KBTCOE

Maratha Vidya Prasarak Samaj's

Karmaveer Adv. Baburao Ganpatrao Thakare College of Engineering

An Autonomous Institute affiliated to Savitribai Phule Pune University, Pune

Udoji Maratha Boarding Campus, Gangapur Road, Nashik - 422 013,

Maharashtra, India

Syllabus

Third Year B.Tech. Civil Engineering (2024 Pattern)

(As per NEP 2020)

Academic Year 2026-27

(Copy for Student Circulation Only)

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Program Specific Outcomes (PSOs).

PSO1: Graduates will apply technical knowledge, engineering skills, and competencies necessary for entering civil engineering career.

PSO2: Graduates will demonstrate knowledge and techniques in engineering fields for effective management and professional development.

PSO3: Graduates will apply technical and professional skills to be nationally competitive for employment/self-employment thereby benefit the society.

Program Educational Outcomes (PEOs).

PEO1: To ensure that graduates will have a mastery of fundamental knowledge, problem solving skills, engineering experimental abilities, and design capabilities necessary for entering civil engineering career and/or graduate school.

PEO2: To incorporate verbal and written communication skills necessary for successful professional practice.

PEO3: Demonstrate knowledge of management principles and engineering techniques for effective project management

PEO4: To prepare graduates to deal with ethical and professional issues, taking into account the broader societal implications of civil engineering.

Program Outcomes (POs)

PO1: **Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 to develop to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development (WK1 to WK4).

PO3: **Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required (WK5).

PO4: **Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions (WK8).

PO5: **Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6).

PO6: **The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5 and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9).

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) Independent and life-long learning, ii) Adaptability to new and emerging technologies and iii) Critical thinking in the broadest context of technological change. (WK8).

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas is the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Third Year B.Tech. Civil Engineering
Curriculum Structure (2024 Pattern) Semester – V

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
105501	**PCC-8**	Design of Steel Structures	3	2	-	40	60	25	25	**150**	3	1	-	**4**
105502	**PCC-9**	Concrete Technology	2	2	-	40	60	25	25	**150**	2	1	-	**3**
105503	**PCC-10**	Environmental Engineering	2	2	-	40	60	25	25	**150**	2	1	-	**3**
105504	**PEC-1**	Program Elective Course-1	3	2	-	40	60	25	-	**125**	3	1	-	**4**
170505	**MDM-3**	Multi-Disciplinary Minor-3	3	2	-	40	60	25	-	**125**	3	1	-	**4**
105506	**VSEC-4**	Software Skills in RCC and Steel Structures	-	4	-	-	-	50	-	**50**	-	2	-	**2**
Total			**13**	**14**	**0**	**200**	**300**	**175**	**75**	**750**	**13**	**7**	**0**	**20**

Course Code	PEC Course – 1
105504A	Earthquake Engineering
105504B	Hydrology and Irrigation Engineering
105504C	Project Management
105504D	Remote Sensing and GIS

Note: MDM-3 Courses are Listed on Page 6.

Third Year B.Tech. Civil Engineering
Curriculum Structure (2024 Pattern) Semester – VI

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
105601	PCC-11	Design of Reinforced Concrete Structures	3	2	-	40	60	25	25	150	3	1	-	4
105602	PCC-12	Transportation Engineering	3	2	-	40	60	25	25	150	3	1	-	4
105603	PEC-2	Program Elective Course-2	3	2	-	40	60	25	25	150	3	1	-	4
105604	PEC-3	Program Elective Course-3	3	2	-	40	60	25	25	150	3	1	-	4
170605	MDM-4	Multi-Disciplinary Minor-4	3	-	1	40	60	50	-	150	3	-	1	4
Total			**15**	**8**	**1**	**200**	**300**	**150**	**100**	**750**	**15**	**4**	**1**	**20**

Course Code	PEC Course – 2	Course Code	PEC Course – 3
105603A	Advanced Design of Steel Structures	105604A	Domestic and Industrial Wastewater Treatment
105603B	Architecture and Town Planning	105604B	Airport and Bridge Engineering
105603C	Advanced Concrete Technology	105604C	Operation Research
105603D	Construction Management	105604D	Engineering Geology with Rock Mechanics

Note: MDM-4 Courses are Listed on Page 6.

Third Year B.Tech. Multi-Disciplinary Course – 3 and 4
List of Courses (2024 Pattern) Semester – V and VI

S #	Offered by Department	Streams (Choose One Stream Only)	Semester-V		Semester-VI		Semester-VIII		Eligible Student
			MDM – 3 Code	MDM – 3 Courses	MDM – 4 Code	MDM – 4 Courses	MDM – 5 Code	MDM – 5 Courses	
1.	Mechanical Engineering	Automobile Engineering	**170505A**	Systems in Mechanical Engineering	**170605A**	Automotive Technology	**170805A**	Automotive Control System	All, except Mech. Engg. Dept
2.	Computer Engineering	Software Development	**170505B**	Data Structures and Algorithms	**170605B**	Database Systems	**170805B**	Software System Design	All, except Computer Engg., Information Tech. and AI&DS Dept.
3.	Instru. & Control Engg.	Measurement and Control	**170505C**	Engineering Measurements	**170605C**	Industrial Control Components	**170805C**	Industrial Control Applications	All, except Instru. Control Engg. Dept.
4.	Electronics & Tele. Engg.	Internet of Things	**170505D**	Sensors and Actuators	**170605D**	Embedded System in IoT	**170805D**	Applications of IoT	All, except E&TC Department
5.	Civil Engineering	Infrastructure Planning	**170505E**	Infrastructure and Planning	**170605E**	Governing Policies	**170805E**	Transportation Systems	All, except Civil Engg. Department
6.	Information Technology	Web Technology	**170505F**	Web Development	**170605F**	Application Development	**170805F**	Digital Governance	All, except Info. Tech., Computer and AI&DS Dept.
7.	AI&DS	Data Analytics	**170505G**	Applied Data Science	**170605G**	Data Visualization	**170805G**	Business Analytics	All, except AI&DS, Computer and Information Tech. Dept.
8.	Electrical Engineering	Electrical Machines & Drives	**170505H**	Electrical Machines	**170605H**	Drives and Controls	**170805H**	Industrial Applications	All, except Electrical Engg. Dept

- **Summary of Credits and Total Marks:**

Semester	Credits	Marks
V	20	750
VI	20	750
Total	**40**	**1500**

• Definition of Credit :

The Under Graduate (U.G.) programmes will have credit system. The details of credit will be as follow.
1 Credit = 1 hour/week for lecture
= 2 hours/week for practical
= 1 hour/week for tutorial

- **Description of Various Courses:**

Type of Course	Description
PCC	Programme Core Course
PEC	Programme Elective Course
MDM	Multidisciplinary Minor Course
VSEC	Vocational and Skill Enhancement Course (Skill Courses)

Semester - V

Course Code: 105501	Course Name: Design of Steel Structures	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Prerequisite Courses:

- Fundamentals of Engineering Mechanics, Mechanics of Materials and Structural Analysis.

Course Objectives:

- To provide fundamental knowledge of steel as a structural material and relevant design codes.
- To enable students to analyze and design various steel structural members under different loading conditions.
- To teach design of tension members, compression members, beams, beam-columns, and connections using limit state method.
- Familiarize students with industrial practices and safety considerations in steel structure design.
- Promote sustainable and efficient use of steel in construction considering environmental and economic aspects.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Design tension members and connections as per IS 800:2007.

CO2: Design compression members including built-up sections.

CO3: Design Eccentric Loaded Columns and Column Bases.

CO4: Design flexural members, plate girders.

CO5: Design of industrial truss and Gantry Girder.

Course Contents:

Unit-I: Design Philosophy and Tension Members **08 Hours**

Types of steel structures, the chemical composition of structural steel, grades of structural steel, various rolled steel sections, relevant IS specifications such as IS:800-2007, IS:808-1989, IS:875 part I to III, SP: 6(1), SP: 6(6), SP:38, IS: 4000-1992, IS 816–1969, maintenance of

steel structure and its methods. Philosophy of limit state design for strength and serviceability, the partial safety factor for load and resistance, various design load combinations. Tension member: various cross sections such as solid threaded rod, cable and angle sections limit strength due to yielding, rupture and block shear, design of tension member using single and double angle sections and design of connection (bolted connection & welded connection).

Unit-II: Design of Compression Members and Columns 08 Hours

Buckling classification, buckling curves, classification of cross, effective length for compression members and columns, design compressive stress, design of compression member of trusses using single and double angle section and design of connections. Design of axially loaded column using rolled steel section, design of built-up column, lacing and battening and its connections.

Unit-III: Eccentric Loaded Columns and Column Bases 08 Hours

Design of eccentrically loaded column providing uniaxial and biaxial bending for section strength, Design of column bases: slab base, gusseted base and moment resistant base for axial load and uni-axial bending.

Unit-IV: Design of Flexural Members 08 Hours

Design bending strength, laterally restrained and unrestrained beams, design of laterally restrained beams using single rolled steel section with and without flange plate, curtailment of flange plates, low and high shear, check for web buckling, web crippling, and deflection. Design of laterally unrestrained beams using single rolled steel section, check for and deflection. Introduction to welded plate girder and its application.

Unit-V: Design of Industrial Truss and Gantry Girder 08 Hours

Roof truss: assessment of dead load, live load and wind load, design of purlin, design of members of a truss, detailing of typical joints and supports. Design of gantry girder: selection and design of cross section, check for moment capacity, buckling resistance, bi-axial bending, serviceability and fatigue strength.

Learning Resources:

Text Books:

1. Limit State Design of Steel Structures, S K Duggal, Tata McGraw-Hill Education, New Delhi.
2. Design of Steel Structure by Limit State Method as per IS: 800- 2007, Bhavikatti S S, I. K. International Publishing House, New Delhi
3. Design of Steel Structures, K. S. Sai Ram, Pearson, New Delhi.

Reference Books:

4. Design of Steel Structure, N Subramanian, Oxford University Press, New Delhi.
5. Limit State Design in Structural Steel, M. R. Shiyekar, PHI, Delhi.
6. Fundamentals of structural steel design, M L Gambhir, Tata McGraw Hill Education Private limited, New Delhi.
7. Limit State Design of Steel Structure, Ramchandra & Gehlot, Scientific Publishers, Pune.
8. Analysis and Design: Practice of Steel Structures, Karuna Ghosh, PHI Learning Pvt. Ltd. Delhi.
9. Structural Design in Steel, Sarwar Alam Raz, New Age International Publisher.
10. Limit State Design of Steel Structure, V L Shah & Gore, Structures Publication, Pune.

IS Codes:

1. IS 800-2007: Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi
2. IS 808-1989: Dimensions for hot rolled steel beam, column, channel and angle sections, Bureau of Indian Standards, New Delhi
3. IS 875- Part 1 and 2 (1987) and Part 3 (2015): Code of practice for design loads (other than earthquake) for building and structures, Bureau of Indian Standards, New Delhi
4. IS 4000-1992: Code of practice for high strength bolts in steel structures, Bureau of Indian Standards, New Delhi
5. IS 816-1969: Code of practice for use of metal arc welding for general construction in mild steel, Bureau of Indian Standards, New Delhi
6. SP-6(1) and 6(6): ISI handbook for Structural Engineers, Bureau of Indian Standards, New Delhi
7. SP-38: Handbook for typified design for structures with steel roof trusses, Bureau of Indian Standards, New Delhi.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/105105162?utm

List of Practicals:

1. Carry out full design of Industrial structure prepare design report & detailed drawings in A2 size drawing sheet
2. Solve at least five design examples from remaining topics (not covered in full design) and draw sketches of various structural components with proper detailing in sketch book/A3 size sheet.
3. Practical examinations shall consist of oral based on term work and above course.

4. Design based problem/ Open ended problem may also considered as a part of Term-work.

Design based Problems (DP)/Open Ended Problem:

5. (Below mentioned problems are for reference only. Similar problems may be designed by the concerned faculty.)
    a. Prepare model of any one steel structure of the syllabus.
    b. Development of spread sheets for design of various structural components of steel structure.
    c. Design of any steel structure from the course using any open-source / professional software and/or self-developed spread sheet/programs.
    d. Site visit related to construction stages and report preparation.

Course Code: 105502	Course Name: Concrete Technology	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week **Practical :** 2 Hours/Week	**2** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Prerequisite Courses:

- Fundamentals of Engineering Mechanics, Mechanics of Materials and Structural Analysis.

Course Objectives:

- To provide an in-depth understanding of cement, aggregates, admixtures, and fresh/hardened properties of concrete.
- To develop knowledge of advanced concretes such as HPC, SCC, Fibre-Reinforced Concrete, Geo-polymer Concrete, and Sustainable Concrete.
- To understand mix design principles as per IS, ACI, and internationally accepted methods.
- To evaluate durability, microstructure, and long-term performance of concrete under diverse environmental conditions.
- To enable students to conduct laboratory investigations, interpret results, and apply concrete technology in modern construction practices.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the physical and chemical properties of cement, aggregates, mineral admixtures, and chemical admixtures.

CO2: Evaluate fresh and hardened concrete properties using standard testing methods (IS/ASTM).

CO3: Design concrete mixes using IS:10262, ACI, and other codes, including special concretes.

CO4: Assess durability, microstructure, and performance of concrete under environmental and mechanical loading.

CO5: Apply advanced concrete technology concepts in real-world applications, sustainable development, and modern construction.

Course Contents:

Unit-I: Ingredients of Concrete and Properties 06 Hours

Portland cement: composition, hydration, microstructure development, Types of cement (OPC, PPC, PSC, RHPC, low-heat cement, SRPC), Aggregates: classification, grading, characteristics, alkali–aggregate reactivity, Water quality requirements. Chemical admixtures: plasticizers, superplasticizers, retarders, accelerators, Mineral admixtures: fly ash, silica fume, metakaolin, slag, rice husk ash.

Unit-II: Fresh & Hardened Concrete 06 Hours

Concrete manufacturing process – batching, mixing, transportation, placing, compaction, Workability: slump, compaction factor, Vee-Bee, flow table, Hardened concrete: strength, shrinkage, creep, permeability, water absorption, non-destructive testing (NDT): rebound hammer, UPV, maturity concept. Microstructure of concrete: SEM, XRD, TGA basics.

Unit-III: Mix Design 06 Hours

Principles of mix proportioning, Mix design as per IS 10262:2019, Mix design as per ACI 211, Rheology of concrete, Quality control in concrete production, Statistical analysis - characteristic strength concepts, Batching plant operation & RMC concepts.

Unit-IV: Durability of Concrete & Special Concretes 06 Hours

Durability: sulfate attack, chloride ingress, carbonation, alkali-aggregate reaction, Influence of temperature, moisture, aggressive environments, Corrosion of reinforcement: mechanisms, measurement & prevention, Special concretes: High Performance Concrete (HPC),Self-Compacting Concrete (SCC), Fibre Reinforced Concrete (FRC), Geo-polymer Concrete, Light-weight & heavy-weight concrete, SIFCON -Slurry infiltrated fibrous concrete.

Unit-V: Advanced Concrete Technology & Sustainable Practices 06 Hours

Smart concrete technologies, Ultra-High-Performance Concrete (UHPC), Nano-materials in concrete (nano-silica, CNTs basics), Recycled aggregate concrete, Low-carbon & green concrete solutions, Performance-based design, Recent research trends and international codes (EN, ASTM guidance).

Learning Resources:

Text Books:

1. Concrete Technology M.S. Shetty S.Chand & Co. Ltd.
2. Concrete Technology M.L.Gambhir Tata McGraw Hill Ltd.

Reference Books:

1. Properties of Concrete A.M.Neville Pitman.
2. Concrete Technology Dr. K.T. Krishna swami Dhanpatrai & Sons.

3. Concrete Technology R.S. Vashney Oxford &IBH Publishing Co, Bombay.

IS Codes:

1. IS 269-2013 Specifications for O.P.C.
2. I.S. 383-2016 Coarse and Fine Aggregate for Concrete - Specification
3. IS 516-2021 Methods of tests for strength of concrete
4. IS 3812-part 1 Specification of fly ash
5. IS 10262 - 2019 Recommended guidelines for concrete mix design
6. I.S. 2386 Part I to VIII
    a. Part I: Particle size and shape.
    b. Part II: Estimation of deleterious materials and organic impurities.
    c. Part III: Specific gravity, density, voids, absorption, and bulking.
    d. Part IV: Mechanical properties.
    e. Part V: Soundness.
    f. Part VI: Measuring mortar-making properties of fine aggregate.
    g. Part VII: Alkali aggregate reactivity.
    h. Part VIII: Petrographic examination.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/105102012
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ce50

List of Practicals:

1. Test the cement for soundness.
2. Grade aggregate into fine and coarse.
3. Determine flakiness and elongation index.
4. Test crushing value for aggregate.
5. Test impact value for aggregate.
6. Determine aggregate abrasion value.
7. Measure workability (slump, compaction factor test).
8. Plot the effect of W/C ratio on Compressive Strength of Concrete.
9. Conduct split cylinder test.
10. Demonstrate non-destructive tests of concrete.
11. Project: Concrete Mix Design as per I. S. Method.
12. Arrange field visit to cement factory and Ready-Mix concrete plant and prepare a report which should be a part of term work.

Course Code: 105503	Course Name: Environmental Engineering	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week **Practical :** 2 Hours/Week	**2** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Prerequisite Courses:

- Basic Fundamentals of Surveying, Building Planning and Fluid Mechanics, Basic Concepts of Engineering Sciences and Mathematics.

Course Objectives:

- To understand the basics of noise, air pollution, and solid waste management.
- To explain the fundamentals of water supply systems, including quantity and quality requirements.
- To describe the principles and operations of water treatment processes such as aeration and sedimentation.
- To apply methods of designing water treatment plants including coagulation, flocculation, and filtration.
- To analyze advanced water treatment techniques and water distribution systems, including disinfection and softening.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand environmental pollution and waste handling concepts and their control methods.

CO2: Explain water supply infrastructure, demand estimation, and quality standards.

CO3: Describe water treatment principles and the design of basic treatment units.

CO4: Apply coagulation, flocculation, and filtration techniques in water treatment plant design.

CO5: Analyze advanced treatment methods and water distribution systems for efficient water management.

Course Contents:

Unit-I: Fundamentals of Environmental Pollution and Waste Handling 06 Hours

Noise pollution: sound measurements – sound pressure, intensity, sound pressure level, loudness, equivalent noise level and cumulative noise level.

Air pollution: atmospheric stability, mixing heights, meteorological parameters. Air pollution control

mechanism. Equipment for particulate contaminants. Principle and working of settling chamber, cyclone, fabric filter, esp. Gaseous contaminants control by adsorption and absorption technique.

Municipal solid waste: concept of municipal solid waste management, sources, classifications, treatment (composting &anaerobic digestion) disposal (sanitary land fill).

