual Facility Planning; Maintenance and Operations in Facility Management; Successful Facility Management.

LEARNING OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply knowledge of real estate to understand and solve problems of real estate and facility management by following relevant standards and latest developments considering society, legal issues, environment, project management and financial besides communicating effectively in graphical form.

CO2. Analyze the real estate management for planning the strategies of real estate activities to solve complex problems of real estate and facility management using appropriate tools and techniques by following relevant standards and latest developments considering society, legal issues, environment, project management and financial besides communicating effectively in graphical form.

CO3. Analyze the facility management for strategic Long-Range and Annual Facility Planning of real estate activities to solve complex problems of real estate and facility management using appropriate tools and techniques by following relevant standards and latest developments considering society, legal issues, environment, project management and financial besides communicating effectively in graphical form.

CO4. Analyze the Maintenance and Operations in Facility Management to solve complex problems of real estate and facilities management using appropriate tools and techniques by following relevant standards and latest developments considering society, legal issues, environment, project management and financial besides communicating effectively in graphical form.

CO5. Analyze the futuristic requirements and developments for the successful facility management to solve the problems of real estate and facilities management using appropriate tools and techniques by following relevant standards and latest developments considering society, legal issues, environment, project management and financial besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	3	2	1	1
CO2	3	3	3	2	3	2
CO3	3	3	3	2	1	1
CO4	3	1	3	2	3	3
CO5	3	1	3	3	3	3
Course Correlation Mapping	**3**	**2**	**3**	**3**	**3**	**2**

Correlation Levels: 3: High;   2: Medium; 1: Low

COURSE CONTENT

Module 1:   REAL ESTATE   (08 Periods)

Real Estate: Real estate, Types of Real Estate- Residential Real Estate, Commercial Real Estate, Industrial Real Estate, Land Real Estate; Important Terms and Definitions of Real Estate, Becoming a Real Estate Agent, Business Plan for Real Estate, Real Estate Transactions, Investing in Real Estate, Real Estate Laws.

Module 2:   REAL ESTATE CONSIDERATIONS, ANALYSIS, AND   (11 Periods)
**   PLANNING**

Real Estate Considerations, Analysis, and Planning: Responsibilities of Real Estate Function, Objectives of the Real Estate Function, Best Practices in Corporate Real Estate Management, Strategic Planning, Issues for Review and Analysis, Real Estate and Facility Inventory, Determining Your Customer's Requirements, Lease Property Negotiating Checklist, Purchase Property Negotiating Checklist, Sample Lease—Proposal Letter, Sample Purchase—Letter of Intent, Site Criteria Considerations, Selecting a Real Estate Broker, Sample Sales Agency Agreement, Principal Analytical and Transactional Activities, The Process of Acquisition, Your Site Evaluation Criteria Your Customer's Site Evaluation Criteria, Environmental and Due Diligence Issues, Sample Property Environmental Executive Summary, Legal Document Review Process, Lease Agreement Sample for ABC Company.

Module 3:   FACILITY MANAGEMENT, LONG-RANGE AND ANNUAL (09 Periods)
**   FACILITY PLANNING**

Facility Management: Introduction to Facility Management, Definitions, Organizational and Human Resources Issues, Ethics, The Facility Management Mission, You and Your Customer, Negotiation Strategies, Total Quality Management.

Long-Range and Annual Facility Planning: Long-range Facility Planning Process, Strategic Facility Management Functions, Synchronizing Corporate Planning and Corporate Facility Management, Strategic Planning, Annual Operating Plan, The Long-range Plan. Sample—Corporate Facilities Procedure, Strategic Real Estate and Facility Planning Sample—Strategic Real Estate/Facility and Market Policy, Strategic Corporate Facility Management Information, Disposition of Assets.

Module 4:   MAINTENANCE AND OPERATIONS IN FACILITY   (09 Periods)
**   MANAGEMENT**

Maintenance and Operations in Facility Management:, The Importance of Maintenance and Operations, Predictive Maintenance, Goals of Maintenance and Operations, Maintenance and Operations Alternatives, The Facility Maintenance Management Function, Management Planning Process, Sample—Outsourcing Maintenance Services Request for Proposal Guidelines and Statement of Work, Managing the Physical Asset, Intracompany and Customer Relations, Financial Reporting and Controls, Administrative Responsibilities, Marketing and Leasing.

Module 5:   FACILITY MANAGEMENT   (08 Periods)

Successful Facility Management: Education, Integrated Asset Management, Communications and Leadership, Main functions of a facility manager for successful facilities management, Skill sets of a Facility Manager, Moving Toward the Future, Traditions, The Future of Facility Management.

**   Total Periods: 45**

EXPERIENTIAL LEARNING

The following is the sample. Faculty shall frame according to the course domain.

1. Take an area of 100 acres and execute a real estate project work flow with a strategic planning to market the plots derived from the 100 acres land. Represent the steps followed from registration of real estate business to selling of the plots.

2. Select any aged residential building in the nearby places and analyze the maintenance and operations cost for renovating the building using the concept of facilities management. Also document a short report with key points of execution.

3. Critically review the case study: Indian Institute of Management -Case Study on Kolkata Facilities Management: https://www.youtube.com/watch?v=e5wTlbYjBU0

4. Real estate project investment strategy in context to market timing and developer experience: In this study, students investigates a decade time cycle (2012 to 2022) in city of Tirupati with stratified sample data of more than 50 completed Real estate projects (residential and commercial) and inquiries into the timing of project announcement in reference to the phases of market cycle; recovery, expansion, hyper supply and recession. A multiple linear regression analysis of the projects should be done to reveal an interesting trend on contrasting decision making adopted by experienced developers as compared to new/amateur real estate developers. A detailed flow of project work should be documented as a project report.

RESOURCES

TEXT BOOKS:

1. Edmond P. Rondeau, Robert Kevin Brown, Paul D. Lapides, Facility Management, 2nd Edition, John Wiley and Sons, 2006.

2. Kathy O. Roper, Richard P. Payant, The Facility Management Handbook, 4th Edition, American Management Association, 2014.

REFERENCE BOOKS:

1. Dr. Adv. Harshul Savla, Real Estate Laws: Compendium of Indian Real Estate Laws, 1st Edition, Notion Press, 2021.

2. Michel Theriault, Managing Facilities & Real Estate, 1st Edition, WoodStone Press, 2010.

3. Dr. Adv. Harshul Savla (Author), Ar. Pallavi Patil, Facility Management: Indian & Global Best Practices, 1st Edition, Notion Press, 2021.

4. Anker Jensen, Theo van der Voordt, Facilities Management and Corporate Real Estate Management as Value Drivers, 1st Edition, Routledge, 2020.

WEB RESOURCES:

1. https://freevideolectures.com/course/4776/nptel-housing-policy-planning/37

2. https://onlinecourses.nptel.ac.in/noc21_me18/preview

3. https://www.facilitiesnet.com/site/casestudies/Case-Studies--1

4. https://key.fm/experience/facilities-management-case-studies/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201009	**ENVIRONMENTAL MANAGEMENT SYSTEM**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with the introduction to Environmental Management Systems and focus on framework for developing an Environmental Management System. This course also reviews the Procedures and Guidelines to conduct Environmental Audit.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze environmental problems to maintain management standards using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO2. Analyze environmental issues and propose a preventive management using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO3. Analyze environmental problems and propose a environmental management system using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO4. Analyze and audit environmental system using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO5. Analyze environmental management system and its applications using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	2	3	1	3
CO2	2	3	2	2	2	3
CO3	2	3	3	3	3	3
CO4	2	3	2	2	2	3
CO5	2	3	2	3	2	3
Course Correlation Mapping	**2**	**3**	**3**	**3**	**2**	**3**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1:   ENVIRONMENTAL MANAGEMENT STANDARDS   (09 Periods)

Unique Characteristics of Environmental Problems - Systems approach to Corporate environmental management - Classification of Environmental Impact Reduction Efforts - Business Charter for Sustainable Production and Consumption – Tools, Business strategy drivers and Barriers - Evolution of Environmental Stewardship – Environmental Management Principles - National policies on environment, abatement of pollution and conservation of resources - Charter on Corporate responsibility for Environmental protection - Environmental quality objectives – Rationale of Environmental standards: Concentration and Mass standards, Effluent and stream standards, Emission and ambient standards, Minimum national standards, environmental performance evaluation: Indicators, benchmarking

Module 2:   PREVENTIVE ENVIRONMENTAL MANAGEMENT   (08 Periods)

Pollution control Vs Pollution Prevention - Opportunities and Barriers – Cleaner production and Clean technology, closing the loops, zero discharge technologies – Four Stages and nine approaches of Pollution Prevention - Getting management commitment – Analysis of Process Steps- source reduction,   raw material substitution, toxic use reduction and elimination, process modification Material balance – Technical, economic and environmental feasibility evaluation of Pollution Prevention options in selected industries – Preventive Environmental Management over Product cycle.

Module 3:   ENVIRONMENTAL MANAGEMENT SYSTEM   (10 Periods)

EMAS, ISO 14000 - EMS as per ISO 14001– benefits and barriers of EMS – Concept of continual improvement and pollution prevention - environmental policy – initial environmental review – environmental aspect and impact analysis – legal and other requirements- objectives and targets – environmental management programs – structure and responsibility – training awareness and competence- communication – documentation and document control – operational control – monitoring and measurement – management review.

Module 4:   ENVIRONMENTAL AUDIT   (10 Periods)

Environmental management system audits as per ISO 19011 – Roles and qualifications of auditors - Environmental performance indicators and their evaluation – Non-conformance – Corrective and preventive actions -compliance audits – waste audits and waste minimization planning – Environmental statement (form V) - Due diligence audit

Module 5:   APPLICATIONS   (08 Periods)

Applications of EMS, Waste Audits and Pollution Prevention opportunities in Textile, Sugar, Pulp & Paper, Electroplating, Tanning industry, Dairy, Cement, Chemical industries, etc

Total Periods: 45

EXPERIENTIAL LEARNING

1.   Frame an Environmental Management System for a community using ISO 14001.

2.   Prepare an Environmental Audit Report for a industry as per ISO 19011.

RESOURCES

TEXT BOOKS:

1. Paul L Bishop „Pollution Prevention: Fundamentals and Practice", McGraw- Hill International, Boston, 2000.

2. Christopher Sheldon and Mark Yoxon, "Installing Environmental management Systems – a step by step guide" Earthscan Publications Ltd, London, 1999.

REFERENCE BOOKS:

1. Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International, Ann Arbor, Michigan, January 2001.

2. ISO 14001/14004: Environmental management systems – Requirements and Guidelines – International Organisation for Standardisation, 2004

3. ISO 19011: 2002, "Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, 2002

VIDEO LECTURES:

1. https://nptel.ac.in/courses/114106017

2. https://nptel.ac.in/courses/120108004

WEB RESOURCES:

1. USEPA - Environmental Management Systems - https://www.epa.gov/ems/learn-about-environmental-management-systems

2. ISO 14001 ENVIRONMENTAL MANAGEMENT - https://www.iso.org/iso-14001-environmental-management.html

3. WHAT ARE ENVIRONMENTAL MANAGEMENT SYSTEMS (EMS)? - https://asq.org/quality-resources/environmental-management-system

PROGRAMME ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201010	**CONSTRUCTION ECONOMICS AND FINANCE**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION:

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze engineering economics to solve complex construction problems following latest developments by using appropriate tools and techniques considering relevant code of practice, communicating and manage effectively.

CO2. Analyze construction economics to solve complex problems following latest developments by using appropriate tools and techniques considering communicating and manage effectively.

CO3. Analyze equipment economics and cost estimation to solve complex construction problems following latest developments by using appropriate tools and techniques considering safety, relevant code of practice, communicating and cost manage effectively.

CO4. Analyze financial management and investments decisions to solve complex construction problems following latest developments by using appropriate tools and techniques considering safety, communicating and cost manage effectively.

CO5. Analyze construction accounts to solve complex construction problems following latest case studies by using appropriate tools and techniques considering safety, relevant code of practice, communicating and cost manage effectively.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	2	2	2	1
CO2	3	3	3	2	2	1
CO3	3	3	2	2	2	3
CO4	3	3	2	2	2	2
CO5	3	3	3	2	2	3
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**2**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1:   ENGINEERING ECONOMICS   (08 Periods)

Role of Civil Engineering in Industrial Development, Flow in Economy, Law of supply and demand; Concept of Engineering Economics, Types of efficiency, Elements of costs and other costs/revenues; Break-Even analysis; Profit/Volume Ratio(P/V Ratio)

Module 2:   ECONOMIC ANALYSIS   (07 Periods)

Simple Economic Analysis, Examples; Time Value of Money, interest formulas, Bases for comparison of alternatives; Present worth method of comparison, Future worth method, Annual equivalent method, Revenue-dominated cash flow diagram, cost-dominated cash flow diagram, Rate of return method.

Module 3:   EQUIPMENT ECONOMICS AND COST ESTIMATION   (10 Periods)

Equipment Economics: Equipment maintenance, Equipment cost, Operating costs, Depreciation analysis, Buy, rent and lease of equipments.
Cost Estimation: Types of estimates, Approximate estimates, parametric estimates, Cost estimation of construction projects, cost plus pricing, Construction cost control

Module 4:   FINANCIAL MANAGEMENT AND INVESTMENTS DECISIONS   (11 Periods)

Financial Management: Need for Financial Management, types of financing, short term borrowing, long term borrowing, leasing, equity financing, internal generation of funds; Assistance from government budgeting support and international finance corporations;
Investment Decision: Introduction, Nature of Investment Decisions, Investment Evaluation criteria, Net Present Value (NPV)Methods, Internal Rate of Return (IRR) Method, Profitability Index; Payback period and Discounted payback period,

Module 5:   CONSTRUCTION ACCOUNTS AND CASE STUDIES   (09 Periods)

Construction Accounts: Accounting Process, Preparation of profit and loss account and balance sheet as per companies Act, Preparation of Contract accounts for projects, Escrow account for PPP Projects
Case Studies: PPP Projects, Dams and canals, Mass Transit system, Government Funded project with respect to a) project appraisal, b) Raising of funds and c) Cost to complete analysis.

Total Periods: 45

EXPERIENTIAL LEARNING

1.   Prepare a detailed report on project investment analysis.

2.   Prepare a ledger report for a construction project.

RESOURCES

TEXT BOOKS:

 1. Anthony Higham, Carl Bridge, Peter Farrell, Project Finance for Constriction, Routledge, 2016

 2. Steven J. Peterson, Construction Accounting & Financial Management, Pearson USA, 2012.

REFERENCE BOOKS:

 1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning, Equipment and Methods", McGraw Hill, Singapore, 2006.

 2. Panneerselvam R., Engineering Economics, PHI Learning, India

 3. "Financial Management" – Indian Institute of Banking and Finance – Macmillan Publications.

VIDEO LECTURES:

 1. NPTEL :: Civil Engineering - Construction Economics & Finance

 2. Intro - Introduction to Accounting and Finance for Civil Engineers - Prof. Sudhir Misra - YouTube

WEB RESOURCES:

 1. Introduction to Construction Economics | PPT (slideshare.net)

 2. Construction Economics: The Economics and Management of Building and Construction (desklib.com)

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE203003	**URBAN PLANNING AND DESIGN**	3	-	-	4	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on city planning, economy and environment, planning theories and institutional mechanisms, infrastructure planning, evaluation of urban structure, concept of urban design

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Acquire knowledge on smart city and aspects to be considered when planning a city by considering environment and economy to solve problems associated with normal city for ensuring safety and sustainability using appropriate tools and techniques in structures through graphical representation besides lifelong learning.

CO2. Analyze the factors by knowing existing theories of planning to solve problems associated with existing theories for ensuring safety and sustainability using appropriate tools and techniques in structures through graphical representation besides lifelong learning.

CO3. Analyze the various aspects of sustainable infrastructure and plan development to solve problems associated with the urban structure for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

CO4. Evaluate the sustainable transportation system to solve problems associated with the existing transportation system for ensuring safety and sustainability using appropriate tools and techniques besides lifelong learning.