Unit-II: Basics of Water Supply Engineering **06 Hours**

Introduction to water supply scheme: Importance of water infrastructure in India, data collection required for implementing water supply schemes, components and layouts. Design periods, factors affecting design periods. Quantity: rate of water consumption for various purposes, fire demand, factors affecting the rate of demand, population forecasting.

Quality: Physical, chemical, radioactivity and bacteriological characteristics, heavy metals. Standards as per IS 10500-2012. Government of India initiatives - Smart City, Amrut, Jal Jeevan Mission, and its implications in rural India.

Unit-III: Principles of Water Treatment **06 Hours**

Principles of water treatment operations and processes, water treatment flow sheets with respect to various sources, and criteria for site selection for WTP. Aeration: principle and concept, necessity, methods, removal of taste and odor, design of aeration fountain. Sedimentation: plain and chemical assisted, principle, efficiency of an ideal settling basin, types of sedimentation, settling velocity, types of sedimentation tanks, design of plain sedimentation tank, introduction and design of tube settlers.

Unit-IV: Design of Water Treatment Plant **06 Hours**

Coagulation and flocculation: necessity of coagulation, principle of coagulation, common coagulants, alum and ferric salts, introduction to other coagulant aids like bentonite clay, limestone, silicates, and polyelectrolytes, etc., Introduction to natural coagulants, concept of mean velocity gradient and power consumption, design of flocculation chamber, design of clarifier flocculator.

Filtration: theory of filtration, mechanism of filtration, filter materials, types: rapid, gravity, pressure filter, multimedia and dual media filters, components, under-drainage system, working and cleaning of filters, operational troubles, design of rapid sand gravity filters.

Unit-V: Advanced Water Treatment Methods and Water Distribution **06 Hours**

Disinfection: Mechanism, factors affecting disinfection, types of disinfectants, types and methods of chlorination, breakpoint chlorination, bleaching powder estimation. Water softening methods and demineralization: lime-soda, ion exchange, RO, and electrodialysis; fluoridation and defluoridation; Introduction to advanced water treatment systems (nanotechnology); introduction to desalination and various desalination methods.

Water distribution system: System of water supply: continuous and intermittent system, different distribution systems and their components.

Elevated Service Reservoir (ESR): Design of ESR capacity, wastage and leakage of water: detection and prevention.

Learning Resources:

Text Books:

1. Water Supply Engineering, S. K. Garg, Khanna Publishers, New Delhi, 35th Edition (2015).
2. Water Supply and Sanitary Engineering, G. S. Birdie and J. S. Birdie, Dhanpat Rai Publishing Company, New Delhi, 9th Edition, (2010).
3. Environmental Engineering-1: Water Supply Engineering, B. C. Punmia, Ashok Jain and Arun Jain. Laxmi Publications (P) Ltd, 2nd Edition, Reprint (2016).
4. Air Pollution: H. V. N. Rao and M. N. Rao, TMH Publications.
5. 5. Solid Waste Management, Sasikumar K and Sanoop Gopi Krishna, PHI (2013).
6. 6. Solid waste management, A.D. Bhide, B.B. Sundaresan, New Delhi: Indian National Scientific Documentation Centre, (1983)

Reference Books:

1. Environmental Engineering, Peavy and Rowe, McGraw-Hill Publications, (2017).
2. Optimal Design of Water Distribution Networks, P. R. Bhave, Narosa Publishing House.
3. Integrated Solid Waste Management: Engineering Principles and Management Issues, George Tchobanoglous, Hilary Theisen, and Samuel A. Vigil, McGraw-Hill publications.
4. Standard Methods for examination of water and wastewater, Mary Franson, American Public Health Association IS Codes 01.
5. IS 3025: 2013, Methods of Sampling and Test (Physical, Chemical and Biological) for Water and Waste Water, Bureau of Indian Standards, New Delhi.
6. CPHEEO, Manual on Municipal Solid Waste Management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi (2000).

Web link for MOOC / NPTEL Links:

1. http://nptel.ac.in/courses/111105038/
2. http://cpheeo.gov.in/cms/manual-on-water-supply-and-treatment.php

List of Practicals:

Term work consists of a journal containing the following experiments, assignments, and site visit report. The practical examination will be based on the term work.

1. Determination of pH of various samples, such as drinking water, prepared acidic and alkaline samples, and other samples, such as soft drinks/tea, etc.
2. Determination of Alkalinity of raw water and other samples, such as prepared samples, soft drinks, and tea, etc.
3. Total hardness and its components in raw water.
4. Determination of chlorides in water.
5. Determination of chlorine demand and residual chlorine.
6. Determination of turbidity and optimum dose of alum.
7. Determination of sodium, potassium, or calcium using a flame photometer.
8. Determination of fluorides or iron contents in water.
9. Determination of Most Probable Number (MPN).
10. Site visit to a water treatment plant.

Assignments:

1. Study of water intake structures.
2. Complete design of WTP using appropriate software/Program/excel spread sheet etc.

Course Code: 105504A	Course Name: Earthquake Engineering	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Prerequisite Courses:

- Engineering Mechanics, Structural Analysis, Advanced Mathematics.

Course Objectives:

- To understand dynamic behavior of structures subjected to various dynamic loads including earthquakes.
- To analyze single and multi-degree of freedom systems under dynamic excitation.
- To apply seismic design codes and ductile detailing for earthquake-resistant structures.
- To use software tools for modeling, analysis, and design of structures under seismic loads.
- To integrate sustainability, resilience, and lifecycle concepts in earthquake engineering.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand principles of structural dynamics and develop equations of motion.

CO2: Analyze SDOF and MDOF systems subjected to dynamic loading.

CO3: Evaluate structural responses under earthquake ground motions using response spectra.

CO4: Design earthquake-resistant buildings using IS 1893 and IS 13920.

CO5: Use software for dynamic analysis and develop sustainable earthquake-resistant designs. Integrate seismic resilience and SDGs in disaster risk reduction and structural planning.

Course Contents:

Unit-I: Introduction to Structural Dynamics 08 Hours

Dynamic loads: wind, blast, earthquake, D'Alembert's principle, types of damping, SDOF systems: free and forced vibration, resonance, Energy methods and damping characteristics.

Unit-II: Multi-Degree of Freedom (MDOF) Systems 08 Hours

Matrix formulation of MDOF systems, Mode shapes and natural frequencies, Modal superposition technique, Numerical methods for solving equations of motion.

Unit-III: Earthquake Ground Motion and Seismic Response 08 Hours

Seismic sources, faults, and wave propagation, Site response and soil-structure interaction, Response spectra and design spectrum, Time-history, and frequency domain analysis.

Unit-IV: Codal Provisions and Earthquake-Resistant Design 08 Hours

IS 1893:2016 seismic analysis procedures, IS 13920:2016 ductile detailing of RC structures. Base shear calculation, lateral load distribution. Design of shear walls, torsional irregularities, soft storey.

Unit-V: Software Applications and Sustainability Integration 08 Hours

Modeling and analysis using advanced software: Introduction to Open Sees for nonlinear dynamic analysis, Seismic vulnerability assessment and retrofitting, Resilient cities, lifecycle design and disaster mitigation.

Learning Resources:

Text Books:

1. Chopra, A.K., Dynamics of Structures, Pearson Education.
2. Clough & Penzien, Dynamics of Structures, McGraw-Hill.
3. S.K. Duggal, Earthquake Resistant Design of Structures, Oxford University Press.

Reference Books:

1. IS 1893 (Part 1): 2016 – Criteria for Earthquake-Resistant Design of Structures
2. IS 13920: 2016 – Ductile Detailing of RC Structures
3. Eurocode 8 – Design of Structures for Earthquake Resistance
4. Paulay & Priestley – Seismic Design of Reinforced Concrete and Masonry Buildings.

Web link for MOOC / NPTEL Links:

1. NPTEL Course: https://nptel.ac.in/courses/105101004
2. NPTEL Course: https://nptel.ac.in/courses/105108069
3. MOOC (edX): Earthquake Engineering for Developing Countries. https://www.edx.org
4. Coursera: Seismic Design and Risk Assessment. https://www.coursera.org
5. NICEE (IIT Kanpur): https://www.nicee.org
6. Earthquake Engineering Research Institute (EERI): https://www.eeri.org
7. IAEE: International Association for Earthquake Engineering: https://www.iaee.or.jp

Software Tools:

1. ETABS (open source) – Earthquake load simulation and design
2. STAAD.Pro – Modal and dynamic load analysis
3. OpenSees – Advanced dynamic simulation
4. QGIS – Seismic risk mapping and resilience planning.

List of Practicals:

1. Model and analyze an SDOF system subjected to harmonic loading. Study damping effects and resonance.
2. Perform modal analysis of a 3-storey building frame using hand calculations and verify with software
3. Use IS 1893 (Part 1): 2016 to generate design response spectra and apply it to a real building.
4. Assess an existing building's seismic vulnerability and propose sustainable retrofitting techniques
5. Simulate earthquake loading on a building using OpenSees or ETABS and analyze lifecycle performance.

Course Code: 105504B	Course Name: Hydrology and Irrigation Engineering	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks

Prerequisite Courses:

- Engineering Geology, Fluid Mechanics.

Course Objectives:

- To apply knowledge of government organizations in the water-resource sector, precipitation, runoff, and the application of QGIS in hydrology.
- To apply concepts of reservoir planning, capacity assessment, and irrigation practices in water resources management
- To analyze groundwater hydrology, including the occurrence, movement, and characteristics of aquifers.
- To evaluate various hydraulic structures based on their functions and performance in water resources systems.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Analyze precipitation and runoff, apply QGIS in hydrology and explain government roles in water resources.

CO2: Apply mass flow curve concepts to determine reservoir storage requirements and effect of sedimentation on reservoir capacity.

CO3: Analyze irrigation practices and crop water demand for efficient irrigation management.

CO4: Analyze the occurrence and movement of groundwater, aquifer characteristics, and groundwater recharge methods.

CO5: Evaluate dam types and the functions of spillways, energy dissipaters, and weirs in water management.

Course Contents:

Unit-I: Introduction to Hydrology and Runoff **08 Hours**

Introduction, hydrological cycle, brief introduction of government organizations, precipitation: types of precipitation, measurement, analysis of precipitation data, evaporation, transpiration, evapotranspiration, infiltration.

Introduction to runoff, factors affecting runoff, empirical techniques to determine runoff,

runoff hydrograph: Introduction, factors affecting flood hydrograph, components of hydrograph, base flow separation, unit hydrograph theory, S-curve hydrograph, uses and limitations of unit hydrograph.

Unit-II: Reservoir Planning **08 Hours**

Introduction, investigation for reservoir planning, applications of mass curve and demand curves, fixation of reservoir capacity from annual inflow and outflow, reservoir sedimentation phenomenon, measures to control reservoir sedimentation, significance of trap efficiency, useful life of reservoir.

Unit-III: Irrigation **08 Hours**

Definitions, advantages and necessity, methods of irrigation, water requirements of crops, principal Indian crops, crop water requirement: crop planning, agricultural practices, calculations of canal and reservoir capacities- duty, delta, irrigation efficiency, Piped distribution network for irrigation (PDN): Introduction, advantages and disadvantages of PDN over conventional canal distribution network and its applications.

Unit-IV: Ground Water Hydrology **08 Hours**

Occurrence and distribution of ground water, specific yield of aquifers, Darcy‘s law, permeability, safe yield of basin, hydraulics of wells under steady flow condition in confined and unconfined aquifers, specific capacity of well, tube wells, open wells and their construction, groundwater recharge methods, water logging and drainage: causes, effects, preventive and curative measures of water logging, land drainage, reclamation of water logged areas, alkaline and saline lands.

Unit-V: Hydraulic Structures **08 Hours**

Gravity dam, various components of dam, forces acting on gravity dam, low and high gravity dam. Earth dam: Introduction, causes of failure of earthen dam. Spillways and energy dissipaters (Introduction), Diversion head works – Weir and barrages, canal and canal structures.

Learning Resources:

Text Books:

1. Hydrology and Water Resources Engineering, Vol-1, S. K. Garg, 21st Edition, Khanna Publishers, New Delhi, 2016.
2. Engineering Hydrology by K. Subramanyam, 3rd Edition, Tata McGraw-Hill, 2017
3. Irrigation Engineering and Hydraulic Structures, Vol.II, S.K.Garg, 32nd Edition, Khanna Publishers, New Delhi, 2016.

Reference Books:

1. Irrigation and Water Power Engineering, Dr. Punmia and Dr. Pande, 16th Edition, Standard Publisher, 2016.
2. Irrigation Engineering, H.M. Raghunath,1st Edition, Wiley India Pvt. Ltd.,2016.
3. Irrigation, Water Resources and Water Power Engineering, P. N. Modi, 8th Edition, Standard Book House, 2012.
4. Q-GIS for Hydrological Applications: Recipes for Catchment Hydrology and Water Management, Hans Van Der Kwast, Kurt Menke, Locate Press.

Web link for MOOC / NPTEL Links:

1. https://pubs.usgs.gov/wsp/2220/report.pdf
2. http://www.cwc.gov.in/water-resources-information-system-wris
3. https://old.amu.ac.in/emp/studym/99994128.pdf
4. http://cgwb.gov.in

List of Practicals:

Term work consists of a journal containing details of assignments and visit report (Any 7, site visit report. Assignment 3 and 8 are compulsory).

1. Analysis of rainfall data (missing rainfall data).
2. Measurement of / video demonstration of evaporation by pan evaporimeter.
3. Marking catchment area on a topo-sheet and working out average annual precipitation and determining yield by various methods.
4. Application of Q-GIS software in groundwater assessment.
5. Determination of peak flood discharge in a basin using unit hydrograph technique.
6. Determination of storage capacity of a reservoir using mass curve of inflow and outflow.
7. Experiment on determination of groundwater flow.
8. Literature collection of types of dams (minimum 5 dams) or case study of failure of any hydraulic structure.
9. Site visit to meteorological station.

Course Code: 105504C	Course Name: Project Management	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks

Prerequisite Courses:

- Basics of Management.

Course Objectives:

- To explain networking methods and their applications in planning and management.
- To categorize the materials as per their annual usage.
- To demonstrates resource allocation techniques and apply it for manpower planning.
- To understand economical terms and different laws associated with project management.
- To apply the methods of project selection and recommend the best economical project.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Apply project planning and scheduling techniques in construction.

CO2: Determine the materials as per their usage and production rate of construction equipment with safety measures.

CO3: Demonstrates resource allocation techniques for planning.

CO4: Explain economical terms and laws associated with project management.

CO5: Apply the methods of project selection for the best economical project.

Course Contents:

Unit-I: Project Planning and Scheduling **08 Hours**

WBS – Work Breakdown Structure, Gantt / Bar chart & its Limitations, Network Planning, Network analysis, C. P. M.- . Activity on Arrow (A.O.A.), Critical Path and Type of Floats, Precedence Network Analysis (A.O.N.), P. E. R.T. Analysis.

Unit-II: Project Monitoring and Control **08 Hours**

Resource Allocation – Resource Smoothening and Leveling, Network Crashing – Time- Cost – Resource Optimization, Project Monitoring.

Unit-III: Project Resources and Site Planning 08 Hours

Objectives of Materials Management: Primary and secondary material procurement procedures. **Material Requirement:** Raising of indents, receipts, inspection, storage, delivery, record and ABC analysis.

Unit-IV: Project Economics 08 Hours

Introduction to project economics - definition, principles, importance in construction industry, Difference between cost, value, price. Cash flow diagram. Demand, demand schedule, law of demand, demand curve, elasticity of demand and supply, supply schedule, supply curve.

Unit-V: Project Appraisal 08 Hours

Types of appraisals: political, social, environmental, techno-legal, financial, and economic; criteria for project selection: benefit-cost analysis, NPV, IRR, payback period, break-even analysis.

Learning Resources:

Text Books:

1. Project planning and Control with PERT and CPM by DR. B.C. Punmia and K. K. Khadelwal Publisher: Firewall Media, Laxmi Publication, New Delhi.
2. Project Management Principles and Techniques by B.B. Goel, Publisher: Deep and Deep Publishers.

Reference Books:

1. Project Management, Khatua, Oxford University.
2. Construction Project Management-Planning, Scheduling and Controlling by K. K. Chitkara, Tata McGraw-Hill Publishing Company, New Delhi.
3. Construction Management and Planning by B. Sengupta and H. Guha, Tata McGraw-Hill Publishing Company, New Delhi.
4. Engineering Economics by R. Panneerselvam, Publisher-PHI Learning; 2nd edition (2014).
5. The Essentials of Project Management by Dennis Lock, Gower Publishing Ltd. UK.
6. Engineering Economics, James Riggs, David Bedworth, Sabah Randhawa, McGraw-Hill.

Web link for MOOC / NPTEL Links:

1. https://kcl.digimat.in/nptel/courses/video/105104348/L26.html
2. https://archive.nptel.ac.in/courses/105/103/105103093/

List of Practicals:

1. Draw a Work Breakdown Structure (WBS) of a small residential building.

2. Draw a Gantt chart using MS Excel.
3. Draw a network diagram for a small Civil engineering Project having about 25 activities.
4. Assignment based on the Crashing of the network.
5. Assignment based on ABC analysis.
6. Prepare cash flow diagram.
7. Draw the supply and demand curve for the given data
8. Assignment based on Project selection criteria. (Benefit Cost Analysis)
9. Visit a construction site and prepare the site layout plan and safety plan for the construction site visited.

Course Code: 105504D	Course Name: Remote Sensing and GIS	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks

Prerequisite Courses:

- Engineering Mathematics, Physics, Surveying, Engineering Geology.

Course Objectives:

- To comprehend the fundamentals and applications of remote sensing (RS) and geographic information systems (GIS) in civil engineering.
- To develop skills in interpreting satellite images and generating thematic maps for engineering purposes.
- To utilize RS and GIS techniques for Civil engineering applications.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the fundamentals and principles of remote sensing.

CO2: Interpret and analyze satellite images for engineering applications.

CO3: Describe the working and applications of GNSS in civil engineering.

CO4: Develop thematic maps and models using GIS data.

CO5: Apply RS and GIS techniques in solving civil engineering problems.

Course Contents:

Unit-I: Fundamentals of Remote Sensing **08 Hours**

Basic concepts, principles, scope, and evolution of remote sensing; electromagnetic radiation and electromagnetic spectrum; interaction of EMR with the atmosphere and Earth's surface, including atmospheric windows; remote sensing platforms and sensors; visual image interpretation using tone, colour, texture, shape, size, pattern, shadow, site, and association; applications of remote sensing in civil engineering, urban planning, transportation, water.

Unit-II: Remote Sensing Satellites and Sensors **08 Hours**

Types and their characteristics, types of sensors, orbital and sensor characteristics of major earth resource satellites, Indian remote sensing satellite programs, introduction to various open-source satellite data portals, global satellite programs, sensor classification, applications of sensor, concept of Swath & Nadir, resolutions, digital image. Introduction to spatial resolution,

spectral resolution, radiometric resolution and temporal resolution, visual image, interpretation, image interpretation.

Unit-III: GPS and GNSS Applications 08 Hours

Introduction to GNSS and GPS: Global Navigation Satellite System (GNSS), Indian Regional Navigation Satellite System (IRNSS), and Global Positioning System (GPS). Components of GPS: Satellite segment, control segment, and user segment. GPS Tracking and Techniques: Types of tracking systems (differential GPS and standalone GPS). Applications in surveying, mapping, and navigation. Applications in Civil Engineering: Road alignment, construction monitoring, and land mapping.

Unit-IV: GIS Fundamentals and Image Processing 08 Hours

Introduction to GIS: Geographic Information System (GIS): Definition, components, and applications. Spatial and non-spatial data types. Data input, storage, retrieval, and transformation processes. Digital Image Processing: Visual image interpretation. Image enhancement, transformation, and classification (supervised and unsupervised). Preprocessing and postprocessing of satellite images. Models and Maps: Digital Elevation Model (DEM), Triangular Irregular Network (TIN), and their applications. Fundamentals of cartography and map design. Applications: GIS applications in hydrogeology, engineering geology, and surveying.

Unit-V: Applications of RS and GIS in Civil Engineering 08 Hours

GIS database creation: GIS data types: raster and vector. Raster to vector conversion, georeferencing, and projection systems. Case studies: demarcation of dam catchment and command areas; application of GIS in reservoir sediment analysis; land use and land cover mapping; urban planning and smart cities development; and irrigation planning and scheduling. Integration of RS and GIS: Remote sensing data integration for thematic mapping, Database management systems for civil engineering projects.

Learning Resources:

Text Books:

1. Principles of Remote Sensing - B.C. Panda, Viva Books Private Limited
2. Remote Sensing & Geographical Information System - M. Anji Reddy, BS Publications.

Reference Books:

1. Remote Sensing and Image Interpretation - Thomas M. Lillesand, Ralph Kiefer
2. Textbook on Remote Sensing - C.S. Agarwal and P.K. Garg, Wheeler Publishing
3. Remote Sensing & Digital Image Processing - John R. Jensen.

Web link for MOOC / NPTEL Links:

1. Remote Sensing Essentials
2. Course Introduction - Remote Sensing: Principles and Applications
3. Remote Sensing and GIS [Intro Video]
4. https://www.youtube.com/watch?v=z7rqVo0GENk&list=PLB-r1KKUsaCo2NXNMTy5h9cYg-u_SaJj8

List of Practicals: (Any 10)

1. Visual interpretation of satellite images: interpret satellite imagery using tone, texture, shadow, and other elements to identify land features.
2. Study of satellite sensors and platforms: analyze specifications of various remote sensing platforms and sensors, including spatial, spectral, and temporal resolutions.
3. Acquisition and geo-referencing of satellite data: download satellite data from open-source platforms, perform geo-referencing, and apply suitable projections.
4. GPS and GNSS survey: Conduct a GPS/GNSS survey to map selected ground features and analyze spatial accuracy.
5. Supervised and unsupervised image classification: perform digital classification of satellite images to generate land use/land cover maps.
6. Generation of digital elevation model (DEM): Create a DEM and derive slope, aspect, and other terrain parameters for a specific area.
7. Raster and vector data analysis: convert raster data to vector format and create thematic layers for spatial analysis.
8. Buffer analysis and overlay operations: perform buffering and overlay analysis to solve real-world civil engineering problems.
9. Creation of thematic maps: develop thematic maps such as vegetation index, land use, and hydrological zones using GIS tools.
10. Integration of remote sensing and GIS data: integrate satellite imagery with GIS layers to create composite maps for decision-making.
11. Applications of RS and GIS in urban planning: Analyze urban land use patterns and propose planning solutions using RS and GIS techniques.
12. Case study on civil engineering applications: conduct a case study involving RS and GIS in applications like dam catchment analysis, urban planning, or irrigation management.

Course Code: 170505A	Course Name: Systems in Mechanical Engineering	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Expected Prerequisite Courses:

- Engineering Physics, Engineering Chemistry.

Course Objectives:

- To identify the sources of energy and their conversions.
- To explain the basic concept of engineering thermodynamics and its application.
- To introduce proper manufacturing process applicable to produce components.
- To understand the basic concepts of mechanical engineering.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Apply knowledge of thermodynamics concepts.

CO2: Explain basic laws of thermodynamics, heat transfer and their applications.

CO3: Select different materials for different applications.

CO4: Explain the basics of engineering components.

CO5: Describe and get exposure to the latest trends in manufacturing processes.

Course Contents:

Unit-I: Thermodynamic Concepts **08 Hours**

Introduction to thermodynamics, introduction to various thermodynamic properties, heat and work, thermodynamic laws. Power plant engineering and sources of energy : conventional thermal, nuclear, hydraulic power plant. Nonconventional- wind, solar, tidal, geothermal.

Unit-II: Heat Transfer **08 Hours**

Modes of heat transfer: conduction, convection and radiation. Fourier's law, Newton's law of cooling and Stefan-Boltzmann's law. Domestic appliances, viz., refrigerator, air-conditioner.

Unit-III: Material Science **08 Hours**

Classification of materials, their properties and applications, phase change material (PCM), composite material.

Unit-IV: Introduction to Transmission Devices 08 Hours

Study of shafts, belt drive, chain drive, gear and gear trains and clutches.

Unit-V: Manufacturing Processes 08 Hours

Metal casting, forging, sheet metal working, machining and machine tools, and metal joining processes.

Learning Resources:

Text Books:

1. Nag, P. K., “Engineering Thermodynamics" Tata McGraw-Hill Publisher Co. Ltd.
2. Chaudhari and Hajra, “Elements of Workshop Technology”, Volume I and II, Media Promoters and Publishers, Mumbai.
3. Rajput, R.K., “Basic Mechanical Engineering”, Laxmi Publications Pvt. Ltd.
4. Raghavan V.,“Materials Science And Engineering: A First Course”,Hall of India.

Reference Books:

1. Khan, B. H., “Non-Conventional Energy Sources, Tata McGraw-Hill Publisher Co Ltd.
2. Khurmi, R.S, and Gupta, J. K., “A Textbook of Thermal Engineering”, S. Chand & Sons.
3. Incropera, F. P.and Dewitt, D.P., “Fundamentals of Heat and Mass Transfer, John Wileyand Sons, USA.
4. Juvinal, R. C., Fundamentals of Machine Component Design, John Wiley & Sons, USA.
5. Kripal Sing, “Automobile Engineering”, Vol.1 and Vol.2.

Web link for MOOC / NPTEL Links:

1. Energy resources. https://www.youtube.com/watch?v=Zgp86PVXXuQ
2. Thermodynamic Concepts. https://nptel.ac.in/courses/112103275
3. https://www.youtube.com/playlist?list=PLbRMhDVUMngeVrxtbBzn8HvP8KAWBpI5

List of Practicals: (Any 5)

1. Study of non-conventional or renewable sources of energy.
2. Study of laws of thermodynamics.
3. Study of laws of heat transfer.
4. Study of domestic appliances like the refrigerator and the air conditioner.
5. Study of materials used for different applications.
6. Study of power transmission devices.
7. Study of manufacturing processes.

Course Code: 170505B	Course Name: Data Structures and Algorithms	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks

Expected Prerequisite Courses:

- Fundamentals of Programming, Programming and Problem Solving.

Course Objectives:

- To learn the fundamentals of data structures.
- To understand how data can be logically organized using data structures.
- To illustrate the types of data structures and their use in engineering.
- To choose suitable data structures for real engineering problems.
- To learn system efficiency, such as time and memory usage, without mathematics or programming.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand basic concepts of data structures.

CO2: Apply the concepts of stacks and queues.

CO3: Implement appropriate non-linear data structures.

CO4: Demonstrate searching and sorting techniques in engineering data handling.

CO5: Illustrate real-world engineering case studies using data structures.

Course Contents:

Unit-I: Introduction to Data Structures **08 Hours**

Need for data organization, Overview of Data structures: Types of data structures, **Abstract Data Types (ADT):** Concept and significance, **Arrays:** Characteristics and representation, types of arrays: 1D and 2D, Use in storing engineering measurements and parameters.

Case Study: Engineering Data Management in a Weather Monitoring System.

Unit-II: Linear Data Structures **08 Hours**

Introduction to linear data structures, **Stack**: Concept, operations, and behavior (LIFO), Applications: undo operations and automation systems. **Queue**: Concept, operations, and behavior (FIFO), Applications: scheduling, buffering, and resource management, Conceptual comparison between stack and queue, **Linked Lists:** Introduction, need, types and applications.

Case Study: Smart Office Management System.

Unit-III: Non-Linear Data Structures **08 Hours**

Need for non-linear data representation, Trees: Terminology: root, node, parent, child, and level, Types of trees: Binary tree, Binary search tree, Tree traversal, Applications of Non-linear Data Structures, Graphs: Basic concepts, Concept of directed and undirected graphs, graph representation. Case Study: College Campus Management System.

Unit-IV: Searching and Sorting **08 Hours**

Importance of searching and sorting, **Searching techniques:** Concept of linear and binary search, Use cases in engineering, **Sorting techniques:** Concept of ordering and prioritization, Examples such as sorting by size, cost and priority using bubble sort, selection sort, merge sort, Time and Space Complexity Concepts. **Case Study:** Engineering Inventory and Component Management System.

Unit-V: Engineering Case Studies **08 Hours**

Data structures used in real time applications, Identification of case studies from Mechanical / Civil / Electrical systems etc., Selection of appropriate data structures for given engineering problems, and discussion on the benefits of proper data structuring.

Learning Resources:

Text Books:

1. Y. Kanetkar and A. Kanetkar, Let Us C++, New Delhi, India: BPB Publications.
2. E. Horowitz and S. Sahni, Fundamentals of Data Structures in C++, New York, NY, USA: W. H. Freeman, ISBN: 978-0716782926.

Reference Books:

1. M. A. Weiss, Data Structures and Algorithm Analysis in C++, 2nd ed., New Delhi, India: Pearson Education, ISBN: 81-7808-670-0.

Web link for MOOC / NPTEL Links:

1. Data Structures And Algorithms By Prof. Naveen Garg, IIT Delhi. https://nptel.ac.in/courses/106102064

List of Practicals:

1. The course instructor should design assignments by considering the required background knowledge, relevant technologies, practical applications, and current trends related to the subject.
2. Preferably, there should be multiple sets of assignments and distributed among batches of students.
3. Giving assignments based on real-life problems can help the students with future projects.
4. Students should be encouraged to use free and open-source software.
5. Instructors can also include an additional assignment or mini-project that goes beyond the syllabus but aligns with the course.

List of Suggested Assignments:

1. Implementation of an array.
2. Implementation of stack.
3. Implementation of queue.
4. Implementation of trees.
5. Implementation of graphs.
6. Implementation of searching techniques.
7. Implementation of sorting techniques.
8. Mini project.

List of Suggested Activity-based Learning:

1. Flipped Classroom.
2. Gamification.
3. Online Interactive Tool.
4. Collaborative and Individual Problem-based learning.
5. Quizzes/Assignments.
6. VLab.

Course Code: 170505C	Course Name: Engineering Measurements	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Expected Prerequisite Courses:

- Engineering Physics, Engineering Chemistry, Basic Electronics and Electrical Engineering.

Course Objectives:

- To explain the static/dynamic characteristics of measurement systems and the working principles of displacement, speed, vibration, and force/torque transducers.
- To impart knowledge on industrial pressure and vacuum measurement techniques along with standard calibration methods.
- To explain the construction, signal compensation, and operational characteristics of contact and non-contact temperature sensors.
- To introduce the mechanics, and selection criteria of various fluid level and flow monitoring instruments.
- To familiarize students with the principles of viscosity, density, humidity, and chemical sensors, alongside an introduction to intelligent SMART sensing systems.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Evaluate the performance of transducers used for mechanical parameters like displacement, speed, vibration, force, and torque.

CO2: Calibrate pressure and vacuum measuring devices using standard dead-weight or vacuum testing rigs.

CO3: Select appropriate temperature sensors for precise thermal monitoring.

CO4: Evaluate the operational dynamics of industrial fluid flow and level sensors based on principles.

CO5: Demonstrate miscellaneous sensors according to their working principles.

Course Contents:

Unit-I: Fundamentals of Engineering Measurements 08 Hours

Measurement system elements, static and dynamic characteristics.

Need for sensors and transducers, definition and classification of transducers.

Displacement Measurement: Resistive-potentiometers, inductive-LVDT, capacitive, piezoelectric, ultrasonic, and proximity sensors.

Speed measurement, vibration measurement, force and torque measurement.

Unit-II: Pressure Measurement 08 Hours

Units and their relations, manometers, elastic sensors, piezoelectric secondary transducers, differential pressure sensors, capacitive (delta cell), vacuum gauges, dead weight tester.

Unit-III: Temperature Measurement 08 Hours

Temperature scales, units and their relations, classification of temperature sensors, bimetallic thermometer, Resistance temperature detectors (RTD), types of RTD, lead wire compensation, thermistors, Thermocouples, thermopiles, thermos-well, cold junction compensation techniques, pyrometers, temperature IC sensor LM35.

Unit-IV: Flow Measurement 08 Hours

Bernoulli's equation for incompressible flow, head type flow meters (orifice, venture meter and pitot tube), variable area type (Rotameter), turbine, electromagnetic, ultrasonic, mass flow meter: Coriolis flow meter.

Unit-V: Level and Miscellaneous Measurement 08 Hours

Level Measurement: Float, DP cell, ultrasonic, capacitive.

Viscosity: Saybolt, Searle's rotating cylinder, rotameter. Density: Hydrometers. Humidity: Resistive and capacitive type sensors. PH sensors, conductivity sensors.

Learning Resources:

Text Books:

1. Instrumentation Measurement and Analysis – B.C. Nakra, K.K. Chaudhry, 4th Edition, McGraw Hill, 2010, ISBN: 978-0070709868
2. Principles of Industrial Instrumentation" — D. Patranabis, ISBN (latest editions): 978 0070605502 (approximate for recent editions)
3. Transducers and Instrumentation – D.V.S. Murty, 3rd Edition, PHI Learning, 2011, ISBN: 978-8120346876.

Reference Books:

1. Industrial Instrumentation – A.K. Sawhney, 4th Edition, Dhanpat Rai & Co., 2010, ISBN: 978-8177000311
2. Measurement Systems: Application and Design – Ernst O. Doebelin, 5th Edition, McGraw Hill, 2003, ISBN: 978-0071223122.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ee105
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_ee32

List of Practicals (Any 8):

1. Measure linear displacement using a Linear Variable Differential Transformer (LVDT).
2. Determine the characteristics of different proximity sensors.
3. Calibrate a load cell and determine its sensitivity for weight measurement.
4. Measure angular displacement using a shaft angle encoder.
5. Calibrate a Bourdon tube pressure gauge using a dead-weight tester.
6. Calibrate a vacuum gauge using a vacuum gauge tester.
7. Calibrate a Resistance Temperature Detector (RTD) and determine the temperature of an unknown liquid.
8. Determine temperature using LM35.
9. Flow measurement using DP transmitter.
10. Measure pH sensor output and calibrate it using standard buffer solutions.
11. Flow measurement using Orifice / Venturi flowmeter.

Course Code: 170505D	Course Name: Sensors and Actuators	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Expected Prerequisite Courses:

- Fundamentals of Electronic Engineering, Programming Language C.

Course Objectives:

- To enable students to apply IoT concepts, architectures (3-layer and 5-layer), and system components (sensors, actuators, devices) in designing basic IoT-based solutions for real-world applications.
- To analyse different types of sensors (such as temperature, pressure, proximity, and optical sensors) and their applications in real-world systems.
- To study various actuators (electrical, mechanical, hydraulic, and pneumatic) and understand their role in control systems.
- To develop the ability to interface sensors and actuators with microcontrollers and embedded systems for data acquisition and control.
- To apply knowledge of sensors and actuators in designing and implementing practical systems used in automation, robotics, and industrial applications.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Apply knowledge of IoT building blocks, architectures, and components to develop and implement simple IoT applications for real-world applications.

CO2: Analyze sensor/transducer performance, signal conditioning, and data acquisition to assess measurement accuracy and errors.

CO3: Apply principles of temperature, pressure, force, flow, and level sensors to select and use appropriate sensors for measurement applications.

CO4: Examine the operating principles and performance characteristics of position, proximity, and motion sensors to compare and select appropriate sensors for specific measurement and control applications.

CO5: Evaluate performance, working principles and control mechanisms of electrical, fluid power, and specialized actuators for various automation and control system applications.

Course Contents:

Unit-I: Introduction to IoT and Architecture 08 Hours

Definition, Need & Scope of IoT, Evolution of IoT, Industry 4.0, Basic Components of IoT: Sensors, Actuators, Devices, IoT System Building Blocks, IoT Architecture: 3-Layer, 5-Layer models (simple explanation), IoT Applications across various sectors, (healthcare, manufacturing, smart homes, agriculture, transport).

Unit-II: Introduction to Signal Conditioning 08 Hours

Concepts: Sensors vs. Transducers, Sensor Classification (Active/Passive, Digital/Analog), Performance Characteristics (Static and Dynamic: Sensitivity, Linearity, Hysteresis, Response Time). **Signal Conditioning:** Bridge circuits, Amplifiers (Op-Amp), Filtering (Low-pass, High-pass), Data Acquisition (ADC/DAC). **Error Analysis:** Calibration, Sensitivity Analysis, and Uncertainty.

Unit-III: Thermal and Mechanical Sensors 08 Hours

Temperature Sensors: Thermocouples (Seebeck effect), Resistance Temperature Detectors (RTDs), Thermistors (NTC/PTC), Bimetallic strips, Pyrometers.

Pressure Sensors: Manometer, Bourdon Tube, Diaphragm, Bellows, Piezoelectric and Strain Gauge.

Force & Weight Sensors: Strain Gauges (Bridge circuits, gauge factor), Load Cells.

Flow & Level Sensors: Ultrasonic, Capacitive, Float Sensors, Turbine Flowmeters, Venturi Tubes.

Unit-IV: Position, Proximity and Motion Sensors 08 Hours

Position and Displacement Sensors: Potentiometers (Linear/Rotary), Linear Variable Differential Transformers (LVDT), Eddy current probes.

Proximity Sensors: Inductive (metallic), Capacitive (non-metallic), Optical/Photoelectric, Magnetic (Reed switches), Light Dependent Resistors (LDR), Fiber-optic sensors.

Motion & Acceleration Sensors: Accelerometers (1-3 axis), Gyroscopes, MEMS inertial sensors, Velocity sensors.

Unit-V: Actuation Systems 08 Hours

Electric Actuators: DC Motors, AC Motors, Stepper Motors, Servo Motors, Solenoids, Relays.