CO5. Analyze the concept of urban design to solve problems associated with existing design for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	1	3	3	2
CO2	2	3	2	3	3	2
CO3	2	3	3	3	3	2
CO4	2	3	3	3	3	2
CO5	2	3	2	3	3	2
Course Correlation Mapping	**2**	**3**	**3**	**3**	**3**	**2**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1: CITY PLANNING, ECONOMY AND ENVIRONMENT **(08 Periods)**

Overview of planning from prehistory to current - Industrialization and the transformation of Urban Space - Types of plans- master plans, development plans, Introduction of Remote sensing, GIS and GPS in urban planning. Smart City Planning, Indian cities and challenges involved in planning -Urban Renewal and Suburbanization - Downtown Redevelopment - Planning for Disaster risk reduction - Energy and Sustainability -Global Sustainability Issues and Climate Change - Concepts of EIA and LCA.

Module 2: PLANNING THEORIES AND INSTITUTIONAL **(08 Periods)**
MECHANISMS

Theory of city form: normative models –cosmic, machine, organic; Concentric Zone Theory, Sector Theory, Multiple Nuclei Theory - Modes of planning -Land use and land value -Emerging Concepts and Environmental Planning. Planning system in India and changes in institutional provisions over time - authorities and mechanisms for planning, implementation and evaluation - levels of hierarchy. Digital Data Integration with Sustainable Smart Cities.

Module 3: INFRASTRUCTURE PLANNING **(09 Periods)**

Infrastructure Planning - Concepts of basic needs, formation of objectives and standards, Critical issues in sustainable infrastructural planning- Data requirements for planning of urban networks and service - feasibility planning studies for structure, infrastructure systems. Technology for Sustainable Smart City Infrastructure. Recycling Technologies and Renewable energy.

Module 4: URBAN STRUCTURE **(10 Periods)**

Infrastructure and management -Sustainable Transportation systems and their types - design and operating characteristics - urban road hierarchy planning - criteria for road and junction improvements - arterial improvement techniques. Integrated inter-modal transport systems.

Module 5: CONCEPT OF URBAN DESIGN **(10 Periods)**

Concept & theories of Urban Design, Tools and techniques of Urban Design mapping and Qualitative survey, Principles of Urban conservation, renewal, regeneration, restoration, preservation and philosophies. Indian case studies related to the project: Cultural, historical, social, political analyses and studies. Design problem and process, Methodologies to resolve the design issues related to the project, Evolution of ideas, concepts, processes.

Total Periods: 45

PROJECT BASED LEARNING

1. Prepare the master plan of Srinivasa Mangapuram.
2. Determine the land use and estimate the land value in Rangampet.
3. Modify a normal city into a smart city.
4. Modify the transportation system into a sustainable transportation system
5. Design a smart city by reducing the environmental Impacts.

RESOURCES

TEXT BOOKS:

1. Peter Hall, Mark Tewdwr-Jones., Urban and Regional Planning, 4th Edition, Routledge, 2010.
2. Darrin Burnnerand Viviana Kaminski., Urban Studies and Sprawl (Concepts, Elements and Issues), Academic Studio, New York, 2016.

REFERENCE BOOKS:

1. Peter Hall., Cities of Tomorrow, An Intellectual History of Urban Planning and Design Since 1880. 4th Edition, Wiley-Blackwell, 2014.
2. Joy Sen., Sustainable Urban Planning, The Energy and Resources Institute (TERI), New Delhi, India, 2013.
3. Martin. E., Housing, Climate and Comfort. The Architectural Press: London, 1980.
4. Williams,D., Sustainable Design: Ecology, Architecture & Planning. New Jersey: John Wiley &Sons, 2007.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/124107158

WEB RESOURCES:

1. Urban Planning and Urban Design:
   https://uccrn.ei.columbia.edu/sites/default/files/content/pubs/ARC3.2-PDF-Chapter-5-Urban-Planning-and-Design-wecompress.com_.pdf
2. The role of urban planning and urban design on safe cities:
   https://iopscience.iop.org/article/10.1088/1757-899X/1058/1/012065/pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE202001	**SUPPLY CHAIN MANAGEMENT**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on supply chain management, sourcing, transportation, pricing, coordination and technology and emerging concepts.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Impart knowledge on supply chain management using different tools and techniques for civil engineering construction considering codes of practice, safety, environment and sustainability besides communicating effectively in graphical form.

CO2. Design supply chain using different tools and techniques and through continuous learning for civil engineering construction considering codes of practice, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyse transportation using different tools and techniques and through continuous learning for civil engineering construction considering codes of practice, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyse pricing, coordination and technology through continuous learning for civil engineering construction considering codes of practice, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyse emerging concepts of supply chain through continuous learning for civil engineering construction considering codes of practice, environment and sustainability.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	1	1	1
CO2	3	3	3	3	3	3
CO3	3	3	-	2	3	3
CO4	2	3	3	1	1	3
CO5	-	1	3	3	1	3
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**3**

Correlation Levels: 3: High;   2: Medium;1: Low

COURSE CONTENT

Module 1:   CONCEPT OF SUPPLY CHAIN MANAGEMENT   (08 Periods)

Supply chain stages, Decision phases process, View of a supply chain, Supply chain flows, Examples, Competitive and supply chain strategies, supply chain performance, Framework for structuring drivers, Obstacles to achieving fit, Case discussions.

Module 2:   DESIGNING AND SOURCING   (09 Periods)

Designing: Distribution Networking, Role, Design, Supply Chain Network, Role, Factors, and Framework for Design Decisions, Models for facility location and capacity allocation, Discounted cash flow analysis, Evaluating network design, Decision trees.
Sourcing: Role of sourcing, supplier – scoring and assessment, selection and contracts, Design collaboration, Case Studies.

Module 3:   TRANSPORTATION   (09 Periods)

Role of transportation, Factors affecting transportation decisions, Modes of transportation and their performance characteristics, Designing transportation network, Trade-off in transportation design, Routing and scheduling in transportation, International transportation, Analytical problems.

Module 4:   PRICING, COORDINATION AND TECHNOLOGY   (10 Periods)

Pricing: Role Revenue Management in the supply chain, Revenue management for: Multiple customer segments, perishable assets, seasonal demand, bulk and spot contracts.
Coordination And Technology: Co-ordination in a supply chain: Bullwhip effect, Obstacles to coordination, Managerial levers to achieve co-ordination, Building strategic partnerships, Supply Chain IT framework, The role of E-business in a supply chain, The E-business framework, E-business in practice, Case discussion.

Module 5:   EMERGING CONCEPTS   (09 Periods)

Global Logistics, Reverse Logistics, Reasons, Activities, Role, Ware house Management, Components, applications, implementation, Lean supply Chains, Sustainable supply Chains.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Creating a new project using MS Project
2. Creating a Work break down structure in MS Project and assign resources to the tasks.
3. Identify different types of resources and allocate for project using PRIMAVERA
4. Scheduling and report preparation, Working with PRIMEVERA
5. Updating and report preparation using PRIMAVERA

RESOURCES

TEXT BOOKS:

1. Sunil Chopra, Peter Meindl and D V Kalra, Supply Chain Management: Strategy, Planning, and operation, Pearson, New Delhi, 2016.

2. Chitalend A. K. and Gupta R. C., Materials Management: A Supply Chain Perspective - Text and Cases, PHI India, New Delhi, 2014.

REFERENCE BOOKS:

1. Jeremy F.Shapiro, Modeling the supply chain, Thomson Duxbury, 2nd Edition, Cengage Learning, 2006.

2. David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi and Ravi Shankar, Designing and Managing the Supply Chain: Concept Startegies and Case Studies, McGraw Hill, 2009.

3. Saurabh Kumar Soni, Construction Management and Equipment, S. K. Kataria & Sons, 2014.

SOFTWARE/TOOLS:

1. MS Project Software
2. PRIMAVERA Software

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/110/106/110106045/
2. https://www.youtube.com/watch?v=Nrl0CtS1m8Y

WEB RESOURCES:

1. https://www.tutorialspoint.com/supply_chain_management/supply_chain_management_tutorial.pdf
2. https://www.investopedia.com/terms/s/scm.asp
3. https://www.geektonight.com/supply-chain-management-pdf/
4. https://ocw.mit.edu/courses/esd-273j-logistics-and-supply-chain-management-fall-2009/pages/lecture-notes/

PROGRAMME ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201011	**QUALITY CONTROL AND SAFETY**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Quality management; Quality control tools and statistical methods; Quality assurance and standards; Six sigma in quality management; safety in construction.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze quality management to solve construction problems by using appropriate tools and techniques considering health, safety, environment, sustainability and besides communicating effectively in graphical form.

CO2. Analyze quality control tools and statistical methods to solve construction problems by using appropriate tools and techniques considering health, safety, environment, and sustainability, relevant codes of practice and besides communicating effectively in graphical form.

CO3. Analyze quality assurance and standards to solve construction problems following latest developments by considering health, safety, environment, and sustainability, relevant codes of practice and besides communicating effectively in graphical form.

CO4. Analyze six sigma in quality management to solve construction problems by considering health, safety, and environment, and sustainability, relevant codes of practice and besides communicating effectively in graphical form.

CO5. Analyze construction safety to solve construction problems by considering health, safety, and environment, and sustainability, relevant codes of practice and besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	-	2
CO2	3	3	1	2	2	2
CO3	3	3	3	2	1	2
CO4	3	3	1	2	2	2
CO5	3	3	1	2	2	2
Course Correlation Mapping	**3**	**3**	**2**	**2**	**2**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1:   QUALITY MANAGEMENT   (08 Periods)

Importance of quality at construction site; Inspection and testing, Organization necessity for implementation of quality, quality manual – contents and data required. Monitoring for quality – PDCA cycle, Development of quality circles, inspection reports, monitoring and control, Ergonomics, Time of Completion, Taguchi's concept of quality

Module 2:   QUALITY CONTROL TOOLS AND STATISTICAL METHODS   (07 Periods)

Quality control tools: Histograms, Pareto diagrams, Fishbone diagram, Quality control – testing required for quality control of construction material used in RCC work- destructive and non destructive test (NDT)
Statistical Quality Control: Necessity, Benchmarking, Application of dispersion methods in quality control of construction activity.

Module 3:   QUALITY ASSURANCE AND STANDARDS   (10 Periods)

Quality Assurance: Objectives, Regulatory agent, Quality in Design, Contract and Construction, Techniques of QA and QC, Appraisals, Factors influencing Construction Quality – Critical, major Failures Aspects and Analysis.
Quality Standards: Planning and control of quality, Quality Audits, Acceptance sampling, ISO 9001, Third Party certification.

Module 4:   SIX SIGMA IN QUALITY MANAGEMENT   (11 Periods)

Evolution – historical aspects, probability distribution, Six sigma ratings, training, Applications – RCC Work in buildings, Dry lean Concrete (DLC) and Pavement Quality Concrete (PQC) layers in road construction.

Module 5:   SAFETY IN CONSTRUCTION   (09 Periods)

Introduction to safety, safety and health programs in construction industry, safety provisions, Analysis of construction hazards and accidents, prevention techniques, safety requirements for scaffolding, site management, training and safety awareness and implementation, safety codes and manuals.

Total Periods: 45

EXPERIENTIAL LEARNING:

1. Statistical Evaluation on field tests

2. Analyze the quality management system of any one construction organization

3. Prepare a report on the Quality assessment on any existing building.

4. Apply the six sigma rule on a company with critical quality risks.

5. Prepare a life cycle costing for a construction project.

RESOURCES

TEXT BOOKS:

1. P. L. Jain, Quality Control and Total Quality Management, Tata Mcgraw Hill publishers.
2. V. J. Davies, K. Tomsain, Construction safety Handbook, 2nd Edition, Thomas Telford Publishing, 1996.

REFERENCE BOOKS:

1. Mantri Handbook – A to Z of construction – Mantri Publications.
2. Miller, Freund – Hall, Probability and Statistics for Engineers, Prentice India Ltd., 9th Edition, 2017.
3. Allan St. John Holt, Principles of Construction Safety, 2nd Edition, Blackwell Science Ltd., 2005.

IS CODES:

1. ISO 9001:2015 Quality Management System
2. IS 5121:1969 Safety code for piling and other deep Foundations
3. IS 5916:1970 Safety code for construction involving use of hot bituminous material
4. IS 4130:1991 Safety code for demolition of buildings
5. IS 4756:1978 Safety Code for Tunnelling Work

VIDEO LECTURES:

1. NPTEL :: Civil Engineering - NOC: Principles of Construction Management
2. Safety in Construction - Course (nptel.ac.in)

WEB RESOURCES:

1. Best ISO Certification Standards for the Construction Industry in UAE (aurioninternational.com)
2. Safety in Construction | Industry Today
3. Total Quality Management-TQM in Construction Industry (constructionplacements.com)

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE203004	**LEAN CONSTRUCTION PRACTICES**	2	-	-	4	3

Pre-Requisite   Construction Practices, Equipment and Automation

Anti-Requisite

Co-Requisite

COURSE DESCRIPTION: This course provides a detailed discussion on lean thinking, lean tools in construction, lean integration, enabling lean through information technology and techniques in construction management

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Acquire knowledge on lean thinking to solve problems associated with normal construction practices with productive measurement for ensuring safety and sustainability using appropriate tools and techniques in construction besides lifelong learning.

CO2. Acquire knowledge on lean tools in construction to solve problems associated with the old tools in construction ensuring safety and sustainability using appropriate tools and techniques besides lifelong learning.

CO3. Analyze the lean construction and safety to solve problems associated with existing construction for ensuring safety and sustainability using appropriate tools and techniques in construction besides lifelong learning.

CO4. Evaluate the building information modelling to solve problems associated with lean construction for ensuring safety and sustainability using appropriate tools and techniques in construction besides lifelong learning.

CO5. Evaluate the techniques in lean construction management to solve problems associated with general construction management techniques for ensuring safety and sustainability using appropriate tools and techniques in construction besides lifelong learning.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	2	3	3	1
CO2	2	3	1	3	3	2
CO3	2	3	2	3	3	2
CO4	2	3	2	3	3	2
CO5	2	3	3	3	3	2
Course Correlation Mapping	**2**	**3**	**2**	**3**	**3**	**2**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO LEAN CONSTRUCTION CONCEPTS   (06 Periods)
Introduction and overview of the construction project management - Review of Project Management & Productivity Measurement Systems – Productivity in Construction, Daily Progress Report, The state of the industry with respect to its management practices, construction project phases, Essential features of contemporary construction management techniques - The problems with current construction management techniques – Current production planning.

Module 2: LEAN MANAGEMENT   (06 Periods)
Introduction to lean management–Toyota's management principle-Evolution of lean in the construction industry-Production theories in construction–Lean construction value-Value in construction-Target value design–Lean project delivery system-Forms of waste in the construction industry–Waste Elimination.

Module 3: CORE CONCEPTS IN LEAN   (06 Periods)
Concepts in lean thinking–Principles of lean construction–Variability and its impact–Traditional construction and lean construction–Traditional project delivery-Lean construction and workflow reliability–Work structuring–Production control.

Module 4: LEAN CONSTRUCTION TOOLS AND TECHNIQUES   (06 Periods)
Value Stream Mapping–Work sampling–Last planner system–Flow and pull based production–Last Planner System–Look ahead schedule–constraint analysis–weekly planning meeting Daily Huddles–Root cause analysis–Continuous improvement–Just in time.

Module 5: LEAN CONSTRUCTION IMPLEMENTATION   (06 Periods)
Lean construction implementation-Enabling lean through information technology–Lean in design-Design Structure Matrix Location Based Management System-BIM (Building Information Modelling)-IPD (Integrated Project Delivery)–Sustainability through lean construction approach.

Total Periods: 30

PROJECT BASED LEARNING

1. Create a project with higher quality output and operations by defining the value.
2. Apply the method of cost control for a project "Construction of Dam across a river" through value stream mapping.
3. For Project construction of residential building of G+20, Identify possible risks and create a flow chart with solutions.
4. Create a network diagram for a project residential apartment project also form decision tree with possible outcomes of successful profit that the owner can gain at the end of the sales.