Fluid Power Actuators: Hydraulic and Pneumatic Cylinders, Valves, Pumps.

Specialized Actuators: Piezoelectric actuators, Shape Memory Alloys.

Control Methods: PWM (Pulse Width Modulation) speed control.

Learning Resources:

Text Books:

1. Milan Milenkovic, “Internet of Things: Concepts and System Design”, Springer, 2020.
2. D. V. S. Murthy, “Transducers and Instrumentation” Prentice Hall of India, 2nd Edition, 2012.
3. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley, 2014
4. Rolando Herrero, “Fundamentals of IoT Communication Technologies”, Springer, 2022.

Reference Books:

1. Ian Sinclair & John Dunton, “Sensors and Transducers”, Newnes (Elsevier) 3rd Edition, 2016.
2. Samayveer Singh, Manju, Aruna Malik, Pradeep Kumar Singh, “IoT-enabled Sensor Networks: Architecture, Methodologies, Security, and Futuristic Applications”, Bentham Science Publishers, 2024.
3. C.S. Rangarajan, “Instrumentation Devices and Systems”, Tata McGraw-Hill, 1st Edition, 2010.
4. Mohan Lal Kolhe, Kailash J. Karande, Sampat G. Deshmukh, “Artificial Intelligence, Internet of Things (IoT) and Smart Materials for Energy Applications”, CRC Press (Taylor & Francis), 2023.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/noc25_ee76/preview
2. https://onlinecourses.nptel.ac.in/noc25_ee82/preview
3. https://onlinecourses.nptel.ac.in/noc26_ee41/preview

List of Practicals: (Any 8)

1. Interfacing of an LED with Arduino board.
2. Display real-time temperature & humidity values on serial monitor using DHT11.
3. IoT-Based Motion Detection / Security System (Interface PIR Motion Sensor. Send alert notification (app pop-up, buzzer or LED indicator).
4. IoT-Based Gas/Smoke Detection System. (Interface MQ-2 Gas sensor (or simulator). Trigger buzzer/alert message when gas level exceeds a threshold. Send alert notification to mobile using cloud app (Blynk/MQTT).
5. IoT-Controlled Servo Motor / Door Lock System. (Interface a servo motor. Control angle/position remotely using a cloud dashboard or mobile app.)
6. Heartbeat / Pulse Monitoring System (IoT-Based). (Interface pulse sensor or simulated heartbeat data. Send health parameters to cloud for real-time monitoring.)

7. Water Level Monitoring & Alert System. (Use ultrasonic sensor to measure water tank level. Send water-level data to cloud and generate alerts when level is low or high.)
8. Fire Detection and Alert System. (Flame sensor or temperature sensor combination. Trigger instant alerts and send real-time fire detection signals to mobile/cloud.)
9. Voice-Controlled IoT Device (Google Assistant/Alexa Integration). Control LED/Fan simulation using voice commands through Google Assistant + IFTTT or Alexa IoT skills.
10. IoT-Based Smart Street Lighting System. Automatically control a street light (LED) using an LDR sensor and send status (ON/OFF) to an IoT dashboard.
11. Smart Energy Monitoring System. Measuring and visualizing electrical parameters (current/voltage simulation allowed) and uploading data to cloud.
12. IoT-Based Weather Station (Multi-Sensor System). Interfacing two or more sensors (temperature, humidity, light, pressure) and publishing combined data to cloud.

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Course Code: 170505E	Course Name: Infrastructure and Planning	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Expected Prerequisite Courses:

- Fundamentals of Building Technology and Architectural Planning.

Course Objectives:

- To understand and analyze urban infrastructure systems, including their types, planning data, standards, and the roles of stakeholders in urban development.
- To apply concepts of water supply, sanitation, stormwater, solid waste, and transport planning to propose sustainable and efficient urban infrastructure solutions.
- To develop knowledge of rural planning principles and government schemes to improve village infrastructure, housing, livelihoods, and social services.
- To use modern planning tools and technologies (GIS, remote sensing, drones) for the implementation, monitoring, management of urban and rural infrastructure projects.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the role and types of urban infrastructure, key planning data and standards, and the planning process with stakeholder roles.

CO2: Apply concepts of water supply, sanitation, stormwater, and solid waste management to plan and propose basic urban infrastructure improvements.

CO3: Apply transport and land-use planning concepts to improve urban mobility, accessibility, and sustainability

CO4: Develop rural planning strategies using government schemes to improve village infrastructure, housing, and livelihoods.

CO5: Implement rural infrastructure and connectivity solutions using GIS and other planning tools.

Course Contents:

Unit-I: Introduction to Urban Planning and Infrastructure 08 Hours

Role of infrastructure in urban development, Types of infrastructure: physical (water, power, transport), social (education, health), utilities Planning data, resource analysis, norms and standards Infrastructure planning process and stakeholder roles layouts.

Unit-II: Water, Sanitation and Stormwater Systems 08 Hours

Water supply sources, treatment, storage, distribution, Water demand forecasting, leakage, reuse, rainwater harvesting, Sanitation systems: sewage generation, collection, treatment, greywater management, Stormwater drainage, natural drainage, stormwater harvesting Institutional and management issues, Municipal solid waste: generation, collection, treatment, recycling.

Unit-III: Transport and Mobility Planning 08 Hours

Importance of transport infrastructure in urban form transport modes (public, private, non-motorized), and mobility demand land use–transport integration, accessibility, TOD (Transit-Oriented Development) transport modeling basics, pricing, congestion and sustainable mobility.

Unit-IV: Principles and Strategies of Rural Planning 08 Hours

Introduction to rural planning: need, scope, and objectives, rural settlement patterns and typologies, planning strategies for rural development central and State government schemes: MGNREGA, PMAY-G, Swachh Bharat Mission, PMGSY, Jal Jeevan Mission, role of planning in livelihood, housing, and social infrastructure.

Unit-V: Rural Infrastructure Management 08 Hours

Physical infrastructure: water supply, sanitation, drainage, roads, energy, solid waste management, social infrastructure: schools, healthcare, community centers, Transport and connectivity: rural road hierarchy, public transport, traffic management, Tools and technology: GIS, remote sensing, drones for rural planning, Implementation, monitoring, and governance of rural projects.

Learning Resources:

Text Books:

1. Town Planning, G. K. Hiraskar, Dhanpat Rai Publications.
2. Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.
3. Rural Development: Planning Strategy & Policy Imperatives - Vivek Saurath & Manoj Agarwal).

Reference Books:

1. Urban Planning by Chris Couch.
2. Urban Infrastructure and Governance by G. Ramesh, Vishnu Prasad Nagadevara, Gopal Naik, Anil Suraj.
3. Urban and Regional Planning Education: Learning for India (edited by Ashok Kumar, Diwakar S. Meshram, Krishne Gowda.

4. MRTP Act 1966 : The director, government printing, stationary and publications, Maharashtra state, Mumbai.
5. URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, Government of India.
6. Role of Edge Analytics on Sustainable Smart City Development: Challenges and Solutions by G. R. Kanagachidambaresan.
7. Sustainable Smart Cities in India: Challenges and Future Perspectives (The Urban Book Series) by Poonam Sharma and Swati Rajput.
8. Rural Development: Principles, Policies and Development by Katar Singh and Anil Shishodia. Atlantic Publications.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.swayam2.ac.in/cec20_ar01/preview
2. https://www.edx.org/certificates/professional-certificate/delftx-inclusive-and-sustainable-cities?index=product&queryId=2d5f1360201b4959787e19d485c4178e&position=3
3. https://www.coursera.org/learn/smart-cities
4. https://onlinecourses.nptel.ac.in/noc25_ar27/preview
5. https://onlinecourses.nptel.ac.in/noc26_ar08/preview
6. https://onlinecourses.nptel.ac.in/noc25_ar25/preview
7. https://onlinecourses.nptel.ac.in/noc26_ce48/preview

List of Practicals:

1. Prepare a case study for any infrastructure project of India and give presentation. (Group Activity).
2. Design a practical rainwater harvesting solution for any building. (Individual work).
3. Prepare a land-use map for a neighborhood with classification (residential, commercial, industrial, etc.) by calculation. (Group Activity)
4. Identify the major causes of congestion on any busy road in the city and suggest practical improvements to reduce traffic delays. Present your findings with brief observations and supporting photos or sketches. (Group work)
5. Draw a simple O–D diagram of your route from home to college, marking key points like home, major junctions, bus stops, and the college gate. Include the approximate distance and travel time with neat sketch map with brief travel details. (Individual work)
6. Select one rural development scheme (MGNREGA, PMAY-G, SBM, PMGSY, or JJM) and prepare a brief report covering its objectives, beneficiaries, key components, impact on rural livelihood or infrastructure, and a simple implementation flowchart (Individual work)

7. Prepare a village infrastructure improvement proposal for a hypothetical village of 1,000–1,500 people, listing existing issues, suggesting improvements in water supply, sanitation, housing, livelihood, and roads, and identifying relevant government schemes for implementation. (Group work)
8. Site visit to any urban infrastructure or rural infrastructure management project.

Course Code: 170505F	Course Name: Web Development	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks

Expected Prerequisite Courses:

- Computer Networks.

Course Objectives:

- To familiarize students with Web Programming basic concepts.
- To learn and understand Web scripting languages.
- To introduce students to responsive web design frameworks and modern UI components.
- To provide knowledge of web page styling and layout design for effective user interfaces.
- To familiarize students with website development using no-code platforms.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand a basic of web application.

CO2: Develop structured web pages using HTML.

CO3: Apply styling and layout design principles to create visually appealing web interfaces.

CO4: Develop responsive and user-friendly web pages using modern design frameworks and layout approaches.

CO5: Create and publish functional websites using modern website development tools.

Course Contents:

Unit-I: Introduction to Web Applications 08 Hours

Internet, Basic internet protocols, World Wide Web, HTTP Request message, HTTP response message, Client–Server Architecture, Frontend vs Backend, World Wide Web, Role of browsers and web servers, Introduction to W3C and web standards.

Unit-II: Web Essentials and Mark-up Language- HTML 08 Hours

HTML: Introduction, history and versions. Tags, elements, and attributes, HTML elements: headings, paragraphs, line break, links, frames, lists, tables, images and forms, Input elements and basic validation, difference between HTML and HTML5.

Unit-III: CSS Styling and Layout Design 08 Hours

CSS: Introduction to Style Sheet, CSS features, Types of CSS, CSS core: Properties, Classes, Child-Class (Nested CSS), Colors, Text, Background, Border, Margin, Padding, Positioning (flex, grid, inline, block), Animation, Transition.

Unit-IV: Bootstrap for Responsive Web 08 Hours

Bootstrap vs plain CSS, Installing and using Bootstrap, Bootstrap grid system, Responsive design using Bootstrap, **Common Bootstrap Classes:** Buttons, Tables, Forms, Cards, Navigation bar, Alerts and Models.

Unit-V: Website Design Using No-Code Platforms 08 Hours

Introduction to no-code and low-code web development and Advantages, Website design using **Wix Studio:** Page structure and layout, Responsive design tools, Customization of UI components, **Website design using WordPress:** Themes and templates, Page builders, Content management basics, Publishing and maintaining websites.

Learning Resources:

Text Books:

1. Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035.
2. Robert W. Sebesta, “Programming the World Wide Web”, 4th Edition, Pearson Education.
3. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley Publications.

Reference Books:

4. Marty Hall, Larry Brown, "Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.
5. HTML5 & CSS3 Complete Reference”, McGraw-Hill.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed79

List of Practicals:

1. Create a simple HTML webpage that displays basic information about yourself including name, photo, educational details, hobbies, and contact information using headings, paragraphs, images, and hyperlinks, ordered and unordered list.
2. Develop a webpage that displays a student marksheet using HTML tables including subjects, marks, and total percentage.

3. Create an HTML form for student registration including fields such as name, email, gender, date of birth, course selection, and submit/reset buttons. Apply basic input validation.
4. Design a webpage using external CSS to demonstrate styling of text, background colors, borders, and fonts also make use CSS Flexbox to arrange elements such as header, navigation bar, content section, and footer.
5. Design a webpage demonstrating CSS animation and transition effects on buttons, images, or text elements.
6. Create a responsive webpage using Bootstrap that includes navigation bar, image banner, cards, alerts, buttons, and tables and content sections.
7. Design a responsive webpage using Bootstrap Grid System that adjusts layout for mobile, tablet, and desktop screens.
8. Develop and publish a basic website using a No-Code platform such as WordPress or Wix Studio that includes at least three pages (Home, About, Contact).
9. Mini Project: Design and develop a complete responsive website for a small business, institute, or portfolio using HTML, CSS, and Bootstrap or a No-Code platform. The website should include navigation, forms, images and a responsive layout.

Course Code: 170505G	Course Name: Applied Data Science	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks

Expected Prerequisite Courses:

- Programming and Problem Solving.

Course Objectives:

- To introduce the fundamentals of Data Science.
- To apply Data Science in different domain.
- To do exploratory analysis on a given data.
- To understand the concept of regression models.
- To facilitate learning of data pre-processing using R Programming.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Apply statistics and probability methods to solve real-life problems.

CO2: Demonstrate the Data Science Process and how its components interact.

CO3: Apply basic tools (plots, graphs, summary statistics) to carry out EDA.

CO4: Solve real life problems using regression techniques.

CO5: Apply machine learning algorithms for real world applications.

Course Contents:

Unit-I: Probability and Statistics **08 Hours**

Basics: sample space, outcomes, probability. Events: mutually exclusive, Conditional probability, Bayes' rule. Describing a Single Set of Data, Correlation and Causation Probability: Dependence and Independence, Conditional Probability, Random Variables, Continuous Distributions, The Normal Distribution. **Case Study:** Probability Analysis of Credit Card Fraud Detection.

Unit-II: Introduction to Data Science and Data Preprocessing **08 Hours**

Defining data science and big data, Recognizing the different types of data, Machine Learning Definition and relation with Data Science, Data Science Process: Data collection; Data preparation; Training a model on the data, evaluation of the model performance, Data visualization techniques and inferences. **Case Study:** Data Preprocessing for Online Shopping

Recommendation System.

Unit-III: Exploratory Data Analysis (EDA) 08 Hours

Statistical measures, Basic tools (plots, graphs and summary statistics) of EDA, Data Analytics Lifecycle, Discovery Developing Initial Hypotheses, Identifying Potential Data Sources, EDA case study, testing hypotheses on means, proportions and variances. **Case Study:** Analysis of Food Delivery Trends.

Unit-IV: Regression models 08 Hours

Simple linear regression, least-squares principle, MLR, logistic regression, Multiple correlation, Partial correlation, Cross Validation, Overfitting, Under Fitting and Model Selection, Prediction by using Ridge Regression. **Case Study:** House Price Prediction Using Real Estate Data.

Unit-V: Introduction to Machine Learning & R Programming 08 Hours

Supervised learning, Unsupervised learning, Association Rule mining, Naive Bayes Classifier, k-means clustering, Introduction to R, R packages, Tidy data, Tabular data and data import, Strings and regular expressions. **Case Study:** Customer Segmentation in Retail Business.

Learning Resources:

Text Books:

1. Data Science from Scratch: Joel Grus, O'Reilly Media Inc. 2015, ISBN: 9781491901427.
2. R for data science: import, tidy, transform, visualize, and model data", Wickham, Hadley, and Garrett Grolemund. O'Reilly Media, Inc.", 2016.
3. Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly, 2015, ISBN: 9781449358655.

Reference Books:

1. Introduction to Probability and Statistics for and Engineers and Scientists, S. Ross, 3rd Edition, Elsevier, 2004.
2. Software for Data Analysis: Programming with R (Statistics and Computing), John M. Chambers, Springer.
3. Hadley Wickham, Garrett Grolemund, "R for Data Science", O'Reilly Media, 12 December 2016, ISBN:9781491910344, 1491910348.

Web link for MOOC / NPTEL Links:

1. Python for Data Science
   https://onlinecourses.nptel.ac.in/noc20_cs36/preview

List of Practicals:

1. Download any standard dataset from Kaggle. Using a programming language such as Python /R, perform statistical analysis to understand the structure, distribution, and relationships within the data.
2. Write python code that loads any standard dataset downloaded from Kaggle and plot the graph.
3. Perform some basic data cleaning operations on standard dataset using Python / R (Dataset should contain minimum 1000 records)
4. Perform data preprocessing, exploratory analysis on any standard dataset (dataset should contain minimum 1000 records) Using Python /R.
5. Perform correlation and regression analysis for any standard dataset downloaded from Kaggle, Government databases etc using Python / R.
6. Perform Simple Linear regression on for any standard data set downloaded from Kaggle, UCI, Government databases Using Python / R
7. Perform data analysis using Python / R / Weka for readily available data set using any one machine learning algorithm.

Course Code: 170505H	Course Name: Electrical Machines	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Expected Prerequisite Courses:

- Basic Electrical Engineering.

Course Objectives:

- To understand selection of machines for specific applications.
- To understand the construction, principle of operation of various motors.
- To test & analyze the performance of single phase and three phase motors.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand the principles of electromechanical energy conversion, torque equation, and constructional features of electric motors.

CO2: Apply characteristics and speed control methods of DC motors to select suitable drives for applications.

CO3: Examine performance characteristics of three-phase induction motors for selection and control in mechanical loads.

CO4: Compare single-phase motors to select appropriate types for domestic and light-industrial use.

CO5: Apply operating principles and control methods of synchronous, BLDC, stepper, and servo motors in engineering applications.

Course Contents:

Unit-I: Fundamentals of Electric Motors **08 Hours**

Basic concepts of electromechanical energy conversion, Fleming's rules, torque and EMF equations. Constructional features: Stator, rotor, windings, bearings, cooling systems, Comparison of AC vs DC motors and their industrial relevance, Safety considerations & motor nameplate data interpretation.

Unit-II: DC Motors 08 Hours

Construction: Lap and wave windings, commutator, field excitation, Working principle and back EMF, Types: shunt, series, compound motors, Torque-speed characteristics and performance curves, Speed control techniques (armature and field control), Applications in traction, lifts, rolling mills, robotics. Brushless DC motors: construction, electronic commutation, uses in EV and drones.

Unit-III: Three-Phase Induction Motors 08 Hours

Construction and working: squirrel cage vs slip-ring, Rotating magnetic field concept, slip, torque production, Torque-speed characteristics: starting torque, breakdown torque, Starting methods: DOL, star-delta, auto-transformer, Speed control: V/f control, rotor resistance, slip power recovery, Selection criteria for mechanical drives (load type, duty cycle), Use in pumps, compressors, crushers, conveyors, HVAC systems.

Unit-IV: Single-Phase Induction Motors & Auxiliary Motors 08 Hours

Limitations of single-phase supply, double-revolving field theory, Types: split-phase, capacitor-start, capacitor-run, shaded pole, Universal motor: working and uses, Applications in domestic & light-industrial mechanical equipment (fans, washing machines, small tools).