RESOURCES

TEXT BOOKS:

1. Forbes, L., Ahmed, S., Modern Construction-Lean project delivery and integrated practices. CRC Press, New York, 2011.
2. Patricia Tzortzopoulos, Mike Kagioglouand Lauri Koskela.,Lean Construction: Core concepts and New Frontiers, Routlege, Taylor and Francis Group, 2020

REFERENCE BOOKS:

1. Shang Gao and Sui Pheng Low.,Lean Construction Management: The Toyota Way,Springer, 2014
2. Lincoln H.Forbes and Syed M. Ahmed.,Lean Project Delivery and Integrated Practices in Modern Construction, Routlege, Taylor and Francis Group, 2020.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc22_ce49/preview

WEB RESOURCES:

1. http://www.leanconstruction.org/readings.htm

2. International Labour Organization (work sampling and Process charts)

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE202002	**ENERGY EFFICIENCY AND CONSERVATION IN BUILDINGS**	2	-	2	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

LEARNING OUTCOMES: After successful completion of the course, students will be able to:

CO1. Impart knowledge on supply chain management using different tools and techniques for civil engineering construction considering codes of practice, safety, environment and sustainability besides communicating effectively in graphical form.

CO2. Design supply chain using different tools and techniques and through continuous learning for civil engineering construction considering codes of practice, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyse transportation using different tools and techniques and through continuous learning for civil engineering construction considering codes of practice, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyse pricing, coordination and technology through continuous learning for civil engineering construction considering codes of practice, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyse emerging concepts of supply chain through continuous learning for civil engineering construction considering codes of practice, environment and sustainability.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	-	2	2	1
CO2	3	3	-	2	2	1
CO3	3	3	-	2	2	1
CO4	3	3	-	2	2	1
CO5	3	3	-	2	2	1
Course Correlation Mapping	**3**	**3**	**-**	**2**	**2**	**1**

Correlation Levels: 3: High;   2: Medium; 1: Low

COURSE CONTENT

Module 1:   NEED FOR ENERGY   **(06 Periods)**

Fundamentals of energy, Energy production systems, heating, ventilation and Air conditioning, Solar energy and conservation, Energy economic analysis, Energy conservation and audits, Domestic energy consumption, savings, challenges; Primary energy use in buildings, Residential, commercial, Institutional and Public Buildings.

Module 2:   PRINCIPLES FOR ENERGY IN BUILDING   **(06 Periods)**

General principles of passive solar heating, Key design elements, Direct Gain, Trombe walls, Water walls, Convective air loops and Concepts; General Principles of passive cooling, Ventilation, predicting ventilation in buildings, window ventilation calculations; Radiation, Evaporation and dehumidification, Load control, Air filtration and odour removal; Heat recovery in large and high-rise buildings.

Module 3:   MATERIAL REQUIREMENT AND ENERGY EFFICIENCY   **(06 Periods)**

Material Requirement: Material components and details, Insulation materials – Earth, Recycled steel, Low – E windows, Thermostat radiant barriers, Wood & plastic composite lumbers, Vacum insulated panels, spray foam insulators, plant based poly urethane foam; Optical materials, Radiant barriers, Glazing materials, Day lighting, sources.

Energy Efficiency: An overview on energy efficiency, design concepts and architecture; energy efficiency of buildings in various zones, cold and cloudy, cold and sunny, composite, hot and dry, moderate, warm and humid; office buildings and other buildings in various zones.

Module 4:   ENERGY AND RESOURCE CONSERVATION   **(06 Periods)**

Tools for building energy, operating energy; peak demand comfort and indoor air quality, Visual and acoustical quality – land, water and materials, air borne emissions and waste management

Module 5:   DESIGN CONSIDERATION AND ENERGY MANAGEMENT   **(06 Periods)**

Natural Building design considerations, energy efficient design strategies, Contextual factor, Longevity and process assessment, renewable energy sources and design, advanced building technologies; smart building, Economics and Cost analysis.

                                                                Total Periods: 30

Experiential Learning:

List of Experiments

1.   A Market survey on identifying different Thermal Insulation Materials

2.   Determination of Thermal Conductivity and Resistivity for the regular building materials

3.   Introduction to Revit software

4.   Creating an energy Model using Revit

5.   Performing energy analysis using Revit

6.   Synchronizing the Revit model into Autodesk insight and perform light analysis.

7.   Generating Energy performance and cost cutting model in Autodesk insight

RESOURCES

TEXT BOOKS:

1. Majumdar M., "Energy Efficient Buildings in India", Tata Energy Research Institute, Ministry of Non Conventional Energy Sources, 2002
2. Waters J. R, "Energy Conservation in Building: A Guide to part of the building regulations", Black well publishing, 2003

REFERENCE BOOKS:

1. Jean pohl, "Building Science Concepts and Application", John Wiley & Sons Ltd. Publications, 2011.
2. Energy Efficient Building in India by Ministry of Non-conventional Energy Sources.
3. Hopkinson .R. G and Kay .J. D, "The Lighting of Building" Faber and Faber, London, 2009

VIDEO LECTURES:

1. Energy Efficiency Acoustics and Daylighting in Building - Course (nptel.ac.in)
2. Principles and Applications of Building Science - Course (nptel.ac.in)

WEB RESOURCES:

1. An Overview of Energy Conservation in Buildings | Electrical Technology
2. Energy Efficiency in Buildings and its Importance - The Constructor
3. Energy efficient building design - Energy Education

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201012	**OFFSHORE CONSTRUCTION**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on offshore structures, construction of offshore structures, construction of foundations for offshore structures, decommissioning of offshore platform, offshore pipeline installation.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the basic features of offshore structures and loads on them to solve offshore construction problems using appropriate techniques following relevant codes considering safety, environment and sustainability.

CO2. Analyze offshore structures in deep sea and arctic sea floor to solve offshore construction problems using appropriate techniques following relevant codes considering safety, environment and sustainability besides communicating effectively.

CO3. Analyze foundations for offshore structures to solve offshore construction problems using appropriate techniques following relevant codes considering safety, environment and sustainability besides communicating effectively.

CO4. Analyze the decommissioning of offshore platforms to solve offshore construction problems using appropriate techniques following relevant codes and latest developments considering safety, environment and sustainability.

CO5. Analyze offshore pipeline installation to solve offshore construction problems using appropriate techniques following relevant codes considering safety, environment and sustainability besides communicating effectively.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	1	2	2	2
CO2	3	3	1	2	2	3
CO3	3	3	2	2	2	3
CO4	3	3	3	2	2	3
CO5	3	3	3	3	2	3
Course Correlation Mapping	**3**	**3**	**2**	**3**	**2**	**3**

Correlation Levels: **3: High; 2: Medium; 1: Low**

COURSE CONTENT

Module 1:   OFFSHORE STRUCTURES   **(09 Periods)**

Introduction: History of offshore structures; Types of offshore structures; Construction stages for offshore structure – Facilities and methods for fabrication, Launching, Assembly and jointing afloat, Material selection and procedures, Access, Quality control, Safety.

Loads on Offshore Structures: Gravity Loads – Dead load, Live load, Impact load, Helicopter landing loads, Crane support structures; Wind load; Offshore loads-Wave load, Current force, Earthquake load, Ice loads & Other loads.

Module 2:   CONSTRUCTION OF OFFSHORE STRUCTURES   **(09 Periods)**

Offshore Structures in Deep Sea: Construction in deep sea – Considerations and phenomena for deep-sea operations, Properties of materials for the deep sea; Construction operations on the deep seafloor, Seafloor well completions, Deep-water bridge piers.

Offshore Structures in Arctic Sea Floor: Arctic marine structures, Sea ice and icebergs, Atmospheric conditions, Arctic seafloor and geotechnics, Ecological considerations, Logistics and operations, Earthwork in the Arctic offshore, Ice structures.

Module 3:   CONSTRUCTION OF FOUNDATIONS FOR OFFSHORE   **(09 Periods)**
               STRUCTURES

Foundations for gravity structures – Types of gravity structures, Installation techniques, Movement of gravity structures; Foundations for jacket type structures – Types, Installation techniques; Foundations for jack up platforms – Types of jack up platforms, Piles and mat supported- Spud cans, Techniques for installation.

Module 4:   DECOMMISSIONING OF OFFSHORE PLATFORM   **(09 Periods)**

Removal of offshore platforms, Piled structures – Terminals, Trestles, Shallow water platforms; Removal of pile-supported steel platforms, concrete gravity based offshore platforms; Removal of harbour structures; New developments in salvage techniques.

Module 5:   OFFSHORE PIPELINE INSTALLATION   **(09 Periods)**

Seabed intervention, Pre-trenching, Pipeline supports, Crossings; Methods of pipe-laying – S-lay method, J-lay method, Reel-lay method and Towed system; Piggy-back installation, In-line components; Pipeline bundles, Protective covers, Pre-commissioning; Abandonment and recovery of offshore pipeline.

                                                                Total Periods: 45

EXPERIENTIAL LEARNING

1.   Compare corrosion-resistant materials used in marine environments and propose suitable coatings or cathodic protection systems for offshore applications.
2.   Study a major offshore construction project and prepare a report on construction methods, materials used, and challenges faced.

RESOURCES

TEXT BOOKS:

1. Mohamed A. El-Reedy, Offshore Structures: Design, Construction and Maintenance, Gulf Professional Publishing, 2012.

2. Goodrich, Tamassia, Gold wasser, Data structures & Algorithms in Java, 6th Edition, Wiley, 2014.

REFERENCE BOOKS:

1. John R. Hubbard, Programming with Java, 2nd Edition, McGraw Hill, 2009.

2. Debasis Samanta, Classic Data Structures, 2nd Edition, Prentice Hall, 2009.

VIDEO LECTURES:

1. Sensodyne- Daily Protection from Tooth Sensitivity (Marathi) (youtube.com)

2. Pipeline Retrieval Tool (P.R.T) | Laydown & Recovery of Subsea Pipelines (youtube.com)

WEB RESOURCES:

1. https://indonesiare.co.id/id/article/pipe-laying-method-in-offshore-subsea-construction

2. https://www.deeplayenergy.com/post/piggyback-pipeline-installation

3. https://www.hse.gov.uk/research/othpdf/500-599/oth535.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE203005	**FORMWORK, SHORING AND SCAFFOLDING**	2	-	-	4	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on formwork materials, design considerations in formwork, overall planning, formwork for different systems and design considerations for different structures.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze formwork materials using different tools and techniques for civil engineering construction considering codes of practice, safety, environment and sustainability besides communicating effectively in graphical form.

CO2. Design the formwork using different tools and techniques and through continuous learning for civil engineering construction considering codes of practice, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyse the overall planning of formwork using different tools and techniques and through continuous learning for civil engineering construction considering codes of practice, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyse the formwork for different systems using different tools and techniques and through continuous learning for civil engineering construction considering codes of practice, environment and sustainability besides communicating effectively in graphical form

CO5. Design different structures using different tools and techniques and through continuous learning for civil engineering construction considering codes of practice, environment and sustainability besides communicating effectively in graphical form

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	1	2	2
CO2	3	3	3	3	3	3
CO3	3	3	-	2	3	3
CO4	2	3	3	2	2	3
CO5	2	3	2	3	3	3
Course Correlation Mapping	**2**	**3**	**2**	**3**	**3**	**3**

Correlation Levels: 3: High;   2: Medium; 1: Low

COURSE CONTENT

Module 1: FORMWORK MATERIALS   **(06 Periods)**

Lumber, Types, Finish, Sheathing ratio, Working stresses, Repetitive member stress, Plywood, Types and grades, Textured surfaces and strength, Reconstituted wood, Steel, Aluminium, Form lining materials, Hardware and fasteners, Nails in Plywood, Bolts, lag screws and connectors, Bolt loads, Tubular steel shores, Patented shores Horizontal shores, Ellis shores, Dayton sure grip and Baker Roof shores, Safeway Symons shores, Dead shore, Raking and Flying shores.

Module 2: DESIGN CONSIDERATIONS   **(06 Periods)**

Design considerations, Live loads and Wind pressure, Concrete pressure on form work, Concrete density, Height of discharge, Temperature, Rate of Placing, Consistency of concrete, Vibration, Hydrostatic pressure and pressure distribution, Adjustment for non-standard conditions, Basic simplification, Beam forms, Slab forms, Column forms, Wall forms, Allowable stresses, Check for deflection, bending and lateral stability, Examples.

Module 3: PLANNING FOR FORMWORK   **(06 Periods)**

Overall Planning, Detailed planning, Standard units, Corner units, Schedule, Planning at Tender stage, Development of basic system, Planning for maximum reuse, Planning examples, Site layout plan, Crane arrangements, Recheck plan details, Planning for safety, Transporting plant, Wales and ties, Vertical transportable form work, Simple wood stresses, Slenderness ratio, Allowable load Site Preparation, Size and spacing, Steel Tower Frames, Safety practices.

Module 4: FORMWORK FOR DIFFERENT SYSTEMS   **(06 Periods)**

Location of job mill, Storage, Equipment, Form for Wall footings, Column footings, Slab on grade and paving work, Highway and Airport paving, External vibration, Prefabricated panel systems, Giant forms, Curved wall forms, Tolerance for walls, Erections Practices, Column heads, Beam or girder forms, Suspended forms, Suggested Tolerances, Concrete Joint construction, Flying system forms, Causes of failures, Case studies, Finish of exposed concrete, Design deficiencies, Safety factors, Stripping sequence, Reshore installation, Advantages of reshoring.

Module 5: DESIGN CONSIDERATIONS FOR DIFFERENT   **(06 Periods)**
**   STRUCTURES**

Shell forms, Design considerations, Loads, Building forms, Strength requirements, Tunnel forming components, Curb and gutter forms, Invert forms, Arch forms, Concrete placement methods, Cut and cover construction, Tolerances, Slip forms, Principles, Types, Advantages, Functions of various components, Planning, Safety in slip forms, Special structures built with slip form technique, Codal provisions, Types of scaffolds, Putlog and Independent scaffold, Single pole scaffolds, Fixing ties, Spacing of ties, bracing, knots safety net, General safety requirements, Gantry and system scaffolds, Shuttering for Precast members and continuous casting forms.

                                                          Total Periods: 30

PROJECT BASED LEARNING:

Projects relevant to the contents of the course will be provided by the course instructor at the beginning.	
1.	Prepare an inspection report a for a formwork at a site "Construction S+3+G+16 building.
2.	Write a detail report for project with maximum possible risk of danger at the site for a scaffolding at a height of 300ft.
3.	Prepare a detailed plan of formwork, scaffolding for any underground structure.

RESOURCES

TEXT BOOKS:

1. Robert L. Peurifoy and Garold D. Oberlender, Formwork for Concrete Structures, McGraw- Hill, 2006

2. Hurd. M.K., Formwork for Concrete, Special Publication No.4 Fifth Edition American Concrete Institute, Detroit, 2003.

REFERENCE BOOKS:

1. Austin. C.K., Formwork for Concrete, Cleaver- Hume Press ltd., London 2006.

2. Guide for Concrete Formwork, American Concrete Institute, Box No. 9150, Michigan 48219.

VIDEO LECTURES:

1. https://www.slideshare.net/hamo92/building-construction-8-formworks-and-scaffoldings

2. https://www.youtube.com/watch?v=Z18EZoqIV2w

3. https://slideplayer.com/slide/12263745/

WEB RESOURCES:

1. http://www.cv.titech.ac.jp/~courses/atce2/Lesson3.pdf

2. https://civilseek.com/formwork-for-concrete/

3. https://sjce.ac.in/wp-content/uploads/2018/01/Formwork.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE203006	**GIS IN CONSTRUCTION ENGINEERING AND MANAGEMENT**	2	-	-	4	3

Pre-Requisite   Construction Practices, Equipment and Automation

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: Introduction to GIS; Types of Data; Data Structure; Data Quality; Different Types of Output.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1.   Analyze maps and geographical locations using appropriate methods in engineering and management considering safety, environment besides effectively through graphical form.

CO2.   Analyze different types of data, using appropriate methods in engineering and management considering safety, environment.

CO3.   Analyze data structures using different techniques in the field of civil engineering considering safety and project management.

CO4.   Analyse geographical data using different tools and techniques through civil engineering.