Unit-V: Synchronous & Special Motors 08 Hours

Synchronous Motors: excitation, torque-angle characteristics, Starting methods, V-curves, power factor improvement. **PMSM:** Construction, electronic controller, uses in EV. **Stepper Motors:** Variable reluctance & PM types, step angle, control, Servo motors for automatic control systems & CNC automation, Application focus in robotics, precision positioning and aerospace actuators.

Learning Resources:

Text Books:

1. Edward Hughes “Electrical Technology”, ELBS, Pearson Education.
2. Ashfaq Husain, “Electrical Machines”, Dhanpat Rai & Sons.
3. S. K. Bhattacharya, “Electrical Machine”, Tata McGraw Hill publishing Co. Ltd, 2nd Edition.
4. Nagrath & Kothari, “Electrical Machines”, Tata McGraw Hill.
5. Bhag S Guru, Husein R. Hiziroglu, “Electrical Machines”, Oxford University Press.
6. K Krishna Reddy, “Electrical Machines- I and II”, SCITECH Publications (India) Pvt. Ltd. Chennai.

Reference Books:

1. I. J. Nagrath and D. P. Kothari, Electric Machines, Tata McGraw Hill, New Delhi, 2005.
2. M. G. Say, The performance and design of alternating current machines, CBS Publishers and distributors, Delhi, 1983.
3. Fitzgerald, Kingsley and Umans, Electric Machinery, Tata McGraw Hill, New Delhi, 2003
4. S. K. Sen, Electrical Machinery, Khanna Pub., Delhi, 2012.
5. Mukherjee and Chakravorty, Electrical Machines, Dhanpat Rai Pub., New Delhi, 2005.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/noc19_ee69/preview
2. https://archive.nptel.ac.in/courses/108/102/108102146/

List of Practicals (Any 8):

1. Load test on DC shunt motor to obtain torque-speed, efficiency and performance characteristics.
2. Speed control of DC motor using armature voltage and field control methods.
3. No-load and blocked-rotor tests on 3-phase induction motor to determine equivalent circuit parameters.
4. Load test on 3-phase induction motor to obtain performance characteristics.
5. Study and comparison of DOL, star-delta & auto-transformer starters for induction motor.
6. V/f (open-loop) speed control of induction motor using inverter (simulation or hardware).
7. Load test on synchronous motor to plot V-curves and study power-factor control.
8. Performance characterization of BLDC motor (simulation or hardware kit).
9. Stepper motor stepping and micro-stepping experiment to determine step angle and positioning accuracy.
10. Servo motor position control using PID controller and performance analysis.
11. Thermal/run-down and insulation resistance test (theoretical analysis for motor selection).

Motor selection and design mini-project based on given mechanical load (simulation/theoretical).

Course Code: 105506	Course Name: Software Skills in RCC and Steel Structures	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Practical : 4 Hours/Week	**2**	**TW : 50 Marks**

Expected Prerequisite Courses:

- Design of Reinforced Concrete Structures, Basic Computer-Aided Drafting/CAD Tools.

Course Objectives:

- To provide hands-on skills in modelling, loading, analysis, and design using software.
- To develop the ability to design steel and RCC structural elements as per IS codes.
- To interpret analysis results such as BMD, SFD, axial forces, and deflections.
- To train students in preparing professional structural design reports.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Model steel and RCC structures using software.

CO2: Apply loads, load combinations, and standards as per IS 875.

CO3: Analyze structural behavior (forces, moments, deflections, reactions).

CO4: Design steel structural members as per IS 800.

CO5: Design RCC members as per IS 456.

CO5: Prepare and interpret software-based analysis & design reports.

Learning Resources:

Text Books:

1. Zeid, I and Sivasubramania, R., (2009), "CAD/CAM: Theory and Practice", 2nd edition, McGraw-Hill Education, ISBN-13: 978-0070151345

Reference Books:

1. Machining Simulation Using SOLIDWORKS CAM 2025 By Kuang-Hua Chang, ISBN: 978-1-63057-724-7.
2. Parametric Modeling with Pro/ENGINEER Wildfire 5.0 By Randy H. Shih, ISBN: 978-1-58503-539-7.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ce76
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ce123

List of Practicals:

1. Introduction to design software, interface, and modelling of a basic steel frame
2. Load assignment for steel structures (DL, LL, combinations)
3. Analysis of steel structure – SFD, BMD, axial forces, deflection
4. Steel design using IS 800 – member design and code check
5. Modelling of RCC frame structure
6. Load assignment for RCC: DL, LL, floor loads, combinations
7. Analysis of RCC structure – BMD, SFD, deflections, reactions
8. RCC design using IS 456 – beams & columns reinforcement output
9. Mini Project A: Design of Steel Structure (DSS).
10. Mini Project B: Design of RCC Structure.

Semester - VI

Course Code: 105601	Course Name: Design of Reinforced Concrete Structures	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Fundamentals of Concrete Technology, Engineering Mechanics, Mechanics of Structure and Structural Analysis.

Course Objectives:

- To provide the students with basic concepts of reinforced concrete structures.
- To analyze, design and detailing of different component of reinforced concrete structures
- To apply design codes and standards.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Assess design philosophies of R. C. structure and estimate the moment carrying capacity of singly, doubly, and flanged sections.

CO2: Design and detailing of one-way, two-way slab and staircase with different boundary conditions.

CO3: Design and detailing of singly/doubly rectangular/flanged beams for flexure, shear, bond and torsion.

CO4: Design and detailing of short columns subjected to axial load, uni-axial/bi-axial bending.

CO5: Design and detailing of pad footing subjected to axial load, uni-axial bending.

Course Contents:

Unit-I: Design Philosophies and Analysis **08 Hours**

Design philosophies of RC structures: working stress method and limit state method, Limit state method: limit state of collapse, limit state of serviceability and limit state of durability, characteristic strength, characteristic load, partial safety factors. Structural properties of concrete and reinforcing steel, assumptions of limit state method, strain variation diagram, stress variation diagram, design parameters for singly reinforced rectangular section, modes.

Unit-II: Design of Slab and Stair Case 08 Hours

Design of one-way simply supported slab, cantilever slab and continuous slab by using IS Code coefficients. Design of dog legged and open well stair case.

Unit-III: Design of beam 08 Hours

Design of simply supported, continuous, cantilever beam - for flexure, shear, bond and torsion, redistribution of moments.

Unit-IV: Design of Column 08 Hours

Assumptions, minimum eccentricity, design of short column for axial load, design of short column subjected to combined axial load and uni-axial/biaxial bending using interaction curves.

Unit-V: Design of Footing 08 Hours

Design of isolated column pad footing for axial load and uni-axial bending.

Learning Resources:

Text Books:

1. Illustrated Reinforced Concrete Design, Dr. V. L. Shah and Dr. S. R. Karve, Structures Publications, Pune.
2. Limit State Design of Reinforced Concrete, P. C. Varghese, PHI, New Delhi.

Reference Books:

1. Illustrated Design of Reinforced Concrete Buildings (G+3), Dr. V. L. Shah and Dr. S. R. Karve, Structures Publications, Pune. 12th ed., 2024.
2. RCC Analysis and Design, Sinha and Roy, S. Chand and Co. New Delhi. Fifth ed., 2007
3. Design of Reinforced Concrete Structures, N. Subramanian, Oxford University Press. 2013
4. RCC Analysis and Design, Sinha and Roy, S. Chand and Co. New Delhi. 4th ed. 2007.

IS Codes

1. IS 456-2000: Plain and reinforced concrete-code of practice, Bureau of Indian Standards, New Delhi.
2. IS 13920-2016: Ductile design and detailing of reinforced concrete structures subjected to seismic forces - code of practice, Bureau of Indian Standards, New Delhi.
3. IS 875-Part 1-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (I) dead loads-unit weights of building materials and stored materials, Bureau of Indian Standards, New Delhi.

4. IS 875-Part 2-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (II) imposed loads, Bureau of Indian Standards, New Delhi.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/105105105

List of Practicals:

1. Design Project: Design of G + 2 (residential/commercial/public) building by any software/ manually covering all types of slabs, beams, columns, footings and staircase (first and second flight) with following details.
   i. Minimum plan area of each floor shall be more than 150 m^2.
2. Design of plinth and ground beams: for each type, two simply supported and two continuous.
3. Design of all slabs and beams of the typical floor (first or second floor).
4. Design of three types of columns: (a) axial load, (b) axial load with uniaxial bending, (c) axial load with biaxial bending, from terrace level to footing, along with detailed load calculations.
5. Design of footing for axial load.
6. Design any one element by using a spreadsheet or using analysis and design with suitable software.
7. Four full imperial drawing sheets. Sheet shall be drawn by using any drafting software/ manually. Schedule of slabs, beams, columns and column footing can be prepared by using any drafting software/ hand.
8. Detailing of reinforcement should be as per SP-34, IS-13920, IS 875-part-III.
9. Reports of two site visits. (Building under construction).

Course Code: 105602	Course Name: Transportation Engineering	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Engineering Mechanics, Geotechnical Engineering, Concrete Technology.

Course Objectives:

- To learn principles and practices of transportation planning.
- To learn geometric design of cross-sectional elements of pavement and drainage systems.
- To enumerate different types of pavements and design of flexible and rigid pavement.
- To describe traffic studies, their analysis and their interpretation.
- To understand the fundamentals of bridge engineering and railway engineering.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Discuss the highway development and planning.

CO2: Design of road geometry with drainage systems.

CO3: Design of road pavement and analysis various pavement materials.

CO4: Discuss the traffic engineering and control methods.

CO5: Understand the fundamentals of bridge engineering and railway engineering.

Course Contents:

Unit-I: Highway Development and Planning 08 Hours

History and development, classification of roads, road patterns, road development in India: vision 2021 and rural road development vision 2025, current road projects in India, highway alignment, highway project report preparation, (planning surveys & master plans based on saturation system), problems based on saturation system.

Unit-II: Geometric Design of Highways and Drainage Systems 08 Hours

Introduction, highway cross section elements, sight distance, design of horizontal alignment, problems of horizontal alignment, design of vertical alignment, design of intersections. Highway drainage - Importance of highway drainage, subsurface and surface drainage systems.

Unit-III: Pavement Design 08 Hours

Introduction to various types of pavements, flexible pavements: computation of design traffic (vehicle damage factor, lane distribution factor, and traffic growth rate), flexible pavements, computation of design traffic, problems, stresses in flexible pavements, design guidelines for flexible pavements as per IRC 37-2018 without numerical. Rigid pavements: components and functions, factors affecting design, ESWL, Stresses in rigid pavements, wheel load stresses and temperature stresses, design guidelines for concrete pavements as per IRC 58-2015 without numerical, Joints in CC pavements, problems, highway drainage: subsurface and surface drainage.

Unit-IV: Traffic Engineering and Control 08 Hours

Traffic characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control devices (signs, signals, islands, road markings), accident studies, types of road intersections, parking studies; highway lighting, problems.

Unit-V: Bridge and Railway Engineering 08 Hours

Bridge Engineering: classification of bridges, components of bridges, preliminary data to be collected during investigation of site for bridges, economical span, afflux, HFL, scour depth and clearance, locations of piers and abutments, factors influencing the choice of bridge super structure, approach roads. Loads on bridges: brief specifications of different loads, forces and stresses coming on bridges as per IRC, Substructure: abutment, piers, and wing walls with their types. Railway Engineering: role and necessity of railway, merits of railways with respect to roadways and waterways, permanent way, component parts of permanent way, requirements of an ideal permanent way, gauge: types of gauges and their suitability.

Learning Resources:

Text Books:

1. T. P. Kanetkar and S.V.Kulkarni, “Surveying and Levelling Vol. I and Vol. II”, Pune Vidyarthi Griha Prakashan.
2. Subramanium R., “Surveying and Levelling”, Oxford University Press.
3. Dr. B. C. Punmia, Ashok K. Jain, Arun K. Jain, “Surveying” Vol. I, Laxmi Publications.
4. S. K. Duggal , “Surveying”, Vol. I & II, Tata McGraw-Hill.

Reference Books:

1. A. M. Chandra , “Plane Surveying”, New Age International,Publishers.
2. N. N. Basak , “Surveying and Levelling”, Tata McGraw Hill.
3. Dr. K. R. Arora , “Surveying”, Vol. I & II, Standard Book House.

Web link for MOOC / NPTEL Links:

1. https://archive.nptel.ac.in/courses/105/104/105104101/

List of Practicals:

Tests on Aggregate (Any Five)

1. Aggregate Impact Value Test.
2. Aggregate Crushing Strength Test.
3. Los Angeles Abrasion Test.
4. Shape Test (Flakiness & Elongation Index).
5. Specific Gravity and Water Absorption Test.
6. Stripping Value Test.
7. Soundness Test.

Tests on Bitumen (Any Five)

1. Penetration Test.
2. Ductility Test.
3. Softening Point Test.
4. Flash Point & Fire Point Test.
5. Bitumen Extraction Test (compulsory).
6. Viscosity Test (Tar Viscometer).
7. Specific Gravity Test.

Tests on Aggregate Bitumen Combined (Compulsory)

1. Marshall Stability Test.

Technical Visits

1. Road Construction and/or RAP Site.
2. Hot mix Plant.

Mandatory Assignments

1. Construction process of GSB, WBM, WMM; Cemented base, Introduction to bituminous works such as prime coat, tack coat, seal coat
2. Built-up Spray Grout (BSG), Asphaltic Concrete (AC) or Bituminous Concrete (BC), Bituminous Macadam (BM), Dense Bituminous Macadam (DBM) and premix carpet, Dry lean Concrete (DLC), Pavement Quality Concrete (PQC)
3. Mastic Asphalt, Cold Mix Asphalt Technology, Warm Mix Asphalt Technology, Recycled/Reclaimed Asphalt Pavement (RAP) (Manual Series - 2), Concept of Super pave Mix Design (Super pave Series 2), Non-Destructive Evaluation of Pavements (Falling Weight Deflect meter FWD).
4. Pavement Materials and Tests - Soil sub-grade and CBR test, Aggregates and related tests, Bitumen and tests, Bituminous binders, bituminous paving mixes, viscosity based

gradation of bitumen, modified bitumen cutbacks, emulsions, crumbed rubber modified bitumen, polymer modified bitumen, foamed bitumen, Marshall stability mix design and test (All 5 test parameters).

Course Code: 105603A	Course Name: Advanced Design of Steel Structures	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Structural Analysis, Design of Steel Structures.

Course Objectives:

- To impart advanced knowledge of structural steel design under complex loading and support conditions.
- To ensure comprehensive understanding of limit state and plastic design philosophies.
- To promote design practices that contribute to sustainability, efficiency, and resilience.
- To integrate modern design tools and global standards (IS, AISC, Eurocode) in advanced structural steel systems.
- To address sustainability principles and SDG-aligned engineering practice.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Analyze and design steel tension, compression, and flexural members using IS 800:2007.

CO2: Apply design strategies to prevent buckling and failure, integrating stability and slenderness concepts.

CO3: Design bolted and welded connections using practical detailing considerations.

CO4: Design industrial structures such as trusses, portal frames, gantry girders, and plate girders for functional and sustainable performance.

CO5: Utilize software tools for analysis and detailing, integrating sustainable and BIM-based practices.

Course Contents:

Unit-I: Introduction to Advanced Steel Design and Limit States 08 Hours

Review of Limit State Design (IS 800:2007), Classification of cross-sections, Design of tension and compression members, Slenderness limits and effective length, Sustainability in material selection (recycled/low-carbon steel).

Unit-II: Flexural Members and Stability Design 08 Hours

Design of laterally supported/unsupported beams, Lateral-torsional buckling, Built-up members and stiffeners, Plastic analysis: shape factors, collapse mechanisms, Structural optimization for sustainability.

Unit-III: Advanced Design of Connections 08 Hours

Rigid, semi-rigid, pinned connections, Design of bolted and welded connections, Moment-resisting connections, Software-aided detailing (BIM).

Unit-IV: Industrial Structures and Special Steel Systems 08 Hours

Design of trusses, portal frames, bracings, Gantry girders and fatigue considerations, Plate girders: shear buckling and stiffeners, Lifecycle assessment in structural steel design.

Unit-V: Software Tools and Sustainable Design Practice 08 Hours

FRAME3DD (Open Source) and OPENSees and OSDAG (Open Source) modeling and design, Tekla Structures & FREECAD (Open Source) for detailing Case study of sustainable steel building, ISO 14040 and LCA, LEED/IGBC for steel design.

Learning Resources:

Text Books:

1. Subramanian, N., Design of Steel Structures, Oxford University Press.
2. Duggal, S.K., Limit State Design of Steel Structures, McGraw Hill.
3. Sinha, S. K., Sustainable Construction Materials and Technologies, Elsevier.

Reference Books:

1. Salmon, C.G., Johnson, J.E., Steel Structures: Design and Behavior, Pearson.
2. AISC Manual of Steel Construction, AISC.
3. IS 800:2007, General Construction in Steel – Code of Practice, BIS.
4. IS 875 (Parts 1 to 5). Loading Standards, BIS.
5. LEED Green Building Design Guide, USGBC.
6. Eurocode 3 (EN 1993), Design of Steel Structures.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/105105113
2. https://nptel.ac.in/courses/105106118
3. https://nptel.ac.in/courses/105105162
4. https://nptel.ac.in/courses/105105248
5. https://www.edx.org/course/structural-steel-design
6. https://www.coursera.org/learn/structural-steel
7. https://www.udemy.com/course/staadpro-structural-analysis-and-design-of-building/

List of Practicals:

1. Structural Member Design Using IS 800:2007

   Objective: Design tension and compression members using IS 800:2007

   Classify cross-sections for given steel profiles. Design a tension and a compression member for a specified load and length. Check slenderness limits and effective length. Justify material selection based on sustainability (e.g., recycled steel).

   Deliverable: Design report with hand calculations, IS code references, and sustainability rationale.

2. Flexural Member Analysis and Plastic Design

   Objective: Analyze and design a laterally unsupported beam with LTB and plastic design principles. Design an I-section beam subjected to bending (with and without lateral restraint). Calculate lateral-torsional buckling capacity. Perform plastic analysis to determine the collapse mechanism and shape factor. Propose weight optimization strategies.

   Deliverable: Design calculations, LTB analysis, plastic mechanism diagrams, optimization proposal.

3. Steel Connection Design and BIM Detailing

   Objective: Design bolted and welded steel connections using software tools

   Design a bolted beam-to-column connection and a welded base plate. Classify connection type (rigid/semi-rigid). Include detailing (bolt layout, weld size, edge distances).

   Deliverable: Design sheets, connection models, exported detail drawings (PDF or screenshots)

4. Analysis and Design of Industrial Frame Structure

   Objective: Design a steel portal frame or truss using FRAME3DD (Open Source), OPENSees and OSDAG Model a 2D/3D portal frame or roof truss. Apply DL, LL, WL as per IS 875. Design key members and connections (manually or software-assisted). Consider fatigue if dynamic or cyclic loads are given. Deliverable: Model file, output reports, member design sheets, and sustainability review (LCA snapshot or embodied carbon estimate).

5. Case Study – Sustainable Steel Building Design

   Objective: Conduct a case study on a real or hypothetical green steel building

   Select a steel structure (real or conceptual). Perform lifecycle assessment using ISO 14040 principles. Analyze steel selection based on embodied carbon and recyclability. Map the project to LEED or IGBC criteria. Suggest sustainable design improvements.

   Deliverable: PPT presentation + written report with case study insights, LCA summary, and certification alignment.

Course Code: 105603B		Course Name: Architecture and Town Planning
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Fundamentals of Building Technology and Architectural Planning.

Course Objectives:

- To use principles of architectural planning and understand futuristic need of users.
- To discuss and demonstrate the concepts of landscaping, urban renewal and sustainable architecture.
- To distinguish and relate planning levels and understand use of act and to develop neighborhood plan.
- To encourage critical thinking through case studies and real-world examples of smart city projects, focusing on challenges and best practices.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand principles of architectural planning, the futuristic needs of users, and discuss the concepts of Urban renewal and sustainable architecture.

CO2: Apply town planning concepts, planning levels, policies, and the functions of planning agencies in analyzing and preparing urban and regional development proposals.

CO3: Demonstrate planning strategy with reference to different acts, guidelines, and norms.

CO4: Examine civic surveys and property valuations to support development planning and urban decision-making.

CO5: Assess planning strategies for townships, new towns, satellite towns, and rural areas using GIS, GPS, remote sensing, and government schemes.

Course Contents:

Unit-I: Architecture and Urban Planning **08 Hours**

Principles and elements of architectural composition and its expected outcome, qualities of architecture: user-friendly, contextual, eco-friendly, utility of spaces, future growth, etc., with a case study. Role of urban planner and architect in planning and designing in relation to spatial organization, utility, demand of the area, and supply, etc., considering situations like disasters / pandemic conditions. Urban renewal process and its impact on quality of life and livability,

and importance of sustainable architecture. Conservation of heritage structure.

Unit-II: Town Planning **08 Hours**

Scope, purpose and benefits of town planning, components of town planning, planning levels: regional plan, development plan, town planning scheme, neighborhood planning, legislative mechanism for preparation of DP: MRTP Act 1966 National Urban Transport Policy, National Land-utilization policy, National Housing Policy, Functions, roles and responsibilities, Planning agencies (CIDCO, MHADA, MIDC, MMRDA/PMRDA, SRA and HUDCO).

Unit-III: Acts and Guidelines **08 Hours**

Land acquisition rehabilitation and resettlement Act, 2013, The Real Estate (Regulation and Development) Act, 2016 (MAHA-RERA), Right to Information Act 2005, URDPFI Guidelines (for land use, infrastructure etc.), UDCPR, MRTP Act, Environment Protection Act, 1986, SDG goals related to spatial planning.

Unit-IV: Civic Survey and Valuation **08 Hours**

Civic surveys and its utility for DP proposal: like demographic, housing, land use, water supply and sanitation, Traffic transportation systems: hierarchy of roads, traffic management, intelligent transport systems. **Valuation:** Value, Cost, Price, Purposes of Valuation, Factors affecting valuation, method of valuation, Annual Statement of Rates (ASR).

Unit-V: Integrated Township Planning and Recent Technologies **08 Hours**

Integrated Township Planning, new towns and satellite towns, Application of GIS, GPS, remote sensing, drones in town planning, Rural planning: need, strategies, Central and State Scheme related village development and plan.

Learning Resources:

Text Books:

1. Town Planning, G. K. Hiraskar, Dhanpat Rai Publications.
2. Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.

Reference Books:

1. MRTP Act 1966 : The director, government printing, stationary and publications, Mumbai
2. URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, GoI.
3. LARR Act 2013: Ministry of law and justice, Government of India.
4. Climate Responsive Architecture, Arvind Krishnan, Nick Baker, Simos Yannas and Steve Szokolay, McGraw Hill Education.
5. An Introduction to Landscape Architecture, Michael Laurie, American Elsevier Publishing Company.

6. Role of Edge Analytics on Sustainable Smart City Development: Challenges and Solutions by G. R. Kanagachidambaresan.
7. Sustainable Smart Cities in India: Challenges and Future Perspectives (The Urban Book Series) by Poonam Sharma and Swati Rajput.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.swayam2.ac.in/cec20_ar01/preview
2. https://www.edx.org/certificates/professional-certificate/delftx-inclusive-and-sustainable-cities?index=product&queryId=2d5f1360201b4959787e19d485c4178e&position=3
3. https://www.coursera.org/learn/smart-cities
4. https://onlinecourses.nptel.ac.in/noc25_ar27/preview
5. https://onlinecourses.nptel.ac.in/noc26_ar08/preview
6. https://onlinecourses.nptel.ac.in/noc25_ar25/preview
7. https://onlinecourses.nptel.ac.in/noc26_ce48/preview

List of Practicals:

1. Site analysis and documentation for a comprehensive site study, including land records, climate, soil, roads, vegetation, sun path, wind, noise, and user movement. (Group Activity).
2. Study and analysis of development plan with respect to land use, services, infrastructure, street furniture, housing etc. (Individual work).
3. Prepare a land-use map for a neighborhood with classification (residential, commercial, industrial, etc.) by calculation. (Group Activity).
4. Report on any existing new towns or planned towns or satellite towns like new Mumbai, Gandhinagar etc. (in relation with TP aspects inclusive of infrastructure, disaster management etc) (Individual work).
5. Study of URDPFI/ UDCPR guidelines with a case study (Individual work).
6. Assessment of local area based on SDG 11: Sustainable Cities and Communities. (Group Activity).
7. Report on use of new technologies in town planning like: Drones, GIs, GPS, RS.
8. Valuation of a residential or commercial property using ASR and standard valuation methods.
9. Suggest a village development proposal based on government schemes.
10. Site visit to integrated township planning or group housing project.

Course Code: 105603C	Course Name: Advanced Concrete Technology	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks **PR + OR** : 25 Marks

Expected Prerequisite Courses:

- Project Management and Finance.

Course Objectives:

- To provide in-depth knowledge of the microstructure and properties of concrete constituents and their influence on concrete performance.
- To explore the latest advancements in concrete technology, including special concretes and sustainability aspects.
- To understand the behaviour of concrete under various loading and environmental conditions.
- To develop practical knowledge in the design of concrete mixes for diverse applications.
- To enhance skills in evaluating the performance, durability, and quality control of concrete.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Analyze and evaluate the properties of fresh and hardened concrete with various admixtures and supplementary materials.

CO2: Design concrete mixes for normal and special concrete applications using various methods and IS codes.

CO3: Assess the durability aspects and deterioration mechanisms affecting concrete structures.

CO4: Apply modern testing methods and NDT techniques for concrete quality assurance.

CO5: Recommend sustainable and cost-effective concrete solutions for different structural applications.

Course Contents:

Unit-I: Concrete Materials and Microstructure **08 Hours**

Cement types and hydration process, Aggregates: grading, properties, and influence, Admixtures and pozzolanic materials, Interfacial Transition Zone (ITZ), Microstructure and micro-cracking.

Unit-II: Properties of Fresh and Hardened Concrete 08 Hours

Workability and its measurement, Mechanical properties: strength, elasticity, shrinkage, creep

Factors affecting properties, Rheology of concrete.

Unit-III: Concrete Mix Design 08 Hours

Design methods: IS 10262, ACI, DOE, Mix design for high-strength and self-compacting concrete. Role of admixtures and supplementary cementitious materials, Case studies.

Unit-IV: Durability of Concrete 08 Hours

Permeability, sulphate attack, chloride ingress, carbonation, Alkali-Aggregate Reaction (AAR)

Corrosion of reinforcement, Durability design and specifications.

Unit-V: Special Concretes, Quality Control, Testing and Sustainability 08 Hours

High Performance Concrete (HPC), Self-Compacting Concrete (SCC), Fibre Reinforced Concrete (FRC), Geopolymer and recycled aggregate concrete, Sustainability and life-cycle assessment of concrete Non-destructive testing (NDT) methods, Rebound hammer, ultrasonic pulse velocity, core testing, Statistical quality control of concrete, Ready mix concrete and site quality practices.

Learning Resources:

Text Books:

11. Neville, A.M. – Properties of Concrete, Pearson Education.
12. Mehta, P.K., and Monteiro, P.J.M. – Concrete: Microstructure, Properties and Materials, McGraw-Hill.
13. Shetty, M.S. – Concrete Technology, S. Chand.

Reference Books:

1. Gambhir, M.L. – Concrete Technology, Tata McGraw-Hill.
2. Rixom, R. and Mailvaganam, N. – Chemical Admixtures for Concrete, E&FN Spon.
3. ACI and IS Codes – IS 456, IS 10262, IS 516, IS 1199, IS 9103, ACI 211.1, ACI 318.
4. Neville, A.M. and Brooks, J.J. – Concrete Technology, Pearson.

Web link for MOOC / NPTEL Links:

5. https://nptel.ac.in/courses/105106176,
6. https://onlinecourses.nptel.ac.in/noc24_ce104/preview
7. https://archive.nptel.ac.in/courses/105/106/105106176/

8. https://www.routledge.com/Value-Engineering-Analysis-And-Methodology/Younker/p/book/9780824706968?srsltid=AfmBOooHa5sxuo3fMNy5RFzog_fkRJlLT4sdoUo3yGCAKuP92y22KegT

List of Practicals:

1. Mix Design and Casting:
    a. Design and preparation of concrete mix for M25, M40, and SCC using IS 10262.
    b. Outcome: Hands-on understanding of batching, mixing, and casting with variable parameters.
2. Durability Testing:
    a. Perform permeability, sulphate attack, and chloride penetration tests on concrete cubes.
    b. Outcome: Analyze the durability characteristics under different environments.
3. Non-Destructive Testing (NDT):
    a. Evaluate compressive strength using rebound hammer & UPV on cast specimens.
    b. Outcome: Interpretation of NDT results for concrete integrity assessment.
4. Rheology and Workability:
    a. Conduct slump flow, V-funnel, and L-box tests for SCC.
    b. Outcome: Understanding the flow and passing ability of special concretes.
5. Fiber Reinforced Concrete:
    a. Casting and testing of FRC specimens under flexural load.
    b. Outcome: Understand the role of fibers in improving mechanical behavior.

Course Code: 105603D	Course Name: Construction Management	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Fundamental of Project Management.

Course Objectives:

- To explain the structure, characteristics, and economic importance of the construction industry and understand the fundamentals of project management and PMCs.
- To develop skills in construction planning and scheduling using tools such as WBS, LOB, Work Study methods, and understand the role of BIM in project coordination
- To apply principles of risk management and value engineering for optimizing project cost, time, and performance.
- To understand and interpret labour laws, financial statements, and project financial management practices relevant to construction
- To analyze and apply the concepts of material management, HRM, and AI tools for improving productivity and decision-making in construction projects.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the construction industry's structure and its role in infrastructure development along with the functions of construction management and PMCs in addressing project.

CO2: Apply various planning and scheduling tools such as WBS, Line of Balance, Work Study charts.

CO3: Apply quantitative risk analysis techniques and the Value Engineering job plan to assess risks and propose value-improving alternatives in construction projects.

CO4: Interpret labour laws, financial statements, and basic project financing concepts relevant to construction project management.

CO5: Apply principles of materials management, HRM practices, and basic AI tools to improve productivity and decision-making in construction projects.

Course Contents:

Unit I: Overview of Construction Industry & Project Management 08 Hours

Construction Sector Overview: Role of construction industry in national infrastructure development, Components of the infrastructure sector, Nature, characteristics, size, and structure of the construction industry, Contribution to economic development, Need and importance of construction management, Project Management Consultants (PMC), Role and responsibilities in various project types (BOT, EPC, PPP), Types of PMCs, selection criteria, appointment process, Project Performance Issues project overruns, Strategies and techniques to combat overruns, Project monitoring, reporting systems.

Unit-II: Construction Planning, Scheduling & BIM Applications 08 Hours

Construction Project Scheduling: Definition, objectives, factors influencing schedules Work Breakdown Structure (WBS), Line of Balance (LOB), Work Study (Time–Motion Study) Definition, objectives, need, Method and Time study procedures, Symbols & charting techniques: Multiple activity charts, Two-handed process charts, String diagram – preparation & application

Introduction to Building Information Modelling (BIM) Need & evolution, BIM-based scheduling and coordination (4D, 5D concepts), Role of software tools (general introduction).

Unit-III: Risk Management & Value Engineering 08 Hours

Construction Risk Management: Introduction, principles Risk Identification, types of risk Quantitative Techniques for Risk Analysis Sensitivity analysis, Break-even analysis, Simulation analysis: basic examples, Decision tree analysis, Risk Mitigation & Insurance, Case study on construction risk management, Risk mitigation strategies.

Value Engineering (VE): Concepts: types of value, value analysis, value engineering, Job plan approach, VE applications in construction and infrastructure, Energy cost escalation & its influence on project cost/value.

Unit-IV: Labour Laws & Financial Management in Construction 08 Hours

Labour Regulations in Construction: Need and importance of labour laws, Overview and key provisions of: Workmen Compensation Act 1923, Building & Other Construction Workers Act 1996, Child Labour Act, Inter-State Migrant Workers Act, Minimum Wages Act 1948

Financial Aspects of Construction Projects: Capital investments: importance, types, challenges, means of project finance, Working capital requirement analysis, Project cash flow projections, Balance sheet preparation, Profit & Loss account, Basic financial ratios for project evaluation.

Unit-V: Materials & Human Resource Management, AI Tools 08 Hours

Material Management: Introduction, objectives, functions and scope**,** Integrated material management system, Phases of material flow system & applications, Role of material manager, Inventory control techniques (ABC, EOQ), Logistics and Supply Chain Management, Role of

ERP & Material Resource Information Systems

Human Resource Management in Construction: Nature, scope and need for HRM in construction, Staffing policies & patterns, HRM & HRD processes, Recruitment & selection, Training & development, Performance evaluation, compensation, incentives, Career planning & succession planning, ERP in Human Resource Management

Introduction to Artificial Intelligence in Construction: Artificial Neural Networks, Fuzzy logic, Genetic algorithms, Basic applications in civil engineering (forecasting, optimization, decision-making).

Learning Resources:

Text Books:

1. Construction Management and Planning, B. Sengupta and H. Guha, Tata McGraw-Hill Publications.
2. Total Project Management, The Indian Context, P. K. Joy, Mac Millian Publications.
3. Projects: Planning, Analysis, Selection, Financing, Implementation, and Review by Prasanna Chandra, published by Tata McGraw-Hill
4. Construction Project Management: Theory & Practice, Kumar Neeraj Jha.

Reference Books:

1. Civil Engineering Project Management, C. Alan Twort and J. Gordon Rees, Elsevier Publications.
2. Construction Management for Practicing Engineers, A. N. Prakash.
3. Construction Project Management: Planning, scheduling and controlling K.K. Chitkara, McGraw-Hill.
4. Principles of Construction Management, Roy Pilcher (McGraw-Hill)
5. Human Resource Management, Biswajeet Pattanayak, Prentice Hall Publishers.
6. Materials Management, Gopalkrishnan & Sundaresan, Prentice Hall Publications.
7. Labor and Industrial Laws, S. N. Mishra, Central Law Publications.
8. Artificial Neural Network, Vega Narayanan, Prentice Hall.

Web link for MOOC / NPTEL Links:

1. Principles of Construction Management, IIT Kanpur. https://onlinecourses.nptel.ac.in/noc22_ce56/preview NPTEL Online Courses+1
2. Construction Methods and Equipment Management https://onlinecourses.nptel.ac.in/noc24_ce07/preview NPTEL Online Courses
3. Construction Management Specialization by Columbia University https://www.coursera.org/specializations/construction-management.

List of Practicals:

1. Site visit to a construction project to study following documents and preparing a report-
    a. Project cash flow analysis.
    b. Use of ERP software.
    c. Work break down structure.
    d. Materials flow system in the project.
2. Scheduling of a construction project using line of balance technique.
3. Prepare a Work breakdown structure of any construction project.
4. Prepare project balance sheet, profit and loss account statement for any construction project.
5. Assignment on work study on any two construction trades.
6. Assignment on EOQ model and its variation.
7. Students present on any ONE topic: (Group).
    a. Emerging technologies in construction management.
    b. BIM in India.
    c. ERP systems for construction.
    d. AI tools in civil engineering.
    e. Modern scheduling methods.
    f. Value Engineering case examples.
    g. Labour welfare practices in construction.

Course Code: 105604A	Course Name: Domestic and Industrial Wastewater Treatment	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Engineering Sciences and Mathematics.

Course Objectives:

- To understand the basics of sanitation systems, wastewater characteristics, and natural stream self-purification.
- To describe the preliminary and primary wastewater treatment processes and the design of related units.
- To explain the principles of aerobic biological treatment and the working of secondary treatment systems like ASP.
- To identify anaerobic, tertiary, and emerging wastewater treatment technologies used for advanced purification.
- To recognize industrial wastewater characteristics and methods for treatment, disposal, recycle, and reuse.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand wastewater collection, quantification, characteristics, and stream self-purification processes.

CO2: Explain preliminary and primary treatment units and their design principles.

CO3: Describe aerobic secondary treatment processes including activated sludge and wetland systems.

CO4: Identify anaerobic and advanced treatment systems and their applications.

CO5: Apply suitable treatment, disposal, and reuse methods for industrial wastewater based on CPCB norms.

Course Contents:

Unit I: Sanitation Infrastructure System **08 Hours**

Sanitation infrastructure and wastewater quantification: wastewater, sources and types, importance of sanitation infrastructure, wastewater collection and conveyance, quantitative

estimation of wastewater, sewage, storm water, self-cleansing velocity and non-scouring velocity in sanitary sewer, hydraulic design of circular sanitary sewer, necessity and location of pumping station. Wastewater characteristics: methods of sampling, treatability index, effluent discharge standards as per CPCB norms. Self-purification of natural streams: oxygen sag curve, Streeter - Phelps equation and terminology (without derivation and numerical).

Unit-II: Preliminary and Primary Wastewater Treatment 08 Hours

Treatment: stages (preliminary, primary, secondary, and tertiary treatment), sewage/effluent treatment plant - flow diagram, unit operation and process, preliminary and primary treatment, screens: types, hydraulics, velocity and head loss, design of screens, disposal of screenings. Grit chamber: sources of grit, importance of grit chamber, types, control of velocity, proportional flow weir, Parshall flume, design of grit chamber, disposal of grit, skimming tanks: sources of oil and grease, importance of removal, methods of oil and grease removal.