CO5.   Analyse data using different tools and techniques in the field of civil engineering considering safety besides communicating effectively through graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	1	2	2
CO2	3	2	1	3	-	2
CO3	3	1	3	2	1	1
CO4	3	2	3	1	1	1
CO5	3	2	2	2	1	1
Course Correlation Mapping	**3**	**2**	**3**	**2**	**1**	**2**

Correlation Levels: 3: High;   2: Medium; 1: Low

COURSE CONTENT

Module 1:   INTRODUCTION TO GIS   **(06 Periods)**

GIS – Definition – Components of GIS -Maps – Definition – Types of Maps – Characteristics of Maps – Map Projections –– Hardware, Software and Organizational Context – GIS software

Module 2:   TYPES OF DATA   **(06 Periods)**

Data Types – Spatial and Non-Spatial – Spatial Data – Points, Lines and areas– Non-spatial data – Nominal, Ordinal, Interval and Ratio – Digitizer – Scanner – Editing and Cleaning – Geo reference data

Module 3   DATA STRUCTURE   **(06 Periods)**

Raster and Vector Data Structure – Raster data storage – Run length, Chain and Block Coding – Vector Data Storage – Topology – Topological Models – Arc Node Structure – Surface Data – DEM – Grid DEM and TIN structure- Applications of DEM

Module 4   DATA QUALITY   **(06 Periods)**

Reclassification – Measurement – Buffering – Overlaying – SQL for Queries – Neighborhood and zonal operations – Data Quality – Components of data quality - Sources of errors in GIS – Meta data

Module 5   DIFFERENT TYPES OF OUTPUT   **(06 Periods)**

Output – Maps, Graphs, Charts, Plots , Reports – Printers – Plotters – Fields of application – Natural Resource Management, construction management-Parcel based, AM/FM applications examples – Case study

Total Periods: 30

PROJECT BASEDL LEARNING
Project based learning to the contents of the course will be provided by the course instructor at the beginning.

RESOURCES

TEXT BOOKS:

1. Burrough P.A., "Principles of GIS for Land Resources Assessment", Oxford Publication, 2008

2. Robert Laurini and Derek Thompson, "Fundamentals of Spatial Information Systems", Academic Press, 2006

REFERENCE BOOKS:

1. Anji Reddy, "Remote Sensing and Geographical Information Systems", BS Publications 2001

2. Srinivas M.G. (Edited by), "Remote Sensing Applications", Narosa Publishing House, 2001

3. Rhind, D., "Understanding of GIS, The ARC / INFO Method", ESRI Press. 2000.

VIDEO LECTURES:

1. GIS Applications in Civil Engineering - YouTube

2. Use of GIS for Planning Rs 80,000 Cr of Rural Road Investments | Harsh Nisar India FOSS 2.0 - YouTube

WEB RESOURCES:

1. Paper Title (use style: paper title) (dbuniversity.ac.in)

2. GIS and its applications in Construction Industry (constructionplacements.com)

3. GIS in Construction: What It Is and Why It Matters (unearthlabs.com)

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201013	**HIGHWAY CONSTRUCTION MANAGEMENT**	3	-	-	-	3

Pre-Requisite   -

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: highway construction; highway management system; highway inventories and evaluation; highway construction equipment; highway maintenance and quality control.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze highway construction to solve complex highway engineering problems using appropriate tools and techniques following relevant codes considering society, environment and sustainability besides communicating effectively in graphical form.

CO2. Understand the highway construction management system to implement pavement maintenance management, network and project level analysis, prioritization techniques and formulation of maintenance strategies.

CO3. Analyze the highway inventories to solve complex serviceability concepts, serviceability index, roughness measurements, distress modes, pavement deflection – and safety aspects.

CO4. Analyze various highway construction equipment to solve highway engineering problems using appropriate tools and techniques following latest developments ensuring safety and environment.

CO5. Analyze highway maintenance and quality control issues to solve complex highway engineering problems using appropriate tools and techniques following relevant codes considering society, environment and sustainability.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	3	3	3
CO2	3	3	3	3	1	3
CO3	2	2	2	3	3	3
CO4	2	2	2	2	3	3
CO5	2	2	1	2	1	3
Course Correlation Mapping	**2**	**2**	**3**	**3**	**3**	**3**

Correlation Levels: **3: High;   2: Medium;   1: Low**

COURSE CONTENT

MODULE 1:   HIGHWAY CONSTRUCTION   (09 Periods)

General construction; Earth work; Construction of fill and subgrade, Gravel roads; WBM roads; Bituminous pavements; Cement concrete pavements; Different types of joints in cement concrete pavements - Joint filler and sealer; Interlocking concrete block (ICBP) pavements.

MODULE 2:   HIGHWAY MANAGEMENT SYSTEM   (09 Periods)

Components of PMS and their activities; Major steps in implementing PMS; Pavement Maintenance Management, Components of Maintenance Management and Related Activities – Network and Project Level Analysis; Prioritization Techniques and Formulation of Maintenance Strategies.

MODULE 3:   HIGHWAY INVENTORIES AND EVALUATION   (09 Periods)

Serviceability Concepts; Visual Rating; Pavement Serviceability Index; Roughness Measurements; Distress Modes – Cracking, Rutting etc; Pavement Deflection – Different Methods, Skid Resistance, Roughness, Safety – Aspects; Inventory System – Assessment of Deficiencies

MODULE 4:   HIGHWAY CONSTRUCTION EQUIPMENT   (09 Periods)

Excavators - Drilling rock and earth; Aggregate production – Trucks and haulage equipment, Dozers, Scrappers; Finishing equipment, Hot mix plants for bituminous mixes, Pavers and compacting equipment for hot bituminous mixes, Plants and equipment for cement concrete and paving equipment; Piles and pile driving equipment, Air compressors and pumps, Latest developments in highway construction equipment.

MODULE 5:   HIGHWAY MAINTENANCE AND QUALITY CONTROL   (09 Periods)

Causes of Deterioration, Traffic and Environmental Factors, Methods of Maintaining WBM, Bitumen and Cement Concrete Roads, Quality Assurance; Quality Control; ISO 9000; Sampling Techniques; Tolerances and Controls related to Profile and Compaction.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Visit nearby NHAI situated in toll booths and report the details about the process on highway maintenance.

2. Demonstrate the technologies adopted by NHAI on repairing roads.

3. Take field survey with the highway users regarding the drawbacks of highway and its maintenance and suggest the modifications required in the future.

4. Suggest the suitable strategy given by NHDB for the existing highway NH-71.

5. Visit highway construction sites and take survey about the factors affecting to complete the project on time and submit the report.

CASE STUDIES/ ARTICELS

1. Give the case study on highway planning and execution.
2. Explain about the various repairing methods followed by NHAI with a case study.

RESOURCES

TEXT BOOKS:

1. Haas and Hudson , W. R. Pavement management systems –McGraw Hill publications
2. Sargious, M. A. – Pavements and surfacing for highways and airports – Applied Science Publishers ltd.
3. Khanna, K. and Justo, C. E. G., Highway Engineering, Nem Chand & Bros, Roorkee, 10th Edition, 2014.
4. Kadiyali, L. R., Traffic Engineering and Transport Planning, Khanna Technical Publications, 7th Edition, 2010.

REFERENCE BOOKS:

1. Jotin Khisty, C. and Kent Lall, B., Transportation Engineering – An Introduction, Prentice Hall of India Pvt. Ltd., 3rd Edition, 2016.
2. Partha Chakro borthy and Amines Das, Principles of Transportation Engineering, Prentice Hall of India Pvt. Ltd, 2nd Edition, 2017.
3. Papa Costas, C. S. and Prevedouros, P. D., Transportation Engineering and Planning, Prentice Hall of India Pvt. Ltd., 3rd Edition, 2009.
4. Mannering, F. L. and Washburn, S. S., Principles of Highway Engineering and Traffic Analysis, John Wiley& Sons, Inc., 5th Edition, 2013.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105101087
2. https://onlinecourses.nptel.ac.in/noc22_ce94/preview
3. https://onlinecourses.nptel.ac.in/noc22_ce104/preview
4. https://nptel.ac.in/courses/105/103/105103206/

WEB RESOURCES:

1. https://www.udemy.com/course/construction-management-road-construction/
2. https://www.brighthubengineering.com/structural-engineering/108202-role-of-the-manager-in-highway-road-projects/
3. https://www.nntw.org/career-pathway/highway-construction-project-manager/
4. https://www.designingbuildings.co.uk/wiki/Road_construction

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201014	**OPERATIONS RESEARCH**	3	-	-	-	3

Pre-Requisite   -

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: This course provides a detailed discussion on introduction to operation research, linear programming and graphical analysis, simplex method and duality method, Assignment problems and transportation problems

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Acquire knowledge on operation research to solve problems associated with its implementation and limitations for ensuring safety and sustainability using appropriate tools and techniques besides lifelong learning.

CO2. Analyze the operation research by linear programming and graphical analysis to solve problems associated with different types of constraints used in construction ensuring safety and sustainability using appropriate tools and techniques besides lifelong learning.

CO3. Analyze the model by simplex and duality method to solve problems associated with fundamental properties, formulation of algorithms for ensuring safety and sustainability using appropriate tools and techniques besides lifelong learning.

CO4. Evaluate the assignment problems to solve problems associated with balancing and unbalancing problems for ensuring safety and sustainability using appropriate tools and techniques besides lifelong learning.

CO5. Evaluate the transportation problems to solve problems associated with normal feasible and infeasible solution using appropriate tools and techniques besides lifelong learning.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	3	2	3	3	2
CO2	2	3	2	3	3	2
CO3	2	3	3	3	3	2
CO4	2	3	2	3	3	2
CO5	2	3	2	3	3	2
Course Correlation Mapping	**2**	**3**	**3**	**3**	**3**	**2**

Correlation Levels: 3: High;   2: Medium;   1: Low

COURSE CONTENT

Module 1:   LINEAR PROGRAMMING   **(09 Periods)**
Introduction to Operations Research - Linear Programming - Mathematical Formulation – Graphical method – Simplex method – Penalty methods: M-method, Two Phase method- Duality.

Module 2:   SIMPLEX METHOD AND DUALITY METHOD   **(09 Periods)**
The Simplex Method – Two–Phase Simplex method, Formulation of L.P.P and its solutions by Simplex Method.
Duality in Linear Programming – Fundamental properties of Duality, Duality and Simplex method, Bounded variable simplex algorithm.

Module 3:   TRANSPORTATION PROBLEMS, ASSIGNMENT AND   (09 Periods)
**   SEQUENCING MODELS**
Transportation Problems: Introduction - Formulation - Solution of the transportation problem (Min and Max): Northwest Corner rule, row minima method, column minima method, Least cost method, Vogel's approximation method – Optimality test: MODI method.
Assignment and Sequencing Models: Assignment problems – Applications - Minimization and Maximization; Sequencing - Problem with N jobs and 2 machines – N jobs and 3 machines problem - N jobs and M machines problem.

Module 4:   PROJECT MANAGEMENT AND INVENTORY CONTROL   **(09 Periods)**
Project Management: Introduction - Phases of project management-Construction of Network diagrams- Critical path method (CPM) and Project evaluation and review technique (PERT) - Crashing of project network.
Inventory Control: Necessity for maintaining inventory - Inventory costs -Inventory models with deterministic demand - inventory models with probabilistic demand - Inventory models with price breaks - Buffer stock.

Module 5:   QUEUING MODELS   **(09 Periods)**
Poisson arrivals and Exponential service times – Single channel models and Multi-channel models - Simulation: Basic concepts, Advantages and disadvantages - Random number generation - Monte Carlo Simulation applied to queuing problems.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Create an example on transportation problems using sequencing models.

2. Evaluate the inventory analysis for a project.

3. Evaluate queuing theory model in construction project

RESOURCES

TEXT BOOKS:

1. Gupta P. K., Hira D. S., Operation Research, S Chand Publishers, 2006

2. G.Srinivasan., Operations Research: Principles and Applications, PHI Learning Pvt. Ltd.

REFERENCE BOOKS:

1. Vohra, N. D., Operations Research, Tata McGraw Hill Co., New Delhi.

2. Wagner., Operation Research, Wiley Eastern Ltd., New Delhi.

3. https://nptel.ac.in/courses/110106062

WEB RESOURCES:

1. Introduction to operation research:https://www.bbau.ac.in/dept/UIET/EMER-601%20Operation%20Research%20Queuing%20theory.pdf
2. Operation Research and Project Management: https://link.springer.com/content/pdf/10.1007/978-3-642-49344-7_11.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201015	**BUILDING SERVICES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Mechanical Ventilation And Air-Conditioning – Introduction, Air-Conditioning Systems, Mechanical Transportation Systems In Buildings, Fire Safety In Buildings & Passive Fire Protection, Active Fire Protection And Fire Safety In High Rise Buildings

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze quality management to solve construction problems by using appropriate tools and techniques considering health, safety, environment, sustainability and besides communicating effectively in graphical form.

CO2. Analyze quality control tools and statistical methods to solve construction problems by using appropriate tools and techniques considering health, safety, and environment, sustain ability, relevant codes of practice and besides communicating effectively in graphical form.

CO3. Analyze quality assurance and standards to solve construction problems following latest developments by considering health, safety, and environment, sustain ability, relevant codes of practice and besides communicating effectively in graphical form.

CO4. Analyze six sigma in quality management to solve construction problems by considering health, safety, and environment, sustain ability, relevant codes of practice and besides communicating effectively in graphical form.

CO5. Analyze construction safety to solve construction problems by considering health, safety, and environment, sustain ability, relevant codes of practice and besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	-	2	-	2
CO2	3	3	-	2	2	2
CO3	3	3	-	2	-	2
CO4	3	3	-	2	-	2
CO5	3	3	-	2	-	2
Course Correlation Mapping	**3**	**3**	**-**	**2**	**2**	**2**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1: MECHANICAL VENTILATION AND AIR-CONDITIONING - (08 Periods) Introduction

Introduction to Mechanical Ventilation: Need for mechanical ventilation for spaces like Basements, Kitchen, Toilets, etc. Guidelines as per NBC / ISHRAE: Types of ventilation systems.

Introduction to Air-conditioning: Definition, Psychometric processes and requirements, Air & Refrigeration cycles, Basics of Load Calculations, Zoning and Air Distribution, Heating system,

Module 2: AIR-CONDITIONING SYSTEMS   (07 Periods)

Air Conditioning systems: Window, Split, Packaged, Basics of Centralized Air conditioning system, Water & Air Cooled Chillers, Air Handling Units, Basics of duct sizing and routing, preferred locations of equipment and Architectural Requirements of various equipment. Illustration of duct layout through a small example.

Specialized Air Conditioning Systems: Clean Rooms, Server, Hub & UPS Rooms, Operation Theaters etc.

Module 3: MECHANICAL TRANSPORTATION SYSTEMS IN   (10 Periods) BUILDINGS

Elevators: Types of Elevator systems, design considerations like Peak Handling capacity, Average Waiting Time, Lift speed etc., Architectural Requirements & Details for Elevator shaft - Elevator pit - Elevator Machine Rooms, Automatic Rescue Device for Elevators, Elevator car interiors, Possible Location and arrangements of Elevators in a building. Lift Acts and National Building Code.

Escalators & Travelators: Applications, Calculation of Traffic capacity, Location and arrangements of escalators and travelators, inclination factor.

Module 4: FIRE SAFETY IN BUILDINGS & PASSIVE FIRE (11 Periods) PROTECTION

Introduction: Classification of fire, causes & hazards; Grading of structural elements for its fire resistance as per NBC. Classification of building types as per NBC and brief description of characteristics of combustible and noncombustible materials.

Concepts in passive fire protection in buildings: Escape routes, fire driveways, fire refuge area, fire assembly areas, pressurization, travel distance, fire tower and compartmentation, fire signages etc.

Module 5: ACTIVE FIRE PROTECTION AND FIRE SAFETY IN HIGH   (09 Periods) RISE BUILDINGS

Active fire control: Basic concepts in fixed firefighting installations, Fire sprinklers, Fire Hydrants, Automatic fire detection and alarm systems.

National Building Code Requirements for Fire Safety: Rules for Fire Protection and Fire Fighting Requirements for High Rise Buildings in India.

Total Periods: 45

EXPERIENTIAL LEARNING:

1.   Create an example on **transportation problems using sequencing models**..
2.   Evaluate the **inventory analysis** for a project.