Equalization and neutralization tanks: introduction, application, and benefits. Primary sedimentation tank: types of settling, types of sedimentation tanks, assumptions, efficiency, factors affecting efficiency and design of primary sedimentation tank.

Unit-III: Secondary Treatment: Aerobic Suspended Growth 08 Hours

Aerobic secondary treatment: unit Operations and processes for secondary treatment, principles of biological treatment, role of microorganisms in wastewater treatment, types of microorganisms, microbial metabolism, microbial growth pattern in batch and continuous systems, requirements of microbial growth.

Activated sludge process (ASP): Conventional plug flow ASP, biochemical reactions, hydraulic and organic loading, F/M ratio, mean cell residence time, aeration method, oxygen requirement, assumptions, design of ASP, sludge volume index, sludge recycle and rate of return sludge, operational problems and maintenance in ASP, modifications in ASP. Constructed wetlands, phytoremediation, and root zone technology: principles, advantages, and disadvantages.

Unit-IV: Anaerobic Tertiary and Emerging Treatment 08 Hours

Anaerobic treatment: septic tank: Suitable conditions and situations, biological principle, method of treatment and disposal of septic tank effluent and design of septic tank.

Anaerobic lagoon: principle, advantages & disadvantage, applications. Up-flow anaerobic sludge blanket (UASB) reactor: principle, advantages & disadvantage, applications.

Tertiary (advanced) treatment: objectives, introduction to nutrients removal processes, adsorption, ion exchange, membrane processes, advanced oxidation processes, disinfection. Emerging wastewater treatment systems: sequencing batch reactor (SBR), membrane bio

reactors (MBR), moving bed bio reactor (MBBR), fluidized membrane bio reactor (FMBR), packed bed reactor (PBR), advantages, limitations and applications.

Unit-V: Industrial Wastewater Treatment 08 Hours

Equalization and neutralization. Application of preliminary, primary, and secondary treatment for industrial wastewater as per the CPCB norms. Sources of wastewater generation from manufacturing processes, characteristics of effluent, different methods of treatment & disposal of effluent for the following industries: Sugar, dairy, and distillery. Discharge standards as per CPCB norms.

Recycle and reuse of treated wastewater: Gardening, sewage farming, W.C. Flushing, reuse in industry.

Learning Resources:

Text Books:

1. Manual on Sewerage & Sewage Treatment published by Ministry of Urban Development, New Delhi, Third Edition.
2. Waste Water Treatment & Disposal, Metcalf & Eddy, McGraw-Hill Education (India) Private Limited.

Reference Books:

1. Environmental Engineering, Peavy Rowe, McGraw-Hill Education (India) Private Limited.
2. Wastewater Treatment for Pollution Control and Reuse, Arceivala and Asolekar, McGraw-Hill Ed. Pvt Ltd.
3. Industrial Wastewater Treatment, A. D. Patwardhan, Eastern Economy Edition, PHI Learning Pvt Ltd.
4. Sewage Disposal & Air Pollution Engineering, S. K. Garg, Khanna Publication.
5. Standard Methods for examination of water and wastewater, Mary Franson, American Public Health Association.
6. IS 3025: 2013, Methods of Sampling and Test (Physical, Chemical and Biological) for Water and Waste Water, Bureau of Indian Standards, New Delhi.

Web link for MOOC / NPTEL Links:

1. http://cpheeo.gov.in/cms/manual-on-sewerage-and-sewage-treatment.php
2. http://cpheeo.gov.in/cms/manual-on-storm-water-drainage-systems---2019.php
3. http://cpcb.nic.in
4. http://moef.nic.in

List of Practicals: (Any 8 + Assignments 2)

1. Determination of dissolved oxygen in a given water and wastewater sample.

2. Determination of Bio-Chemical Oxygen Demand in a given wastewater sample.
3. Determination of Chemical Oxygen Demand in a given wastewater sample.
4. Determination of solids -Total solids, suspended solids, volatile solids, settleable solids and non-settleable solids in a given wastewater sample.
5. Determination of Sludge Volume Index in a given wastewater sample.
6. Determination of Electrical Conductivity in a given wastewater sample.
7. Determination of Phosphates by spectrophotometer in a given wastewater sample.
8. Determination of Nitrates by spectrophotometer in a given wastewater sample.
9. Determination of heavy metals like Cr6+ or Zn or Ni or Cd in a given wastewater sample.
10. Determination of Kjeldahl nitrogen in a given wastewater sample.
11. Visit to domestic / Industrial wastewater treatment plant & its detailed report.
12. Computer aided design of Sewage Treatment Plant (STP) OR Effluent Treatment Plant (ETP) of Sugar/ Dairy/Distillery Industry using suitable software (e.g., ASIM, STOAT) or excel sheets.

Assignments (Compulsory):

1. Brief report on sewer materials, choice of materials, testing of sewer pipes, sewer appurtenances.
2. Brief report on a case study of package wastewater treatment plant.

Course Code: 105604B	Course Name: Airport and Bridge Engineering	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Engineering Mechanics, Strength of Materials, Structural Analysis, Transportation Engineering, Surveying.

Course Objectives:

- To introduce students to planning, design, and operation of airport infrastructure.
- To develop knowledge of bridge engineering principles including structural systems, loads, and construction techniques.
- To expose students to modern tools such as BIM, drones, and digital monitoring systems used in infrastructure projects.
- To analyze real-world airport and bridge projects through case studies and field exposure.
- To prepare students for transportation infrastructure careers in consulting and construction industries.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Outline the principles of airport planning, classification, and airport layout components.

CO2: Examine runway orientation, airport capacity, and airside infrastructure requirements.

CO3: Implement airport pavement design concepts and modern smart airport technologies.

CO4: Differentiate bridge types, structural components and loading conditions in bridge engineering.

CO5: Assess bridge construction techniques, inspection methods, and modern infrastructure monitoring technologies.

Course Contents:

Unit I: Introduction to Airport Engineering 08 Hours

Role of airports in transportation systems, classification of airports, airport planning process, site selection criteria, airport master planning, airport zoning regulations, environmental considerations in airport planning, ICAO and DGCA standards. Study of airport master plans

of major airports.

Unit-II: Airside Infrastructure and Airport Operations 08 Hours

Runway orientation using wind rose diagrams, runway length determination, runway configuration, taxiways, aprons, holding bays, runway markings and lighting systems, airport capacity analysis, air traffic control systems, airport safety considerations. Modern airport infrastructure planning and operations.

Unit-III: Airport Pavements and Smart Airports 08 Hours

Types of airport pavements (flexible and rigid), aircraft loads and wheel configurations, pavement design principles, ICAO pavement classification number (PCN), materials used in airport pavements, pavement drainage, maintenance and rehabilitation. Smart Airport Infrastructure, BIM applications in airport planning, Digital twin technology, Automated baggage handling systems, and Sustainable airport infrastructure.

Unit-IV: Fundamentals of Bridge Engineering 08 Hours

History and development of bridges, classification of bridges, bridge components (deck, bearings, piers, abutments, foundations), bridge loads as per IRC codes, impact factor, wind and seismic effects on bridges. Case Studies: Major national and international bridge projects.

Unit-V: Bridge Construction, Inspection and Smart Infrastructure 08 Hours

Bridge construction techniques: balanced cantilever method, incremental launching method, precast segmental bridges, cable-stayed and suspension bridges. Bridge inspection and maintenance: deterioration mechanisms, structural health monitoring, non-destructive testing methods, retrofitting techniques, and bridge management systems. Modern Techniques: AI-based bridge damage detection, Drone-based bridge inspection, IoT sensors for structural health monitoring, Digital twin models for infrastructure maintenance.

Learning Resources:

Text Books:

1. Airport Planning and Design – S.K. Khanna & M.G. Arora
2. Bridge Engineering – S.P. Bindra.

Reference Books:

1. Airport Engineering – Norman Ashford
2. Bridge Engineering Handbook – Wai-Fah Chen
3. Design of Highway Bridges – T.R. Jagadeesh & M.A. Jayaram
4. Transportation Engineering and Planning – C.S. Papacostas.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ae01

2. https://nptel.ac.in/courses/105105216

List of Practicals: (Any 10)

1. **Preparation of Wind Rose Diagram:** Collect wind data of a selected location from meteorological sources and prepare a wind rose diagram. Based on the analysis, determine the optimum runway orientation for an airport at that location.
2. **Study of Airport Master Plan:** Study the master plan of an existing airport using satellite imagery and publicly available reports. Identify key components such as runways, taxiways, aprons, terminal buildings, and support facilities.
3. **Case Study of International Airport Infrastructure:** Prepare a detailed case study of a major international airport highlighting airport planning principles, runway configuration, terminal layout, and smart infrastructure systems.
4. **Airport Pavement Design Exercise:** Perform basic design calculations for airport pavements considering aircraft loading, pavement type (rigid or flexible), and subgrade conditions. Compare design approaches used in modern airport infrastructure.
5. **Conceptual Airport Layout Planning:** Prepare a conceptual layout of an airport showing runways, taxiways, aprons, and terminal buildings using CAD or GIS tools. Consider safety clearances and functional zoning.
6. **Structural System Study of Different Bridge Types:** Study various bridge structural systems such as beam bridges, arch bridges, truss bridges, cable-stayed bridges, and suspension bridges. Compare their structural behavior, span ranges, and applications.
7. **Case Study of Iconic Bridges:** Prepare a technical case study of a major bridge project highlighting structural system, construction method, materials used, and engineering challenges involved in its construction.
8. **Bridge Load Calculation as per IRC:** Perform bridge load calculations using IRC provisions, considering dead load, live load, impact factors, and other relevant loads. Illustrate the calculations with suitable examples.
9. **Study of Modern Bridge Construction Techniques:** Study and prepare a report on modern bridge construction methods such as balanced cantilever construction, incremental launching, precast segmental construction, and cable-stayed bridge erection.
10. **Study of Modern Bridge Construction Techniques:** Study and prepare a report on modern bridge construction methods such as balanced cantilever construction, incremental launching, precast segmental construction, and cable-stayed bridge erection.

11. **Study of Smart Infrastructure Technologies:** Prepare a report on emerging technologies used in bridge and airport infrastructure, including IoT sensors, digital twins, structural health monitoring systems, and smart monitoring techniques.
12. **Industry Interaction / Site Visit Report:** Prepare a technical report based on a site visit or interaction with industry professionals involved in airport or bridge infrastructure projects, highlighting practical challenges and engineering solutions.

Course Code: 105604C	Course Name: Operation Research	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Engineering Mathematics and Project Management.

Course Objectives:

- To analyze the data for a given problem and formulate mathematical model
- To optimize linear & non-linear programming problems
- To apply the knowledge for optimization for Civil Engineering Projects.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Correlate applications of Operations Research in Civil Engineering field and solution for the problems related to dynamic models.

CO2: Solve the problems related to stochastic programming.

CO3: Optimize transportation and assignment problems.

CO4: Apply linear programming techniques.

CO5: Analyze nonlinear programming problems.

Course Contents:

Unit I: Introduction of Operations Research and Dynamic Programming 08 Hours

Introduction to operations research and optimization techniques, applications of operations research in civil engineering, introduction to linear and non-linear programming methods, formulation of linear optimization models for civil engineering applications (objective function, constraints), graphical solutions to L P problems, local & global optima, unimodal function, convex and concave function. Dynamic programming: multi stage decision processes, principle of optimality, recursive equation, applications.

Unit-II: Stochastic Programming 08 Hours

Sequencing: n jobs through 2, 3 and M machines, queuing theory: elements of queuing system and its operating characteristics, waiting time and ideal time costs, Kendall‘s notation, classification of Queuing models, single channel Queuing theory: Model I (Single channel Poisson Arrival with exponential services times, Infinite population (M/M/1): (FCFS/ /),

simulation: Monte Carlo simulation.

Unit-III: Linear Programming - Transportation Model 08 Hours

The transportation model and its variants, the assignment model and its variants.

Unit-IV: Linear Programming – Simplex Method 08 Hours

The simplex method, the method of big M, the two-phase method, and duality.

Unit-V: Nonlinear Programming 08 Hours

Single variable unconstrained optimization: sequential search techniques-dichotomous, Fibonacci, golden section, multivariable optimization without constraints: the gradient vector and hessian matrix, gradient techniques, steepest ascent/decent technique, Newton's Method, Multivariable optimization with equality constraints: Lagrange multiplier technique.

Learning Resources:

Text Books:

1. Operations Research, Premkumar Gupta and D. S. Hira, S. Chand Publications.
2. Engineering Optimization: Methods and Application, A. Ravindran and K. M. Ragsdell, Wiley India.
3. Engineering Optimization, S. S. Rao, New Age International (P) Ltd.
4. Quantitative Techniques in Management, N.D. Vohra, McGraw-Hill.
5. Operations Research, Pannerselvam - PHI publications.

Reference Books:

1. Topics in Management Science, Robert E. Markland, Wiley Publication.
2. A System Approach to Civil Engineering Planning & Design, Thomas K. J-HR Pub.
3. Operations Research, Hamdy A. Taha, Pearson Publication.
4. Introduction to game theory, Stef Tijs, Hindustan Book Agency, New Delhi.
5. Dynamic programming and optimal control, P. Bertsekas, Athena Scientific, Belmont.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/105103210
2. https://nptel.ac.in/courses/105108127

List of Practicals:

1. Assignment 1 on Operations Research & dynamic Programming
2. Assignment 2 on Stochastic Programming
3. Assignment 3 on Linear Programming-I
4. Assignment 4 on Linear Programming-II
5. Assignment 5 on Non-Linear Programming
6. Solve any one of the above problems using Software (Open Source).

Course Code: 105604D	Course Name: Engineering Geology with Rock Mechanics	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Engineering Mathematics, Engineering Mechanics.

Course Objectives:

- To understand the utility and application of geological principles in various phases of civil engineering activities.
- To develop ability to carry out independently civil engineering and geological investigations.
- To highlight Geophysical Explorations and their applications in geology.
- To understand fundamentals of rock mechanics and application part of units.
- Assess the methods required for geological investigations for tunnels, bridges and dams.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Elaborate Mineralogy, Petrology, Historical Geology and stratigraphy.

CO2: Explain plate tectonics, morphological structural features.

CO3: Explore subsurface Geology for Civil Engineering projects to suggest foundation treatments for various geological defects and tail channel erosion.

CO4: Validate the suitability of rocks on the basis of mechanical properties, R.Q.D. and geophysical exploration.

CO5: Illustrate the suitability of proposed alignments for tunnels and bridges on the basis of Geological investigations.

Course Contents:

Unit-I: Mineralogy, Petrology, Historical Geology and Stratigraphy 08 Hours

Mineralogy: Properties of Minerals, Classification of Minerals.

Petrology: Igneous Petrology: Classification, texture and structures

Sedimentary Petrology: Rock weathering, Classification, Textures and structures, **Metamorphic Petrology:** Agents and types of metamorphism, classification, Texture and

Structures.

Stratigraphy and Building Stones: General principles of Stratigraphy, geological time scale, physiographic divisions of India. Requirements of good building stone.

Unit-II: Geomorphology, Plate Tectonics, Structural Geology 08 Hours

Geomorphology: Endogenic and Exogenic processes, Geological action by river, wind, and Coastal geomorphology.

Introduction to plate tectonics and mountain-building activity.

Structural Geology: Outcrop, dip, and strike, conformable series, unconformity, and overlap, Faults, Folds, Joints, inliers, and outliers, Structural features resulted due to igneous intrusions: concordant and discordant.

Unit-III: Geological Explorations 08 Hours

Subsurface Explorations for Water Retaining Structures: Physical and Mechanical properties of rocks affecting strength and water tightness. Case studies illustrating economics made possible by proper geological studies and wasteful expenditure or difficulties resulting from their negligence.

Geological Foundation Treatments for various Civil Engineering Projects: Foundation investigations and treatment for adverse geological features. Determination of foundation levels.

Erosion of Tail Channels: Erosion of tail channel, Causes of rapid erosion of tail channels of side spillways. Geological conditions leading to tail channel erosion. Case studies.

Unit-IV: Geophysical Explorations and Rock Mechanics 08 Hours

Geophysical Explorations: Electrical Resistivity method and Seismic method of exploration. Evaluation and analyzing the data produced through electrical resistivity for the determination of thickness of overburden, locating ground water potential zones which lead for strengthening the major civil engineering projects.

Rock Mechanics: General principles of rock mechanics. Dependence of physical and mechanical properties of rocks on geological characters. Analyzing and evaluating core recovery, R.Q.D. and Joint Frequency Index. Various Methods of Geomechanical classifications of rocks such as Terzahagi, U.S.B.M, R.M.R., R.S.R., Q- system, Deer and Miller, Bieniawaski's geomechanical classification.

Unit-V: Geology in Reservoirs, Dams, Tunneling and Bridges 08 Hours

Geology of Dams & Reservoir: Strength, stability and water tightness of foundation rocks,

influence of geological conditions on the choice and type of dam, preliminary geological work on dam sites, precaution to be taken to counteract unsuitable conditions and their relevant treatments with case studies.

Tunnelling: Preliminary geological investigations, important geological considerations while choosing alignment, difficulties during tunnelling as encountered due to various geological conditions, role of groundwater, and suitability of common rock types for excavation and tunnelling and case studies.

Bridges: Investigation for bridge foundation, difference in objectives of investigation of bridge foundation. Bridge foundation based on nature & structure of rock. Foundation settlements. Case studies.

Learning Resources:

Text Books:

1. Text Book of Engineering Geology by R.B. Gupte - 2001, P.V.G. Publications, Pune.
2. A Text Book of Engineering Geology by N. Chenna Kesavulu. 2010, McMillan India Ltd.
3. Principles of Engineering Geology by S. K. Garg.1999, Khanna Publ, New Delhi
4. Principles of Engineering Geology by D. Venkat Reddy. 2010, Vikas Publishers.
5. Geology and Engineering by K. V. G. K. Gokhale.

Reference Books:

1. Physical Geology by P K Mukarjee, World Press, 2013
2. Physical Geology by Arthur Holmes-ELBS Publication.
3. Principles of Engineering Geology and Geotechniques – D P Krynine & W R Judd. CBS Publishers, New Delhi
4. Engineering Geology by F G H Blyth and De Frietus,2006, Reed Elsevier India Ltd.,
5. Engineering Geology by Bell.

Web link for MOOC / NPTEL Links:

1. www.ebd.co.in/undergraduate/eng.
2. www.library.iisc.ernet.in
3. www.iitb.ac.in
4. https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_ce68
5. https://nptel.ac.in/courses/105104190

List of Practicals:

1. Megascopic identification of following mineral specimens.
   Rock Forming Minerals, Economic Minerals and Ore Minerals.