RESOURCES

TEXT BOOKS:

1. Shan K. Wang , "Handbook of Air Conditioning and Refrigeration", 2000, McGraw-Hill Edu

2. Roy J Dossat , "Principles of Refrigeration" 1961, John Wiley & Sons

REFERENCE BOOKS:

1. Walter T. Grondzik, Alison G. Kwok, "Mechanical and Electrical Equipment for Buildings", 2010; 11th edition, Wiley Publication

2. Don Kundwar, "Refrigeration and Air Conditioning", 2016, Dhanpat Rai & Co. (P) Limited.

IS CODES:

1. "National Building Code of India (NBC)", 2016, Bureau of Indian Standards

2. IS 1391 (Part 1 & 2) : 1992 - Specification for room air conditioners

3. 8148 : 2003 - Specification for packaged air conditioners

4. 4591 : 1968 - Code of practice for installation and maintenance of escalators

5. 14671 : 1999 - Hydraulic lifts

6. 14665 : 2000 - Traction lift

7. 15259 : 2002 - Home Lifts

8. 15330 : 2003 - Lifts for handicapped persons; IS codes for Fire Services

VIDEO LECTURES:

1. Fire Protection Services and Maintenance Management of Building - Course (nptel.ac.in)

2. Building Services Engineering - YouTube

WEB RESOURCES:

1. Masters of Architecture (jmi.ac.in)

2. Introduction To Building Services | PPT (slideshare.net)

3. National Building Code - Bureau of Indian Standards (bis.gov.in)

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE202003	**STRUCTURAL HEALTH MONITORING**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Structural Health monitoring; Vibration based techniques for structural health monitoring; Non-Destructive testing of concrete structures; Sensors and it for health monitoring systems; Applications and case studies of SHM in civil infrastructure systems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze structural health monitoring system to solve complex problems either individually or in a team using appropriate techniques by following relevant standards considering safety and society besides communicating effectively in graphical form.

CO2. Analyze vibration based techniques for structural health monitoring to solve complex problems either individually or in a team using appropriate techniques by following relevant standards considering safety, society and environment besides communicating effectively in graphical form.

CO3. Analyze non-destructive testing of concrete structures to solve complex problems either individually or in a team using appropriate tools and techniques by following standards, codes and latest developments by considering safety and environment besides communicating effectively in graphical form.

CO4. Analyze sensors and IT for health monitoring systems to solve complex problems either individually or in a team using appropriate tools and techniques by following relevant standards, codes and latest developments considering safety and environment besides communicating effectively in graphical form.

CO5. Analyze applications and case studies of SHM in civil infrastructure systems to solve complex problems either individually or in a team using appropriate tools and techniques by following relevant standards, codes and latest developments considering safety, society and environment, besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	2	3	2	-
CO2	3	2	2	3	2	-
CO3	3	2	2	3	2	1
CO4	3	2	2	3	2	1
CO5	3	2	2	3	2	1
Course Correlation Mapping	**3**	**2**	**3**	**3**	**2**	**1**

Correlation Levels: 3: High;   2: Medium;   1: Low

COURSE CONTENT

Module 1: STRUCTURAL HEALTH MONITORING   (09 Periods)
Need for SHM, SHM - A way for smart materials and structures, SHM and biomimetic analog between the nervous system of a man and a structure with SHM, SHM as a part of system management, Passive and active SHM, NDE, SHM and NDECS, Basic components of SHM, Materials for sensor design.

Module 2: VIBRATION BASED TECHNIQUES FOR STRUCTURAL   (09 Periods)
**   HEALTH MONITORING**
Basic vibration concept for SHM, Mathematical description for structural system with damage, Linking experimental and analytical data, Damage localization and quantification, Neural network approach to SHM, Connectionist algorithms for anomaly detection, time domain damage detection methods for linear system, damage identification in non-linear system and application

Module 3: NON - DESTRUCTIVE TESTING OF CONCRETE   (09 Periods)
**   STRUCTURES**
Situations and contexts, Need, Classification of NDT procedures, Visual inspection, Half-Cell electrical potential methods, Schmidt rebound hammer test, Resistivity measurement, Electrical resistance, Electromagnetic methods, Radiographic testing, Ultrasonic testing, Infrared thermography, Ground penetrating radar, Radio isotope gauges, Other methods.

Module 4: SENSORS AND IT FOR HEALTH MONITORING SYSTEMS   (09 Periods)
Sensors for SHM: Acoustic emission sensors, Ultrasonic sensors, Piezoelectric sensors and actuators, Fibre optic sensors and Laser stereography techniques, Imaging techniques.
Information Technology for Health Monitoring: Information gathering, Signal analysis, Information storage, Archival, Retrieval, Security, Wireless communication, Telemetry, Real time remote monitoring, Network protocols, Data analysis and interpretation, Artificial Intelligence (AI) in structural health monitoring.

Module 5: APPLICATIONS AND CASE STUDIES OF SHM IN CIVIL   (09 Periods)
**   INFRASTRUCTURE SYSTEMS**
Capacitance probe for concrete cover, Applications for external post tensioned cables, Structural health monitoring of bridges, Structural health monitoring of cable – supported bridges, structural health monitoring of historical buildings.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Vibration Characteristics of Aluminium Cantilever Beam Using Piezoelectric Sensor

2. Identification of High Frequency Axial Modes of Beam in "Free-Free" Condition Using Electro-Mechanical Impedance (EMI) Technique

3. Forced Excitation of Steel Beam Using Portable Shaker

4. Photogrammetry for Displacement Measurement

5. Modes of Vibration of Simply Supported Beam Under Flexure

6. Modes of Vibration of Simply Supported Plate

7. Damage Detection and Qualitative Quantification Using Electro-Mechanical Impedance (EMI) Technique

8. Structural health monitoring using low cost instruments and EMI.

9. Shear Lag Effect in Electro-Mechanical Impedance (EMI) Technique

10. Rebar Corrosion Detection and Assessment Using Electro-Mechanical Impedance (EMI) Technique

RESOURCES

TEXT BOOKS:

1. Daniel Balageas, Claus-Peter Fritzen and Alfredo Guemes, Structural Health Monitoring, Published by ISTE Ltd., U.K. 2006.

2. Vistasp M. Karbhari and Farhad Ansari, Structural Health Monitoring of Civil Infrastructure System, Wood Head Publishing Limited, Cambridge, 2009.

REFERENCE BOOKS:

1. M. L. Wang, J. P Lynch and H. Sohn, Sensors Technologies for Civil Infrastructure, Vol.1 & 2, Wood Head Publishing Limited, Cambridge, 2009.

2. Philip, W., Industrial Sensors and Applications for Condition Monitoring, MEP, 1994.

3. Armer, G. S. T (Editor), Monitoring and Assessment of Structures, Spon, London, 2001.

4. J. Prasad and C. G. K. Nair, Non-destructive Test and Evaluation Materials, McGraw Hill, 2nd Edition, 2011.

5. Poonam I. Modi and Chirag N. Patel, Repair and Rehabilitation of Concrete Structures, Prentice-Hall of India Pvt. Ltd., New Delhi, 2016.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/114106046

2. https://nptel.ac.in/courses/112104160

WEB RESOURCES:

1. https://link.springer.com/book/10.1007/978-3-030-74258-4

2. https://www.diva-portal.org/smash/get/diva2:991115/FULLTEXT01.pdf

3. https://theconstructor.org/digital-construction/structural-health-monitoring-civil-engineering/554160/

4. https://www.encardio.com/dam-monitoring

5. http://vssd-iitd.vlabs.ac.in/Introduction.html

6. https://web.iitd.ac.in/~sbhalla/cvl864.html

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201016	**SUSTAINABLE MATERIALS AND GREEN BUILDINGS**	3	-	-	-	3

Pre-Requisite	Modern Construction Materials
Anti-Requisite	-
Co-Requisite	-

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Sustainable Materials, Sustainability of Materials, Planning of Green Building, Green Building Technologies, Economics and Environment benefits

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze sustainable building materials about various aspects and applications to address problems associated with the building materials for ensuring safety and sustainability besides lifelong learning.

CO2. Analyze sustainability in building materials to solve problems associated with structures for ensuring safety and sustainability besides lifelong learning.

CO3. Analyze various planning aspects of green buildings to solve problems associated with structures for ensuring safety and sustainability besides lifelong learning.

CO4. Analyze various technologies used in green buildings to solve problems associated with structures for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

CO5. Analyze the economic and environmental benefits to solve problems associated with structures for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	3	2	3
CO2	2	3	2	2	3	2
CO3	2	3	2	2	3	3
CO4	2	3	3	2	1	3
CO5	2	3	2	1	1	2
Course Correlation Mapping	**2**	**3**	**3**	**2**	**2**	**3**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1:   INTRODUCTION TO SUSTAINABLE MATERIALS   (08 Periods)

Introduction, Principles of Sustainability and life-cycle analysis, Sustainable materials – Earthern materials, Bamboo, Plant-based Polyurethane Rigid Foam, Hempcrete, Low clinker cement, alkali cement activated cementitious materials and geopolymers, sewage slude ash; Applications in ceramic industry, concrete industry, geotechnical applications and Road pavements.

Module 2:   SUSTAINABILITY OF MATERIALS   (08 Periods)

Intrinsic properties controlling the sustainability, Nanotechnologies for sustainable construction materials; Sustainability analysis of aggregates, masonry, glass, timber, engineered wood, metals and alloys.

Module 3:   PLANNING OF GREEN BUILDING   (09 Periods)

Introduction, Necessity, Concept of Green building, Principles of planning, Relevant building bylaws, site selection for buildings, Orientation of buildings, Common errors in planning, Provision of rain water harvesting.

Module 4:   GREEN BUILDING TECHNOLOGIES   (11 Periods)

Principles of green building, Usage of low energy materials, Effective cooling and heating systems, HVAC controlling, Thermal insulation and Moisture protection, Effective electrical systems, Effective water conservation systems, Acoustics. Building Commissioning.

Module 5:   ECONOMICS AND ENVIRONMENT BENEFITS   (09 Periods)

Energy efficiency, Water efficiency, Waste reduction, Construction phase, Building Operations and Maintenance, Occupant health and productivity, Building value, Local Economic development opportunities, Measuring Economic performance and environmental performance. Certification systems, Green Rating for Integrated Habitat Assessment (GRIHA) and Leadership in Energy and Environmental Design (LEED), Case studies

Total Periods: 45

EXPERIENTIAL LEARNING

1.   Visit a LEED rated green building and prepare a report of your observation pertaining to plan, design and technology aspects.

2.   Design a smart home with major utilization of smart materials and energy saving techniques.

3.   Write a comparative report on any two green buildings in India.

RESOURCES

TEXT BOOKS:

1. Jamal. M. Khatib., Sustainability of Construction Materials, Woodhead Publishing Series in Civil and Structural Engineering, Science Direct, 2nd Edition, 2016.

2. Sustainable Building Technical Manual, Green Building Design, Construction, and Operation, Public Technology, Inc, US Green Building Council, 1996.

REFERENCE BOOKS:

1. Ravindra K. Dhir, Gurmel S. Ghataora, Ciaran J. Lynn, Sustainable Construction Materials, Elsevier, 1st Edition, 2016.

2. Michael Bauer, Peter Mosle and Michael Schwarz, Green Building – Guidebook for Sustainable Architecture, Springer, 2010.

3. TERI, Sustainable Building Design Manual- Volume I & II, Tata Energy Research Institute, 2009.

4. Shahane Y. S, Planning and Designing Building, Allies Book Stall, 2004.

VIDEO LECTURES:

1. https://onlinecourses.swayam2.ac.in/arp19_ap75/preview

2. https://nptel.ac.in/courses/124107011

3. https://onlinecourses.nptel.ac.in/noc20_ar01/preview

4. https://www.youtube.com/watch?v=oRt0zRuFKC4&list=PLLy_2iUCG87CfjAcR9lGNrJ16Fe6O qXzr

WEB RESOURCES:

1. A Course on Sustainable Materials use in Civil Engineering: https://peer.asee.org/a-course-on-sustainable-materials-use-in-civil-engineering-syllabus-delivery-and-student-feedback.pdf

2. Green Building Materials: https://www.buildinggreen.com/content/green-building-materials-101-syllabus-supplement

3. https://www.elsevier.com/books/sustainable-construction-materials/dhir/978-0-08-100987-1

4. https://www.sciencedirect.com/book/9780081009956/sustainability-of-construction-materials

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE203007	**OCCUPATIONAL HEALTH AND SAFETY IN CONSTRUCTION**	2	-	-	4	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction to safety and health; Hazards; Occupational injuries; Control and prevention of accidents; Responsibilities and compensation algorithms.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyse the techniques, skills, and modern scientific technical tools necessary for professional practice and apply the principles of occupational health and safety, self-motivation for lean and sustainability

CO2. Understand the various hazards in construction and apply the knowledge to identify the hazard problems and life cycle analysis

CO3. Understand professional and ethical responsibility in occupational safety and health and analyse the loss in life of construction labours in the situation of the hazardous accidents like hearing loss, chemical flame and biological accidents.

CO4. Analyse the preventive and control measures necessitate in the construction industry to ensure the occupational health and safety and apply knowledge to prepare standard operating procedures

CO5. Demonstrate the knowledge on standards, responsibilities, rules and regulations of employee and employer and understand about the employer liabilities and compensation to workers in case of accidents.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	2	3	3
CO2	3	3	2	1	3	3
CO3	3	3	1	2	3	3
CO4	3	3	3	1	2	3
CO5	3	3	1	2	1	3
Course Correlation Mapping	**3**	**3**	**2**	**2**	**3**	**3**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

MODULE 1:   INTRODUCTION TO SAFETY AND HEALTH   **(06 Periods)**

Occurrence of accident, sequence; injuries, occupational injuries, industrial accidents; key principles; OSH principles; Environmental management system (EMS);
Motivational environment, principles, self motivation, behavior based safety; Heinrich's Domino concept; Benefits of lean and sustainability

MODULE 2:   HAZARDS   **(06 Periods)**

Hazard identification, types, reporting system, audits; root cause analysis; job hazard analysis; risk versus cost; Life cycle analysis.

MODULE 3:   OCCUPATIONAL INJURIES   **(06 Periods)**

Bureau of labour statistics – occupational trauma death – injuries – injury and death cost – temperature extremes – ionizing radiation – noise induced hearing loss – vibrations – chemical hazards – flammable combustible liquids – biological monitoring

MODULE 4:   CONTROL AND PREVENTION OF ACCIDENTS   **(06 Periods)**

Occupational illness prevention – industrial modes of entry of contaminants – types of air contaminants – exposure monitoring – units of concentration – limits of exposure – ergonomic risk factors – physical work activities and conditions - Hazard prevention and control – elimination or substitution – awareness devices – personal protective equipment – safe operating procedures – fleet safety.

MODULE 5:   RESPONSIBILITIES AND COMPENSATION   **(06 Periods)**

Standards, employer's responsibilities, violations, medical and exposure records; employer liability; worker's compensation; Employment laws and regulation; Labours laws and regulations.

Total Periods: 30

PROJECT BASED LEARNING

1. Report about the occupational accidents and the severity of injuries in high rise building construction project.

2. Identify the hazardous construction materials and submit the report on causes and possibilities of utilizing the hazardous materials.

3. Take a survey on chemical hazards and report the process of transiting flammable liquids from factory to site.

4. Submit the report on defined compensations to workers as per government norms in case of various occupational injuries.

5. Take a field survey on the preventive measures followed in construction sites to avoid accidents and suggest the initiatives to be carried out to improve safety.

6. Compare the flaws of existing laws and act regarding occupational accidents and Report your suggestions to improve the employers welfare and changes need in the existing laws.

RESOURCES

TEXT BOOKS:

1. Phil Hughes, Ed Ferrett , Introduction to Health and Safety in Construction, Taylor & Francis, 2012.

2. Helen Lingard, Steve Rowlinson, Occupational Health and Safety in Construction Project Management, CRC Press, 1st edition, 2004.

3. Jimmie Hinze, Theo C. Haupt, Richard J. Coble, The Management of Construction Safety and Health, Taylor & Francis, 2000.

4. Charles D. Reese, James Vernon Eidson, Handbook of OSHA Construction Safety and Health, CRC Press, 2006.

REFERENCE BOOKS:

1. Handbook of environmental health and safety, Vol I & II, Herman Kooren, Michael Bisesi, Jaico Publishing House, 1999.

2. David L. Goetsch, Industrial safety and health for technologist, engineers and managers, 8th Edition, Pearson Publishers, 2014.

3. International Labour Office, Safety, Health and Welfare on Construction Sites
   A Training Manual, 1995.

4. Government Institutes, Occupational Safety and Health Simplified for the Construction Industry, Government Institutes Research Group , 2007.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_ce16/preview

2. https://alison.com/course/construction-safety-and-health

3. https://nptel.ac.in/courses/110105094

4. https://archive.nptel.ac.in/courses/105/102/105102206/

WEB RESOURCES:

1. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjPs6RlKL4AhU14DgGHbU1CNAQFnoECB0QAQ&url=https%3A%2F%2Flabour.gov.in%2Fsites%2Fdefault%2Ffiles%2FOSH_Gazette.pdf&usg=AOvVaw33TmhCzojz6uy6UL4_judr

2. https://training.itcilo.org/actrav_cdrom2/en/osh/intro/inmain.htm

3. https://www.verywellhealth.com/what-is-occupational-health-and-safety-4159865

4. https://www.who.int/health-topics/occupational-health

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE204002	**AI AND IOT IN CONSTRUCTION**	2	-	2	4	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Data Science, Python Fundamentals in Construction, Pandas Data Analytics Library and Design Phase Application, Statistics and Visualization Basics and Operations, Machine Learning for the Built Environment.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Design, develop and deploy a portable IoT using Arduino/ equivalent boards and relevant protocols.

CO2. Evaluate, design, develop and deploy web services to access/control IoT devices for applications in real time scenario by connecting to the cloud.

CO3. Evaluate and apply AI methods in construction engineering management, automation, risk mitigation, high efficiency, digitalization, and computer vision.

CO4. Apply and demonstrate basic principles of AI in solving real world problems in solutions that require problem solving, inference, perception, knowledge representation and learning.

CO5. Design, develop and deploy a portable IoT using Arduino/ equivalent boards and relevant protocols.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	3	2	2	1	1
CO2	2	2	3	3	3	3
CO3	1	2	3	1	3	3
CO4	2	3	2	3	2	3
CO5	1	3	3	3	3	3
Course Correlation Mapping	**2**	**3**	**3**	**3**	**3**	**3**

Correlation Levels: 3: High;   2: Medium; 1: Low

COURSE CONTENT

Module 1:   DATA SCIENCE   (08 Periods)

About Data Science, Benefits and uses of data science and big data, Facets of data, The Current Landscape of Data Science, Data Science Profile and Thought Experiment Meta-Definition, The big data ecosystem and data science, Overview of Python concepts

Module 2:   PYTHON FUNDAMENTALS IN CONSTRUCTION   (07 Periods)

Overview of key python concepts, Control Statements, Functions and Libraries; Motivating factors for building industry, Construction professionals to learn to code, The application of python in Net Zero Energy Building (NZEB), Various uses of data science and related technologies in design, construction and operation.

Module 3:   PANDAS DATA ANALYTICS LIBRARY AND DESIGN   (10 Periods) PHASE APPLICATION

Overview of the design phase of buildings, Pandas data analytics library – Concept, Basics of pandas data structures, Common pandas functions; Applications for designers on Energy Plus, Revit, Rhino, Spatial analytics, Generation design; Construction phase of buildings, Time-series data and its challenges, Applications in project management, Building Management System (BMS) data analysis and digital construction.

Module 4:   STATISTICS   AND   VISUALIZATION   BASICS   AND   (11 Periods) OPERATIONS

Overview of operations phase of buildings, Occupant satisfaction in buildings, Pandas statistical aggregations and visualization techniques in pandas, Seaborn visualization library, Applications for operations focused on occupant satisfaction , Spatial optimization and feedback collection.

Module 5:   MACHINE LEARNING FOR THE BUILT ENVIRONMENT   (09 Periods)

Prediction impact on building industry, Implementation of prediction, classification and clustering using the sci-kit learn library, Application to smart meter and occupant comfort data for prediction and classification of data. Applications on machine learning in construction industry.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1.   a) Design and simulate LED 7-segment display interfacing with Arduino.
        b) Design and simulate servo motor interfacing with Arduino.

2.   a) Design and simulate ultrasonic sensor and LCD interfacing with Arduino.
        b) Design and simulate flame sensor interfacing with Arduino.

3.   Design and implement to capture gas Sensor and send sensor data to cloud from your node mcu device using Arduino IDE.

4.   Design and implementation of humidity and temperature monitoring using Arduino and upload data to cloud using MQTT.

5.   Design and implementation of an iot ECG (Electrocardiogram) system to record heart's electrical activity.

6.   Design and simulate controlling an LED 7-Segment display with Raspberry Pi.

7. Design and implementation of raspberry Pi home security system with camera and PIR sensor with email notifications.

8. Design and implement to upload light sensor (TSL) data to cloud through raspberry Pi.

9. Design and implementation of motion detector with node mcu and BLYNK.

10. Design and implementation of fire notification ιοτ system with BLYNK.

PROJECT BASED LEARNING:

Projects relevant to the contents of the course will be provided by the course instructor at the beginning.

1. Design a sensor that detects the temperature differences and records data.

2. Design a building with Building Automation System (BAS).

3. Design a data collection equipment for a building.

RESOURCES

TEXT BOOKS:

1. Rakesh. K. Jain. Data Science for Civil Engineering _ A beginners Guide, CRC Press, Taylor & Francis Group, London.

REFERENCE BOOKS:

1. Michael Rustell, Innovation in construction, Springer, 2022

SOFTWARE/TOOLS:

1. Pyton
2. Microsoft Power BI

VIDEO LECTURES:

1. Course | Data Science for Construction, Architecture and Engineering | edX

2. Machine Learning Application to Structural Engineering - Part 1 - YouTube

WEB RESOURCES:

1. Data Science in Civil Engineering - Analytics Vidhya

2. Conquer Data Science in Civil Engineering | Data Trained Blogs

3. Artificial Intelligence and Data in Civil Engineering | SpringerLink

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE204003	**DATA SCIENCE FOR CIVIL ENGINEERS**	2	-	2	4	4

Pre-Requisite   -

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: Data Science, Python Fundamentals in Construction, Pandas Data Analytics Library and Design Phase Application, Statistics and Visualization Basics and Operations, Machine Learning for the Built Environment.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Design, develop and deploy a portable IoT using Arduino/ equivalent boards and relevant protocols.

CO2. Evaluate, design, develop and deploy web services to access/control IoT devices for applications in real time scenario by connecting to the cloud.

CO3. Evaluate and apply AI methods in construction engineering management, automation, risk mitigation, high efficiency, digitalization, and computer vision.

CO4. Apply and demonstrate basic principles of AI in solving real world problems in solutions that require problem solving, inference, perception, knowledge representation and learning.

CO5. Design, develop and deploy a portable IoT using Arduino/ equivalent boards and relevant protocols.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	3	2	2	1	1
CO2	2	2	3	3	3	3
CO3	1	2	3	1	3	3
CO4	2	3	2	3	2	3
CO5	1	3	3	3	3	3
Course Correlation Mapping	**2**	**3**	**3**	**3**	**3**	**3**

Correlation Levels: 3: High;   2: Medium; 1: Low

COURSE CONTENT

Module 1:   DATA SCIENCE   (06 Periods)

About Data Science, Benefits and uses of data science and big data, Facets of data, The Current Landscape of Data Science, Data Science Profile and Thought Experiment Meta-Definition, The big data ecosystem and data science, Overview of Python concepts

Module 2:   PYTHON FUNDAMENTALS IN CONSTRUCTION   (06 Periods)

Overview of key python concepts, Control Statements, Functions and Libraries; Motivating factors for building industry, Construction professionals to learn to code, The application of python in Net Zero Energy Building (NZEB), Various uses of data science and related technologies in design, construction and operation.

Module 3:   PANDAS DATA ANALYTICS LIBRARY AND DESIGN (06 Periods)
             PHASE APPLICATION

Overview of the design phase of buildings, Pandas data analytics library – Concept, Basics of pandas data structures, Common pandas functions; Applications for designers on Energy Plus, Revit, Rhino, Spatial analytics, Generation design; Construction phase of buildings, Time-series data and its challenges, Applications in project management, Building Management System (BMS) data analysis and digital construction.

Module 4:   STATISTICS   AND   VISUALIZATION   BASICS   AND (06 Periods)
             OPERATIONS

Overview of operations phase of buildings, Occupant satisfaction in buildings, Pandas statistical aggregations and visualization techniques in pandas, Sea born visualization library, Applications for operations focused on occupant satisfaction , Spatial optimization and feedback collection.

Module 5:   MACHINE LEARNING FOR THE BUILT ENVIRONMENT   (06 Periods)

Prediction impact on building industry, Implementation of prediction, classification and clustering using the sci-kit learn library, Application to smart meter and occupant comfort data for prediction and classification of data. Applications on machine learning in construction industry.

Total Periods: 30

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

11.   A) Design and simulate LED 7-segment display interfacing with Arduino.
      B) Design and simulate servo motor interfacing with Arduino.

12.   A) Design and simulate ultrasonic sensor and LCD interfacing with Arduino.
      B) Design and simulate flame sensor interfacing with Arduino.

13.   Design and implement to capture gas Sensor and send sensor data to cloud from your nodemcu device using Arduino IDE.

14.   Design and implementation of humidity and temperature monitoring using Arduino and upload data to cloud using MQTT.

15.   Design and implementation of an iot ECG (Electrocardiogram) system to record heart's electrical activity.

16.   Design and simulate controlling an LED 7-Segment display with Raspberry Pi.

17. Design and implementation of raspberry Pi home security system with camera and PIR sensor with email notifications.

18. Design and implement to upload light sensor (TSL) data to cloud through raspberry Pi.

19. Design and implementation of motion detector with nodemcu and BLYNK.

20. Design and implementation of fire notification ιοτ system with BLYNK.

PROJECT BASED LEARNING:

Projects relevant to the contents of the course will be provided by the course instructor at the beginning.

1. Design a sensor that detects the temperature differences and records data.

2. Design a building with Building Automation System (BAS).

3. Design a data collection equipment for a building.

RESOURCES

TEXT BOOKS:

2. Rakesh. K. Jain. Data Science for Civil Engineering _ A beginners Guide, CRC Press, Taylor & Francis Group, London.

REFERENCE BOOKS:

2. Michael Rustell, Innovation in construction, Springer, 2022

SOFTWARE/TOOLS:

3. Pyton
4. Microsoft Power BI

VIDEO LECTURES:

3. Course | Data Science for Construction, Architecture and Engineering | edX

4. Machine Learning Application to Structural Engineering - Part 1 - YouTube

WEB RESOURCES:

4. Data Science in Civil Engineering - Analytics Vidhya

5. Conquer Data Science in Civil Engineering | Data Trained Blogs

6. Artificial Intelligence and Data in Civil Engineering | SpringerLink

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201017	**STRATEGIC MANAGEMENT IN CONSTRUCTION**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Construction, Strategic management, Strategic roles of clients, contractors and competitors, Strategic behavior of construction firms, and Strategies for international construction.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Determine construction strategies to solve problems associated with construction projects for ensuring safety and sustainability using appropriate tools and techniques in structures, besides lifelong learning.

CO2. Analyze various concepts of strategy management to solve problems associated with construction projects for ensuring safety and sustainability using appropriate tools and techniques in structures besides lifelong learning

CO3. Analyze strategic roles of clients, contractors to solve problems associated with construction projects for ensuring safety and sustainability using appropriate tools and techniques in structures, besides lifelong learning.

CO4. Analyze the behavior of construction firm strategies to solve problems associated with projects for ensuring safety and sustainability using appropriate tools and techniques in structures, besides lifelong learning.

CO5. Analyze strategies for international construction to solve problems associated with construction projects for ensuring safety and sustainability using appropriate tools and techniques in structures, besides lifelong learning.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	2	1	1	1
CO2	3	1	3	2	2	1
CO3	3	2	2	3	3	1
CO4	3	2	3	2	3	2
CO5	3	2	3	3	3	2
Course Correlation Mapping	**3**	**2**	**3**	**3**	**3**	**1**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1:   CONSTRUCTION – AN OVERVIEW OF THE MARKET   (08 Periods)

The evolution of the construction industry in the post-World war II era, Construction and its business environment, Industrial buildings, commercial buildings, The housing market, Repairs and Maintenance and making sense of the trends.

Module 2:   CONCEPTS OF STRATEGIC MANAGEMENT   (08 Periods)

Introduction, Concepts and definitions, strategic management, strategic management process, organizational change, strategic planning, strategic vision, strategic learning, Strategic behavior.

**Module 3:   STRATEGIC ROLE OF CLIENTS, CONTRACTORS AND   (08 Periods)
COMPETENCIES IN THE CONSTRUCTION INDUSTRY**

The concept of product and project life cycle in construction, The strategic concept industry and market in construction, market structure, price determination and competition in construction.

Module 4:   STRATEGIC BEHAVIOR OF CONSTRUCTION FIRMS   (12 Periods)

Core business and core competencies in construction, levels of strategy, firm strategy - structure and competitiveness, managing the diversified construction firms, Strategies at the operating core in contracting firms, project portfolios and potential capacity, sub-contracting as a production strategy within project portfolios, The management resources in construction firms as a source of competitive advantage – resolving a strategic paradox.

Module 5:   STRATEGIES FOR INTERNATIONAL CONSTRUCTION   (09 Periods)

Background - International business strategy, Size and structure, reasons for internationalism, characteristics and obstacles to internationalism, competitive advantage in international construction, factors, domestic demand conditions, supplier/sub-contractor industries, country analysis, strategic positioning competitive intelligence.

Total Periods: 45

EXPERIENTIAL LEARNING

1.   Conduct a study on real estate project investment strategy in relation to market timing and developer experience.

2.   Select any aged residential building nearby and analyze the maintenance and operation costs for renovation using facilities management concepts.

RESOURCES

TEXT BOOKS:

1.   Langford, D., and Male, S., Strategic management in construction. John Wiley and Sons, 2008.

2.   Fellows, R. F., Langford, D., Newcombe, R., and Urry, S., Construction management in practice. John Wiley and Sons, 2009.

REFERENCE BOOKS:

1.   Harris, F., McCaffer, R., Baldwin, A., and Edum-Fotwe, F., Modern construction management. John Wiley and Sons, 2021.

2.   McCabe, S., Corporate strategy in construction: Understanding today's theory and practice. John Wiley and Sons, 2010.

3.   Winch, G. M., Managing construction projects. John Wiley and Sons, 2009.

VIDEO LECTURES:

1. NPTEL : Management - Strategic Management

WEB RESOURCES:

1. 10 construction management strategies that work – Lets build

2. Strategic Management in Construction - World Construction Today

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201018	**ACOUSTICS AND NOISE CONTROL IN BUILDINGS**	3	-	-	-	3

Pre-Requisite   -

Anti-Requisite   -

Co-Requisite   -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to sound and room acoustics; Acoustical tools, measurements and materials; Acoustical design; Noise reduction in building; Noise reduction in building and Noise reduction and control in industries and urban spaces

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Identify the basics of sound and room acoustics in buildings to solve problems associated with infrastructure for ensuring safety and sustainability, using appropriate tools and techniques in structures, besides lifelong learning.

CO2. Analyze various acoustical tools, measurements and materials to solve problems associated with buildings for ensuring safety and sustainability using appropriate tools and techniques in structures, besides lifelong learning

CO3. Analyze various acoustical designs to solve problems associated with buildings for ensuring safety and sustainability using appropriate tools and techniques in structures, besides lifelong learning.

CO4. Analyze Noise reduction techniques used in buildings to solve problems associated with urban infrastructure for ensuring safety and sustainability, using appropriate tools and techniques in structures, besides lifelong learning.

CO5. Analyze the noise control in industries, urban spaces to solve problems associated with smart structures for ensuring safety and sustainability using appropriate tools and techniques in structures, besides lifelong learning.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	2	-	1	2
CO2	2	2	1	-	1	2
CO3	2	2	2	-	2	2
CO4	2	-	1	-	2	2
CO5	2	-	1	-	2	2
Course Correlation Mapping	**2**	**2**	**2**	**-**	**2**	**2**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO SOUND AND ROOM ACOUSTICS   (10 Periods)

Introduction to sounds: Origin and nature of sound, its characteristics and measurement – amplitude, frequency, period, wavelength, velocity of sound, sound pressure, sound intensity, decibel scale, sound and distance – inverse square law. Human hearing and auditory range for humans.

Room Acoustics: Reflection – Nature of reflection from plane, convex and concave surfaces, diffraction, absorption, echoes, focusing of sound, dead spots, flutter echo. Room resonances, reverberation – reverberation time (RT) calculation using Sabine's and Eyring's formulae. Effect of RT on speech and music.

Module 2: ACOUSTICAL TOOLS, MEASUREMENTS AND MATERIALS   (10 Periods)

Acoustical Tools and Measurements: Use of SLM (Sound Level Meter), AI (Articulation Index), STI (Speech-Transmission Index), Speech Intelligibility. Sound Attenuation. Absorption coefficients of acoustical materials, NRC value, NC Curves for various spaces.

Acoustics Materilas: Porous materials, panel absorbers, membrane absorbers, acoustical platers, diffusers, cavity or Helmholtz resonators. Role of functional absorbers, adjustable acoustics and variable sound absorbers. Acoustical correction and retrofits to existing spaces.

Module 3: ACOUSTICAL DESIGN   (09 Periods)

Acoustical Design of Auditoriums – Multipurpose Halls: History of Greek, Roman theaters. Use of IS code 2526-1963 for design and detailing of auditoriums – cinema halls, multi-purpose halls, Halls for speech and music.

Acoustical Design and Detailing of Other Spaces: Open-air theatres, Halls for indoor sports, home theatres, recording studios, open plan offices, etc. Need and use of sound reinforcement systems, sound masking systems and speech privacy.

Module 4: NOISE REDUCTION IN BUILDING   (07 Periods)

Enclosures, barriers, sound insulation (AC ducts and plants), vibration isolation – control of mechanical noise, floor, wall, ceiling treatment; Sound isolation, Construction details of composite walls, Double walls, floating floors, wood-joist floors, plenum barriers, sound locks, etc. STC (Sound Transmission Class) ratings.

Module 5: NOISE REDUCTION AND CONTROL IN INDUSTRIES AND   (09 Periods)
URBAN SPACES

Industrial Noise: Sources of industrial noise, Impact, Friction, reciprocation, air turbulence and other noise, methods of reduction by enclosures and barriers.

Urban Spaces: Introduction to Urban noise, Noise Sources – Air traffic, rail traffic, road traffic, seashore and inland, town planning and regional planning consideration, Role of architects/urban planners in shaping the urban soundscape, sustainable design strategies in building acoustics.

Total Periods: 45

EXPERIENTIAL LEARNING:

1.   conduct noise surveys, measure and analyze reverberation time, study acoustic materials, design an acoustically efficient space, and prepare a case study on real-world noise control measures.
2.   perform noise and reverberation analysis, evaluate acoustic materials, design sound-controlled spaces, and document real-world noise control applications through case studies.

RESOURCES

TEXT BOOKS:

1. M. David Egan, Architectural Acoustics, J Ross Publications, 2007
2. Vern Oliver Knudsen, Cyril M. Harris, Acoustical Designing in Architecture, Wiley Publishers, 2008

REFERENCE BOOKS:

1. Leslie L. Doelle, Environmental Acoustics, McGraw-Hill publications, 2008.
2. National Building Code of India (NBC) 2016; Part 8 Section 4
3. IS 1950: 1962 Code of practice for sound insulation of non-industrial buildings
4. IS 3483: 1965 Code of practice for noise reduction in industrial buildings
5. IS 4954: 1968 Recommendations for noise abatement in town planning

VIDEO LECTURES:

1. Energy Efficiency, Acoustics and daylighting in Building - Course

WEB RESOURCES:

1. Noise Control in Structural Design: Building for Acoustics
2. Noise Control in Buildings through Architectural Acoustic Design Techniques – theconstructor.org

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25AI201701	**BUSINESS ANALYTICS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course emphasizes on the basic concepts of Business Analytics. It covers the basic excel skills, Excel look up functions for database queries in business analytics. By the end of this course students will acquire basic knowledge to implement statistical methods for performing descriptive, predictive and prescriptive analytics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic concepts and models of Business Analytics

CO2. Select Suitable basic excel function to perform analytics on spread sheets.

CO3. Apply different statistical techniques and distributions for modeling the data

CO4. Develop user-friendly Excel applications by using statistical models for effectiveness decision making.

CO5. Analyze the performance of different optimization models used in prescriptive analytics on Binary and Categorical data.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	-	-	-	-
CO2	2	3	-	-	-	-
CO3	2	2	-	-	3	-
CO4	1	1	-	-	-	-
CO5	-	-	-	-	-	-
Course Correlation Mapping	**2**	**2**	**-**	**-**	**3**	**-**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: FOUNDATIONS OF BUSINESS ANALYTICS (09 Periods)

Introduction, What is Business Analytics, Evolution of Business Analytics, Scope of Business Analytics, Data for Business Analytics, Applications of Business Analytics, Models in Business Analytics, Problem Solving with Analytics.

Module 2: ANALYTICS ON SPREADSHEETS (09 Periods)

Basic Excel Skills, Excel Functions, Using Excel Lookup Functions for Database Queries, Spreadsheet Add-Ins for Business Analytics.
Visualizing and Exploring Data: Data Visualization, Creating Charts In Microsoft Excel, Other Excel Data Visualization, Statistical Methods For Summarizing Data, Exploring Data Using Pivot tables.

Module 3: DATA MODELING (09 Periods)

Basic concepts of Probability, Random Variables and Probability Distributions, Continuous Probability Distributions.
Statistical Sampling, Estimation population parameters, Sampling Error, Sampling Distributions, Hypothesis Testing, ANOVA, Chi Square Test.

Module 4: PREDICTIVE ANALYTICS (09 Periods)

Trend lines And Regression Analysis, Modeling Relationships And Trends In Data, Simple Linear Regression, Multiple Linear Regression, Building Good Regression Models,
Strategies for predictive decision modeling, implementing models on spreadsheets, spreadsheet applications in business analytics, developing user-friendly excel applications, analysing uncertainty and model assumptions, model analysis using analytic solver platform

Module 5: PRESCRIPTIVE ANALYTICS (09 Periods)

Linear Models: Building Linear Models, Implementing Linear Optimization Models On Spreadsheets, Graphical Interpretation Of Linear Optimization, Linear Optimization Models for prediction and Insight.
Integer Models: Solving models with Integer Variables, Integer Optimization Models with Binary Numbers
Decision Analysis: Formulating Decision Problems, Decision Strategies Without Outcome Probabilities, Decision Trees With Outcome Probabilities, Decision Trees.

Total Periods: 45

EXPERIENTIAL LEARNING

1. **Diabetic Prediction:**
   The National Institute of Diabetes and Digestive and Kidney Diseases has a created a dataset. The objective of the dataset is to diagnostically predict whether or not a patient has diabetes, based on certain diagnostic measurements included in the dataset. Several constraints were placed on the selection of these instances from a larger database. In particular, all patients here are females at least 21 years old of Pima Indian heritage. The datasets consists of several medical predictor variables and one target variable, Outcome. Predictor variables includes the number of pregnancies the patient has had, their BMI, insulin level, age, and so on. Build a machine learning model to accurately predict whether or not the patients in the dataset have diabetes or not?

2. Solve the house price prediction problem using **Linear regression analysis** method. Optimize the parameters of the regression function using gradient descent method.

3. Visualize the decision tree built for solving Heart disease prediction problem and measure the impurity of nodes created via **Decision Tree Analysis**.
   Dataset:https://www.kaggle.com/arviinndn/heart-disease-prediction-uci dataset/data

4. The data set baby boom (Using R) contains data on the births of 44 children in a one-day period at a Brisbane, Australia, hospital. Compute the skew of the wt variable, which records birth weight. Is this variable reasonably symmetric or skewed?

5. Visualize the **Distribution of data** with different feature scaling methods on online news popularity dataset for article word count.
Dataset:https://www.kaggle.com/datasets/deepakshende/onlinenewspopularity

6. **Human Activity Recognition System:**
The human activity recognition system is a classifier model that can identify human fitness activities. To develop this system, you have to use a smart phone dataset, which contains the fitness activity of 30 people which is captured through smart phones. This system will help you to understand the solving procedure of the **Multi-classification problem**.

RESOURCES

TEXT BOOKS:

1.   James Evans, Business Analytics, Pearson Education, 2nd Edition, 2017.

REFERENCE BOOKS:

1.   Marc J. Schniederjans, Business Analytics, Pearson Education,2015

2.   Camm, Cochran, Essentials of Business Analytics, Cenage learning, 2015

VIDEO LECTURES:

1.   https://nptel.ac.in/courses/110105089

2.   https://archive.nptel.ac.in/courses/110/107/110107092/

3.   https://nptel.ac.in/courses/110106050

WEB RESOURCES:

1.   https://www.proschoolonline.com/certification-business-analytics-course/what-is-ba

2.   https://michael.hahsler.net/SMU/EMIS3309/slides/Evans_Analytics2e_ppt_01.pdf

3.   https://www.guru99.com/business-analyst-tutorial-course.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25AI201702	**ETHICS FOR AI**	3	–	–	–	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

Recognize the fundamental ideas and standards of AI ethics. Recognizing fairness and prejudice in artificial intelligence. Obstacles to obtaining explain ability and openness. Frameworks based on ethics and the law that designate accountability. Privacy and security concerns related to AI ethics. Ethics in AI in the future.

COURSE OUTCOMES: At the end of the course, student will be able to:

CO1. Understand the basic concepts of AI Ethics and ethical principles.

CO2. Understanding the concept of bias and fairness in AI.

CO3. Challenges in achieving the transparency and explainability.

CO4. Legal and ethical frameworks for assigning responsibility.

CO5. Security and privacy issues of AI Ethics. Future of AI ethics.

CO-PO Mapping Table

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	2	-	-	-
CO2	3	3	3	-	-	-
CO3	3	3	-	-	-	-
CO4	2	3	3	-	-	-
CO5	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**3**	**3**	-	**-**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

MODULE 1:   INTRODUCTION TO AI ETHICS   (09 Periods)

Overview of ethical issues in AI. Historical context and key concepts. Importance of ethical considerations in AI development and deployment.
Ethical Principles and Frameworks:
Utilitarianism, deontology, virtue ethics, and other ethical theories. Ethical principles for AI, such as fairness, transparency, accountability, and privacy.

MODULE 2:   BIAS AND FAIRNESS IN AI   (09 Periods)

Understanding bias in AI systems. Types of bias (e.g., algorithmic bias, dataset bias). Approaches to detecting and mitigating bias. Fairness metrics and fairness-aware machine learning algorithms.

MODULE 3:   TRANSPARENCY AND EXPLAINABILITY   (09 Periods)

Importance of transparency and explainability in AI. Techniques for explaining AI decisions. Challenges and trade-offs in achieving transparency and explainability. Regulatory requirements and guidelines for transparent AI systems.

MODULE 4:   ACCOUNTABILITY AND RESPONISIBILITY   (09 Periods)

Holding AI developers, users, and organizations accountable for AI systems' actions. Legal and ethical frameworks for assigning responsibility. Challenges in attributing responsibility in complex AI systems

MODULE 5:   PRIVACY AND DATA PROTECTION   (09 Periods)

Privacy issues in AI, including data collection, storage, and sharing. Privacy-preserving AI techniques. Regulatory frameworks (e.g., GDPR) and ethical guidelines for data protection in AI. Ethical considerations in emerging AI technologies.

Total Periods: 45

EXPERIENTIAL LEARNING

Case -1: Emergence of Bias and Fairness Interventions

For the problem of Loan Approval and Hiring by AI, specify the steps and practices to the entry of bias and fairness improvement interventions.

Case-2: AI governance with critical thinking, negotiation skills, and a multi-stakeholder perspective
Undertake the study from ethical perspective for the problem of Public response system, Policy making and Contract negotiation.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Müller, Vincent C., Ethics of Artificial Intelligence and Robotics. The Stanford Encyclopedia of Philosophy, 2021.

2. Meredith Broussard, Artificial Unintelligence: How Computers Misunderstand the World, Cambridge, MA: MIT Press, 2018.

REFERENCE BOOKS:

1. Brett Frischmann and Evan Selinger, Re-Engineering Humanity, Cambridge University Press, Cambridge, 2018.

2. Cathy O'Neil, Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy, Crown Publishers, 2016.

3. Shoshana Zuboff, The Age of Surveillance Capitalism, Financial Times, 2020.

VIDEO LECTURES:

1. https://rainermuehlhoff.de/en/EoAI2025/

2. https://www.youtube.com/watch?v=qpp1G0iEL_c

3. https://rainermuehlhoff.de/en/EoAI2025/

WEB RESOURCES:

1. https://www.ibm.com/topics/ai-ethics

2. https://www.coursera.org/articles/ai-ethics

3. https://ai.google/responsibility/principles/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CM201701	**COST MANAGEMENT OF ENGINEERING PROJECTS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course will provide an understanding of the cost tools and techniques that can be used throughout a project's design and development. The students will be exposed to the methods, processes, and tools needed to conduct economic analysis, estimation of Project.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the costing concepts and their role in decision-making.

CO2. Understand the project management concepts and their various aspects in selection.

CO3. Interpret costing concepts with project execution.

CO4. Knowledge of costing techniques in the service sector and various budgetary control techniques.

CO5. Become familiar with quantitative techniques in cost management.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	-	-	-	-	2
CO2	-	-	-	-	-	2
CO3	-	-	-	-	-	2
CO4	-	-	-	-	-	2
CO5	-	-	-	-	-	2
Course Correlation Level	**-**	**-**	**-**	**-**	**-**	**2**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1:   INTRODUCTION TO COSTING CONCEPTS   **(05 Periods)**

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost, and Opportunity cost; Creation of a Database for operational control.

Module 2:   INTRODUCTION TO PROJECT MANAGEMENT   **(10 Periods)**

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre-project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

Module 3:   PROJECT EXECUTION AND COSTING CONCEPTS   **(10 Periods)**

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

Module 4:   COSTING OF SERVICE SECTOR AND BUDGETARY CONTROL   **(10 Periods)**

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets

Module 5:   QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT   **(10 Periods)**

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

Total Periods: 45

EXPERIENTIAL LEARNING

1.   Prepare a mini-project report regarding cost control techniques in manufacturing units.

2.   Prepare a report on real-life engineering project case studies, especially those that faced cost overruns or successfully managed costs

3.   Conduct hands-on budgeting exercises where participants are given a project scope, and they have to create detailed budgets.

RESOURCES

TEXT BOOKS:

1. John M. Nicholas, Herman Steyn Project Management for Engineering, Business and Technology, Taylor & Francis, 2 August 2020, ISBN: 9781000092561

2. Albert Lester, Project Management, Planning and Control, Elsevier/Butterworth-Heinemann, 2007, ISBN: 9780750669566, 075066956X.

REFERENCE BOOKS:

1. Charles T. Horngren et al Cost Accounting a Managerial Emphasis, Prentice Hall of India, New Delhi, 2011.

2. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991.

3. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=rck3MnC7OXA

2. https://www.youtube.com/watch?v=QWD1LMzStI4

WEB RESOURCES:

1. https://www.superfastcpa.com/what-are-cost-concepts-in-decision-making

2. https://www.indeed.com/career-advice/career-development/project-cost-controls

3. https://www.geeksforgeeks.org/difference-between-pert-and-cpm/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25CE201701	**DISASTER MANAGEMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on disaster prone areas in India, repercussions of disasters and hazards, disaster preparedness and management, risk assessment and disaster management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the vulnerability of an area to natural and man-made disasters/hazards as per the guidelines to solve complex problems using appropriate techniques ensuring safety, environment and sustainability.

CO2. Analyze the causes and impacts of disasters using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Suggest the preparedness measures using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.

CO4. Analyze the Risk Assessment using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.

CO5. Design disaster management strategies to solve pre, during and post disaster problems using appropriate tools and techniques following the relevant guidelines and latest developments ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	-	-	-	-	2
CO2	-	-	-	-	-	2
CO3	-	-	-	-	-	2
CO4	-	-	-	-	-	2
CO5	-	-	-	-	-	2
Course Correlation Level	-	-	-	-	-	2

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1:   DISASTER PRONE AREAS IN INDIA   (09 Periods)

Introduction: Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types And Magnitude.
Disaster Prone Areas: Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

Module 2:   REPERCUSSIONS OF DISASTERS AND HAZARDS   (09 Periods)

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Module 3:   DISASTER PREPAREDNESS AND MANAGEMENT   (11 Periods)

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Module 4:   RISK ASSESSMENT   (08 Periods)

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Module 5:   DISASTER MANAGEMENT   (08 Periods)

Disaster management organization and methodology, Disaster management cycle, Disaster management in India – Typical cases and Cost–benefit analysis, Disaster management programs implemented by NGOs and Government of India, Usage of GIS and Remote sensing techniques in disaster management, Leadership and Coordination in Disaster management, Emerging trends in disaster management.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Perform hazard assessment and vulnerability analysis for any nearby town/city and prepare a detailed report of possible impacts of various disasters on environment, infrastructure and development.

2. Prepare a detailed report on the causes and effects of Tsunami that was occurred in the year 2004. Also discuss various advancements in Tsunami warning systems.

3. Identify the major causes of urban floods in cities like Chennai, Hyderabad & Mumbai. Also list various mitigation strategies to reduce the impact of floods.

4. Prepare a detailed report on how various man-made activities are directly/indirectly related to the occurrence of landslides that occurred in recent days in India.

5. Visit AP State Disaster Response and Fire Services Department and record about various methods used by them in mitigating disasters and their management.

RESOURCES

TEXT BOOKS:

1. Sharma V. K., Disaster Management, Medtech Publishing, 2nd Edition, 2013.

2. Anand S. Arya, Anup Karanth, and Ankush Agarwal, Hazards, Disasters and Your Community: A Primer for Parliamentarians, GOI–UNDP Disaster Risk Management Program, Government of India, National Disaster Management Division, Ministry of Home Affairs, New Delhi, Version 1.0, 2005

REFERENCE BOOKS:

1. ɔnald Hyndman and David Hyndman, Natural Hazards and Disasters, Cengage Learning, USA, 5th Edition, 2015.
2. Disaster Management in India, A Status Report, Ministry of Home Affairs, Govt. of India, May 2011.
3. Rajendra Kumar Bhandari, Disaster Education and Management: A Joyride for Students, Teachers, and Disaster Managers, Springer India, 2014.
4. Singh R. B., Natural Hazards and Disaster Management, Rawat Publications, 2009.
5. R. Nishith, Singh AK, Disaster Management in India: Perspectives, issues and strategies, New Royal book Company.
6. Sahni, PardeepEt.Al. (Eds.), Disaster Mitigation Experiences And Reflections, Prentice Hall of India, New Delhi.
7. Goel S. L. , Disaster Administration And Management Text And Case Studies, Deep &Deep Publication Pvt. Ltd., New Delhi

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105104183

2. https://www.digimat.in/nptel/courses/video/124107010/L01.html

WEB RESOURCES:

1. https://egyankosh.ac.in/handle/123456789/25093

2. https://www.egyankosh.ac.in/handle/123456789/25912

3. https://www.nios.ac.in/media/documents/333courseE/12.pdf

4. https://ndmindia.mha.gov.in/images/public-awareness/Primer%20for%20Parliamentarians.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS201701	**VALUE EDUCATION**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course deals with understanding the value of education and self-development, Imbibe good values in students, and making them know about the importance of character.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the knowledge of values and self-development

CO2. Analyze the importance of the cultivation of values.

CO3. Learn suitable aspects of personality and behavioral development

CO4. Function as a member and leader in multi-disciplinary teams by avoiding faulty thinking.

CO5. Develop character and competence for effective studies.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	-	-	-	-	-
CO2	2	3	-	-	2	-
CO3	2	-	-	-	2	-
CO4	2	-	-	-	-	-
CO5	2	2	-	-	-	-
Course Correlation Level	**2**	**3**	**-**	**-**	**2**	**-**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: VALUES AND SELF-DEVELOPMENT (09 Periods)

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements- Case studies

Module 2: IMPORTANCE OF CULTIVATION OF VALUES. (09 Periods)

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline- Case studies

Module 3: PERSONALITY AND BEHAVIOR DEVELOPMENT (09 Periods)

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness - Case studies

Module 4: AVOID FAULTY THINKING. (09 Periods)

Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature - Case studies

Module 5: CHARACTER AND COMPETENCE (09 Periods)

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and the same message. Mind your Mind, Self-control. Honesty, Studying effectively- Case studies

Total Periods: 45

EXPERIENTIAL LEARNING

1. Demonstrate orally using your experiences of what values are naturally acceptable in a relationship to nurture or exploit others.

2. Prepare a report by identifying and analyzing the importance of cultivation of values.

3. Present a poster on different attitudes and behaviours.

4. Students give a PowerPoint presentation on doing best for nature.

5. Students are encouraged to bring a daily newspaper to class or to access any news related to the need for human values and note down the points.

6. Prepare a case study on how to maintain harmony with different religious people through character and competence.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in the Course Handout)

RESOURCES

TEXTBOOKS:

1. R. Subramanaian, Professional Ethics, Oxford Higher Education, 2013.
2. Mike W. Martin and Roland Schinzinger, Ethics in Engineering, Tata McGraw-Hill, 3rd Edition, 2007.
3. Chakravarthy, S.K.: Values and ethics for Organizations: Theory and Practice, Oxford University Press, NewDelhi, 1999.

REFERENCE BOOKS:

1. M.G. Chitakra: Education and Human Values, A.P.H. Publishing Corporation, New Delhi, 2003
2. Awakening Indians to India, Chinmayananda Mission, 2003
3. Satchidananda, M.K.: Ethics, Education, Indian Unity and Culture, Ajantha Publications, Delhi, 1991

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=90VQPZURN5c
2. https://www.youtube.com/watch?v=6ofPcK0uDaA
3. https://www.youtube.com/watch?v=5_f-7zCi79A
4. https://www.youtube.com/watch?v=2ve49BWAJRE
5. https://www.youtube.com/watch?v=kCOIfnxxQ5U

WEB RESOURCES:

1. https://www.livingvalues.net/
2. https://livingvalues.net/materials-for-schools/
3. https://www.edb.gov.hk/en/curriculum-development/4-key-tasks/moral-civic/index.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25SS201702	**PEDAGOGY STUDIES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with understanding pedagogical practices that are being used by teachers in formal and informal classrooms, the effectiveness of pedagogical practices, teacher education (curriculum and practicum), and the school curriculum and guidance materials that can best support effective pedagogy.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge of pedagogical methodology

CO2. Analyze the functional knowledge in Pedagogical practices, Curriculum, and Teacher Education

CO3. arn effective pedagogical practices and apply strategies.

CO4. Function effectively as an individual and as a member of the Professional development.

CO5. Understand research Gaps and provide future Directions.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	-	-	-	-
CO2	2	3	-	-	3	-
CO3	2	2	-	-	3	-
CO4	1	1	-	-	-	-
CO5	-	-	-	-	-	-
Course Correlation Level	**2**	**2**	**-**	**-**	**3**	**-**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1:   **INTRODUCTION AND METHODOLOGY**   **(09 Periods)**

Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of Methodology and Searching- Case studies

Module 2:   **THEMATIC OVERVIEW**   **(09 Periods)**

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher Education- Case studies

Module 3:   **EFFECTIVENESS OF PEDAGOGICAL PRACTICES**   **(09 Periods)**

Evidence on the effectiveness of pedagogical practices, Methodology for the in-depth stage: quality Assessment of included studies, teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy, Theory of change, Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' Attitudes and beliefs and Pedagogic strategies- Case studies

Module 4:   **PROFESSIONAL DEVELOPMENT**   **(09 Periods)**

Alignment with classroom practices and follow-up support, Peer support, and Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes- Case studies

Module 5:   **RESEARCH GAPS AND FUTURE DIRECTIONS**   **(09 Periods)**

Research design, Contexts, Pedagogy, Teacher Education, Curriculum and Assessment, Dissemination and research impact- Case studies

Total Periods: 45

EXPERIENTIAL LEARNING

1. List out the self-improvement in you after going through pedagogical methodologies.
2. Discuss different practices that you would like to adopt in the curriculum.
3. Describe in your own words how can you bring effectiveness to the curriculum.
4. Imagine you are a head teacher and illustrate different barriers to learning.
5. Assume you are a teacher and Interpret different directions that you would bring for the assessment of the students.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in the Course Handout)

RESOURCES

TEXTBOOK:
1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.

REFERENCES:
1. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.Oxford and Boston: Blackwell.
3. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
4. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

VIDEO LECTURES:
1. https://www.youtube.com/watch?v=WL40UeySag4
2. https://www.youtube.com/watch?v=MMXaXDIHFJ8
3. https://www.youtube.com/watch?v=7uJL1R6M4Iw

WEB RESOURCES:
1. https://acrl.ala.org/IS/instruction-tools-resources-2/pedagogy/a-selected-list-of-journals-on-teaching-learning/
2. https://guides.douglascollege.ca/TLonline/resourcesforonlinepedagogy
3. https://www.refseek.com/directory/teacher_resources.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25LG201701	**PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course gives awareness to students about the various dynamics of personality development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge in Self-Management and Planning Career

CO2. Analyze the functional knowledge in attitudes and thinking strategies

CO3. Learn and apply soft skills for professional success.

CO4. Function effectively as an individual and as a member in diverse teams

CO5. Communicate effectively in public speaking in formal and informal situations.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	-	-	-	-
CO2	2	3	-	-	-	-
CO3	2	2	-	-	3	-
CO4	1	1	-	-	-	-
CO5	-	-	-	-	-	-
Course Correlation Level	**2**	**2**	**-**	**-**	**3**	**-**

Correlation Levels: **3: High;**   **2: Medium;**   **1: Low**

COURSE CONTENT

Module 1: **SELF-ESTEEM & SELF-IMPROVEMENT** **(09 Periods)**

Know Yourself – Accept Yourself; Self-Improvement: Plan to Improve - Actively Working to Improve Yourself- Exercises- case studies

Module 2: **DEVELOPING POSITIVE ATTITUDES** **(09 Periods)**

How Attitudes Develop – Attitudes are Catching – Improve Your Attitudes – Exercises- case studies

Module 3: **SELF-MOTIVATION & SELF-MANAGEMENT** **(09 Periods)**

Show Initiative – Be Responsible Self-Management; Efficient Work Habits – Stress Management – Employers Want People Who can Think – Thinking Strategies- Exercises- case studies

Module 4: **GETTING ALONG WITH THE SUPERVISOR** **(09 Periods)**

Know your Supervisor – Communicating with your Supervisor – Special Communication with your Supervisor – What Should you Expect of Your Supervisor? – What your Supervisor expects of you - Moving Ahead Getting Along with your Supervisor- Exercises- case studies

Module 5: **WORKPLACE SUCCESS** **(09 Periods)**

First Day on the Job – Keeping Your Job – Planning Your Career – Moving Ahead- Exercises- case studies

Total Periods: 45

EXPERIENTIAL LEARNING

1. List out the self-improvements in you on the charts and explain in detail.
2. Discuss different famous personalities and their attitudes.
3. Describe different personalities with respect to self-motivation and self-management.
4. Imagine you are a supervisor and illustrate different special communications.
5. Assume and Interpret different experiences on the first day of your job.

RESOURCES
TEXTBOOK:

1. Harold R. Wallace and L. Ann Masters, Personal Development for Life and Work, Cengage Learning, Delhi, 10th edition Indian Reprint, 2011. (6th Indian Reprint 2015)
2. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.

REFERENCE BOOKS:

1. K. Alex, Soft Skills, S. Chand & Company Ltd, New Delhi, 2nd Revised Edition, 2011.
2. Stephen P. Robbins and Timothy A. Judge, Organizational Behaviour, Prentice Hall, Delhi, 16th edition, 2014

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=6Y5VWBLi1es
2. https://www.youtube.com/watch?v=H9qA3inVMrA

WEB RESOURCES:

1. https://www.universalclass.com/.../the-process-of-perso.
2. https://www.ncbi.nlm.nih.gov/pubmed/25545842
3. https://www.youtube.com/watch?v=Tuw8hxrFBH8

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
25ME201701	**ENTREPRENEURSHIP AND INNOVATION MANAGEMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course aims to provide students with a deep understanding of entrepreneurship and innovation. It explores entrepreneurial processes, opportunity identification, business planning, innovation management, intellectual property rights, and venture growth strategies. Students will develop entrepreneurial thinking, creativity, and problem-solving abilities to create and manage innovative ventures that contribute to economic and societal development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Explain the fundamentals of entrepreneurship and its role in economic development.

CO2. Analyze opportunities and prepare business plans for entrepreneurial ventures.

CO3. Apply creativity and innovation techniques to business problems.

CO4. Demonstrate knowledge of technology management, IPR, and startup ecosystem.

CO5. Evaluate financing options, marketing strategies, and growth models for ventures.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1	-	-
CO2	3	3	2	2	2	-
CO3	2	3	3	2	2	1
CO4	2	2	2	2	2	1
CO5	3	3	2	2	3	1
Course Correlation Mapping	3	3	2	2	2	1

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1:   INTRODUCTION TO ENTREPRENEURSHIP   (09 Periods)

Concept, meaning and importance of entrepreneurship – Characteristics and skills of entrepreneurs – Types of entrepreneurs: social, women, corporate, rural, technology-based – Intrapreneurship vs. entrepreneurship – Entrepreneurial ecosystem and its components.

**Module 2: ENTREPRENEURIAL   PROCESS   AND   BUSINESS   (09 Periods)
               PLANNING**

Stages of entrepreneurial process: Idea, Feasibility, Startup, Growth – Opportunity identification and evaluation – Market research and environmental scanning – Structure and components of a business plan – Case studies of successful entrepreneurs.

Module 3:   INNOVATION MANAGEMENT   (09 Periods)

Meaning, scope and significance of innovation – Types of innovation: product, process, And business model, disruptive, frugal – Creativity techniques: brainstorming, lateral thinking, design thinking, TRIZ – Managing innovation in organizations – Innovation as a competitive advantage.

Module 4:   TECHNOLOGY, IPR AND STARTUP ECOSYSTEM   (09 Periods)

Technology management and commercialization – Intellectual Property Rights (IPR): patents, copyrights, trademarks, designs, trade secrets – Technology transfer and licensing – Startup India, Atal Innovation Mission, MSME policies – Role of incubators, accelerators and innovation hubs.

Module 5:   FINANCING AND GROWTH OF VENTURES   (09 Periods)

Sources of finance: bootstrapping, angel investors, venture capital, crowdfunding, government support – Entrepreneurial marketing strategies – Financial planning for startups – Scaling up ventures: challenges and strategies – Exit strategies: mergers, acquisitions, IPO.

Total Periods: 45

EXPERIENTIAL LEARNING

1.   Prepare a mini-business plan for a startup idea.

2.   Visit a nearby incubation/innovation center and prepare a report.

3.   Conduct a creativity workshop (brainstorming/design thinking session).

4.   Prepare a case study presentation on a successful entrepreneur/startup.

RESOURCES

TEXT BOOKS:

1. Hisrich, R.D., Peters, M.P., & Shepherd, D.A. (2017), Entrepreneurship, McGraw-Hill Education.
2. Drucker, P. (2007), Innovation and Entrepreneurship, Harper Business.
3. Kuratko, D.F. (2020), Entrepreneurship: Theory, Process and Practice, Cengage Learning.

REFERENCE BOOKS:

1. Timmons, J.A., & Spinelli, S. (2019), New Venture Creation: Entrepreneurship for the 21st Century, McGraw-Hill Education.
2. Schilling, M.A. (2020), Strategic Management of Technological Innovation, McGraw-Hill Education.
3. Scarborough, N.M. (2018), Essentials of Entrepreneurship and Small Business Management, Pearson.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=rA4uKIy5gO0&list=PLsh2FvSr3n7fQlIDbfKutmSL26TsWitGQ
2. https://www.youtube.com/watch?v=itRVzjk9mkg

WEB RESOURCES:

1. https://nacosadsu.org.ng/main/docs/300L/ENT%20301.pdf?utm_source=chatgpt.com
2. https://www.measiim.edu.in/myweb/uploads/2022/05/PMFEA-IE-1.pdf?utm_source=chatgpt.com
3. https://ocw.mit.edu/courses/15-351-managing-innovation-and-entrepreneurship-spring-2008/pages/lecture-notes/?utm_source=chatgpt.com