2. Megascopic identification of following different rock specimens
    a. Igneous Petrology: Plutonic, Hypabyssal, Volcanic Rock.
    b. Sedimentary Rock: Rudaceous, Areanceous, Argillaceous, Chemical and Organic Deposits.
    c. Metamorphic rocks: foliated non-foliated, Schists, and Geisses,
3. Interpretation and construction of geological sections from contoured geological maps
4. Solution of engineering geological problems such as alignment of dams, tunnels, roads, canals, bridges, etc. based on geological maps (Total 3). #(From A. G. Series 8 maps and 2 maps constructed by the faculty members)
5. Logging of drill core and interpretation of drilling data with graphical representation of bore log.
6. Calculations of Core recovery and RQD
7. Electrical resistivity test on field and its applications.
8. Drill hole problems
9. Site visit to study various geological features and their application.

Course Code: 170605A	Course Name: Automotive Technology	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 50 Marks**

Expected Prerequisite Courses:

- Engineering Physics, Engineering Mechanics.

Course Objectives:

- To provide fundamental understanding of construction and working of automobile subsystems.
- To equip students with tools and methods to measure and analyze performance of automobiles.
- To acquaint students with contemporary automotive technologies.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Compare the various chassis and drive-trains of an automobile.

CO2: Analyze axles, wheels, tyres and the steering system of an automobile.

CO3: Select suspension and braking systems of an automobile.

CO4: Measure and analyze the performance of an automobile and describe the safety aspects.

CO5: Discuss electrical systems and assess modern propulsion technologies of an automobile.

Course Contents:

Unit-I: Introduction to Chassis and Drive Train 08 Hours

Introduction: Current scenario in Indian auto/ancillary industries, vehicle specifications and classification.

Chassis and Frames: Types of chassis layout with reference to power plant locations and drive, various types of frames and constructional details.

Drive Trains: Necessity and selection of clutch, necessity of gearbox and different types, overdrive, torque convertor, continuous variable transmission, dual clutch transmission, automated manual transmission, propeller shaft, final drive, and differential.

Unit-II: Axles, Wheels, Tyres and Steering System 08 Hours

Axles: Purpose, requirement and types of front and rear axle, loads acting on rear axles.

Wheels and Tyres: Wheel construction, alloy wheel, wheel balancing and rotation, type of tyres, tyre construction, tyre materials, factors affecting tyre life.

Steering System: Steering mechanism, steering geometry, cornering force, slip angle, scrub radius, steering characteristics, steering linkages and gearbox, power steering, collapsible steering, reversibility of steering, four-wheel steering, wheel alignment.

Unit-III: Suspension and Brake Systems 08 Hours

Suspension: Types of suspension linkages, types of suspension springs- leaf, coil, air springs, hydrogas, interconnected suspension, self-leveling suspension (active suspension), shock absorbers (hydraulic and air). **Brake Systems:** Drum, disc, mechanical, hydraulic, air brakes, power-assisted brakes, hand brake, ABS, EBD, BA.

Unit-IV: Vehicle Performance and Safety 08 Hours

Vehicle performance: parameters; vehicle resistances; traction and tractive effort; power requirements for propulsion; road performance curves (numerical examples); vehicle stability; vehicle testing on a chassis dynamometer; NVH in automobiles. **Vehicle safety:** Types of active and passive safety, vehicle interior and ergonomics.

Unit-V: Electrical Systems and Modern Propulsion Technologies 08 Hours

Batteries: Principles and construction of lead-acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on battery condition, charging methods, introduction to lithium batteries.

Electrical System and Accessories: Basic electric layout of the vehicle, automotive sensors and actuators, electronic control unit/module.

Modern Propulsion Technologies: Concept and environmental importance of EVs and HEVs, Layout, construction and working, Challenges and future scope of EVs and HEV.

Learning Resources:

Text Books:

1. William H. Crouse., “Automotive Mechanics”, Tata McGraw Hill Publishing House.
2. Narang G. B. S, “Automobile Engineering”, S. Chand and Company Ltd.

Reference Books:

1. Kirpal Singh, “Automobile Engineering”, Volume 1, Standard Publishers distributors.
2. R. K. Rajput, “Automobile Engineering”, Laxmi Publications.

Web link for MOOC / NPTEL Links:

1. Fundamentals of Automotive Systems: https://onlinecourses.nptel.ac.in/noc20_de06/preview
2. Autotronics: https://onlinecourses.nptel.ac.in/noc26_me101/preview

3. Vocational: Automotive Services Technician (Four-Wheeler): https://onlinecourses.swayam2.ac.in/nos24_ge28/preview
4. Automotive Industrial Engineering: https://www.coursera.org/learn/automotive-industrial-engineering
5. Automotive Engineering: Automobile Fundamentals: https://www.udemy.com/course/automotive-engineering-automobile-fundamentals-and-advanced/

List of Practicals: (Any 6)

1. Identify four vehicles having different chassis layout and compare their performance.
2. Identify four vehicles equipped with different types of automatic transmission and compare their performance.
3. Visit an automobile service centre for demonstration of wheel alignment and write a detailed report on axle, wheels, tyres and wheel alignment of one car.
4. Experimental study of shock absorber.
5. Measurement of noise and vibration in an automobile.
6. Study of requirements of BNCAP test.
7. Demonstration on basic maintenance and checks of an automobile such as doors etting, consumable checking and replacing, brake pad checking &replacing, checking tyre wear etc.

Course Code: 170605B	Course Name: Database Systems	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 50 Marks**

Expected Prerequisite Courses:

- Fundamentals of Programming.

Course Objectives:

- To understand the fundamental concepts of database management.
- To identify and classify entities, attributes, and relationships in real-world problem domains.
- To understand the principles and structure of the relational data model.
- To demonstrate the use of SQL for secure and efficient database querying and management.
- To understand the basic concepts of transaction processing and concurrency control.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the basic concepts, architecture, and components of database systems.

CO2: Convert ER diagrams into equivalent relational database schemas.

CO3: Normalize relational schemas using functional dependencies.

CO4: Explain the purpose and components of SQL in relational database systems.

CO5: Identify various transaction states and common transaction operations.

Course Contents:

Unit-I: Introduction to Database Systems **08 Hours**

Need of database system, Types of Data, Database System Applications, Database System VS File System, View of Data, Data Abstraction, data independence, Data Models, Structure of Database Management Systems. **Case Study:** Study of Architecture of any Database Management System (DBMS) like Oracle or MySQL.

Unit-II: Entity Relationship Modeling **08 Hours**

Conceptual data modeling: entities, entity types, attributes and its types, relationships, cardinalities on relationship, Entity Relationship diagram extended Features: Specialisation and Generalization on the ER Model. **Case Study:** ER Diagram conversion into Tables for

College Management Systems.

Unit-III: Relational Data Model **08 Hours**

Concept of relations, schema-instance distinction, keys and their types, Codd's Rules, Concept of Anomalies, Normalization, functional dependencies and Normal forms, 1NF, 2NF, 3NF and BCNF decompositions and desirable properties of them. **Case Study:** Library management system to identify different types of keys.

Unit-IV: Structured Query Language (SQL) **08 Hours**

Querying in SQL, DDL to create database and tables, table constraints, update database-update behaviors, DML, aggregation functions group by and having clauses, retrieve data from the database, generate and query views. Different types of Joins. **Case Study:** Design and implementation of Student Course Management System using SQL for effective management of students, courses, and faculty members.

Unit-V: Overview of Transaction Management **08 Hours**

The ACID Properties, Transactions and Schedules, Concurrency Control–The Need for Concurrency Control, Serializability, Locking Methods, Deadlock, Time Stamping Methods, Concurrency Control Protocols. Database Recovery: Need for Recovery, Recovery Techniques. **Case Study:** Design Online Shopping Cart Transaction Management In an e-commerce platform, multiple users simultaneously add, update, and purchase products.

Learning Resources:

Text Books:

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2. S.K.Singh, "Database Systems: Concepts, Design and Application", Pearson Education, ISBN 978-81-317-6092-5
3. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition, ISBN-13: 978-0-136-08620-8.

Reference Books:

1. Shio Kumar Singh, Database Systems Concepts Design and Applications, Pearson
2. Mario Piattini, Oscar Diaz - Advanced Database Technology and Design- online book.

Web link for MOOC / NPTEL Links:

1. Introduction to Database Systems By Prof. Sreenivasa Kumar, IIT Madras.
   https://onlinecourses.nptel.ac.in/noc20_cs03/preview

List of Practicals:

1. Study of installation of various database software like MySQL, MariaDB & Oracle, etc.
2. Draw an ER diagram for any database system with various entities and their attributes on ERWin/ERDPLUS Software.
3. Implement SQL queries to provide students with hands-on experience for studying various commands of DDL.
4. Implement SQL queries to provide students with hands-on experience for studying various commands of DML.
5. Implement SQL queries to provide students with hands-on experience for studying various Logical Operators of SQL.
6. Implement SQL queries to provide students with hands-on experience in implementing various data constraints using SQL commands in MySQL/MariaDB.
7. Write at least 10 SQL queries for suitable database applications using SQL DML statements by implementing all types of joins.
8. Write at least 10 SQL queries for suitable database applications using SQL DML statements by implementing sub-queries and views.
9. Write at least 10 SQL queries for suitable database applications using SQL DML statements for studying various aggregation functions.
10. ER Modeling and Normalization: a. Consider case studies and formulate.
    a. Problem statement for any application to be developed.
    b. Propose a conceptual design using ER.
    c. Convert ER diagram into relational tables and normalize relational data model.
11. Mini- Project.

Course Code: 170605C	Course Name: Industrial Control Components	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 50 Marks**

Expected Prerequisite Courses:

- Fundamentals Electronics Engineering.

Course Objectives:

- To understand the basics of process control, including variables, system types, and real-world applications of control loops.
- to learn about transmitters, signal standardization, communication protocols, and converters used for accurate measurement in process control.
- To explore control actions and tuning methods to optimize controller performance and prevent issues like reset windup.
- To understand control valve design, terminology, types, and sizing using Cv calculations in line with industry standards.
- To learn about valve accessories and actuators, focusing on their design and function for optimal control system performance.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Analyze process variables, control system types, and process characteristics, and evaluate examples of process control loops in industry.

CO2: Apply knowledge of transmitters, signal standards, protocols, and converters to evaluate their role in process control systems.

CO3: Design and apply control actions and tuning methods to optimize controller performance and system stability.

CO4: Evaluate control valve selection, sizing, and design based on key characteristics and industry standards.

CO5: Analyze and evaluate valve accessories and actuators for optimal performance in process control systems.

Course Contents:

Unit-I: Introduction to Process Control **08 Hours**

Key Concepts in Process Control: Process Variables: Definition and differentiation of

manipulated, disturbance, and output variables.

Control System Types: Understanding Open-Loop vs. Closed-Loop systems.

Block Diagram Representation: Structure and components of control loops. Examples of Process Control Loops: Application examples of control loops in industries—temperature, flow, level, and pressure.

Unit-II: Transmitters and Converters **08 Hours**

Transmitters and Signal Standardization: Importance of transmitters in process control systems. Standardization of signals: current (4-20 mA), voltage (0-10 V), and pressure signal standards. **Types of Transmitters:** Live zero vs. dead zero, and concept of two-wire. SMART Transmitters. **Differential Pressure Transmitters (DPT):** Types, installation, and calibration of DPTs. Application in level and flow measurement. Zero elevation, suppression.

Converters: Understanding the difference between converters and transmitters. Types: Current-to-pressure and pressure-to-current converters.

Unit-III: Control Actions and Tuning Techniques **08 Hours**

Discontinuous Control: On-Off, multi-position, floating control modes. **Continuous Control:** Proportional (P), Integral (I), Derivative (D), PI, PD, and PID control modes.
Reset Windup: Techniques to prevent reset windup, rate before reset, and bumpless transfer.

Controller Tuning Methods: Introduction to process reaction curve. Tuning techniques: Ziegler-Nichols.

Unit-IV: Control Valve: Design, Sizing, and Selection **08 Hours**

Control Valve Fundamentals: Key terminology: Rangeability, turndown ratio, cavitation, flashing, noise, viscosity index, valve capacity, AO, AC, and fail-safe actions. **Valve Characteristics:** Linear, equal percentage, and quick-opening characteristics.

Valve Types and Applications: Overview of different valve types: Globe, Ball, Butterfly, Diaphragm, and specialty valves for high-temperature and high-pressure applications.

Valve Sizing and Selection: Cv Calculation.

Unit-V: Control Valve Accessories and Actuator Design **08 Hours**

Valve Accessories: Detailed discussion on accessories such as petitioners (pneumatic, electro-pneumatic, and digital), I/P converters, volume boosters, air lock, limit switches, solenoid valves, and hand wheels.

Actuator Types and Design: Understanding different actuator types: Spring and diaphragm, piston cylinder, and smart actuator.

Learning Resources:

Text Books:

1. C. D. Johnson, Process Control and Instrument Technology, Tata McGraw Hill, Publications, 8th Edition.
2. N. A. Anderson, Instrumentation for Process Measurement and Control, CRC Press.

Reference Books:

1. G. Liptak, "Process Control", Instrument Engineering Handbook CRC Press,

Web link for MOOC / NPTEL Links:

1. Industrial Automation and Control, By Prof. Siddhartha Mukhopadhyay, IIT Kharagpur.
   https://nptel.ac.in/courses/108105062
2. Process Control and Instrumentation, by Dr. P.K. Saha, IIT Guwahati.
   https://nptel.ac.in/courses/103103037

List of Practicals: (Any 8)

1. Identification of industrial control components.
2. Block diagram of an industrial automation system.
3. Comparison of open-loop and closed-loop systems.
4. Direction control valve applications.
5. Control valve sizing basics.
6. Actuator selection.
7. Valve characteristic comparison.
8. PID control exercises.
9. Tuning of PID controller for level/flow control loop.
10. Controller tuning problems.
11. Process reaction curve analysis.
12. Study of the control valve & plot the installed characteristics of the control valve.

Course Code: 170605D	Course Name: Embedded System in IoT	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 50 Marks

Expected Prerequisite Courses:

- Basic Electronics Fundamentals, Sensors and Actuators, Basic C Programming.

Course Objectives:

- To understand the fundamentals of embedded systems, IoT architecture, and the role of hardware–software co-design in connected devices.
- To develop the ability to interface sensors, actuators, and communication modules with microcontrollers for IoT applications.
- To analyze and implement embedded programming concepts using platforms such as Arduino, Raspberry Pi, or ARM-based controllers.
- To design and develop IoT-based systems using networking protocols (e.g., MQTT, HTTP) and cloud integration techniques.
- To evaluate security, power management, and real-time constraints in embedded IoT systems for efficient and reliable performance.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain fundamentals of embedded systems, including components, classifications, design metrics, and the role of microcontrollers.

CO2: Apply IoT hardware design concepts using microcontroller platforms, interfaces, and communication modules with effective power management.

CO3: Apply IoT communication models, protocols, data transmission, and basic cloud integration concepts.

CO4: Analyze Embedded C programming, real-time processing, RTOS concepts, and low-power design techniques in IoT-based embedded systems.

CO5: Evaluate end-to-end IoT system design, security mechanisms, and real-world IoT applications across domains.

Course Contents:

Unit-I: Introduction to Embedded Systems **08 Hours**

Definition, characteristics, and requirements of embedded systems, Embedded system

components: hardware, software, processors, peripherals, Classification of embedded systems, Embedded system design metrics: cost, power, performance, memory, reliability, Applications of embedded systems in various domains, Overview of microprocessors vs microcontrollers, Role of 8-bit microcontrollers in embedded development.

Unit-II: IoT Hardware Platforms and Interfacing 08 Hours

Design Considerations for IoT Hardware, Microcontroller Platforms: Arduino, ESP32, NodeMCU, Nucleo (STM32 Overview), ADC, DAC, GPIO Programming, Communication Interfaces: UART, SPI, I2C, Wireless Communication Modules (Wi-Fi, BLE, GSM, LoRa – Basics), Power Management in IoT Devices.

Unit-III: IoT Communication Protocols and Networking 08 Hours

IoT Communication Models, IP Addressing Basics, Application Layer Protocols: MQTT, HTTP, CoAP (Overview), Client-Server vs Publish-Subscribe Model, Data Acquisition and Transmission, Introduction to Cloud Platforms (ThingsBoard / AWS IoT – Conceptual), REST API Basics.

Unit-IV: Embedded Software and Real-Time Concepts for IoT 08 Hours

Embedded C for IoT Applications, Interrupt Handling and Timer-Based Programming, Real-Time Data Monitoring, Introduction to RTOS for IoT Devices, Task Scheduling Basics, Data Logging and Local Storage, Edge Computing Concept, Low Power IoT Design Techniques.

Unit-V: IoT System Design, Security and Applications 08 Hours

End-to-End IoT System Design Methodology, IoT Security: Authentication, Encryption Basics, Secure Communication (TLS Concept), Data Analytics Basics for IoT, Industrial IoT (IIoT) Overview, Smart City Applications, Smart Energy Monitoring System, IoT-Based Environmental Monitoring, Smart Irrigation System, Remote Health Monitoring System.

Learning Resources:

Text Books:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi & Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Pearson Education.
2. Zdravko Karakehayov, “Embedded Systems Design with 8051 Microcontrollers: Hardware and Software”, CRC Press / Taylor & Francis.
3. Raj Kamal, “Embedded Systems: Architecture, Programming & Design”, Tata McGraw-Hill.
4. David E. Simon, “An Embedded Software Primer”, Pearson Education.

Reference Books:

1. Daniel D. Gajski, Samar Abdi, “Embedded System Design: Modeling, Synthesis and Verification”, Springer, 2021.
2. Peter Marwedel, “Embedded System Design: Foundations of Cyber-Physical Systems and the Internet of Things”, Springer
3. Qing Li & Caroline Yao, “Real-Time Concepts for Embedded Systems”, CRC Press (Taylor & Francis)
4. Marilyn Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Elsevier
5. Catherine H. Gebotys, “Security in Embedded Devices”, Springer.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/noc24_ee68/preview
2. https://onlinecourses-archive.nptel.ac.in/noc19_cs32/course
3. https://www.coursera.org/learn/iot

List of Practicals: (Any 8)

1. Draw and explain 3-layer and 5-layer IoT architecture. Map real-world application to architecture layers.
2. Comparison of IoT Development Boards. Compare Arduino, ESP32, Raspberry Pi based on: Processing speed, Memory, Connectivity, Power consumption, Application suitability.
3. Sensor & Actuator Selection. Select appropriate sensors for:
    a. Smart irrigation system
    b. Health monitoring system
    c. Smart energy meter

    Justify selection with technical reasoning.
4. Protocol Comparison. Compare MQTT, HTTP, CoAP. Identify best protocol for given IoT scenario.
5. IoT Communication Model Analysis. Device-to-Device. Device-to-Cloud. Device-to-Gateway. Draw block diagrams and explain.
6. Embedded C Programming Problems. Write logic for:
    a. Sensor threshold detection
    b. PWM-based motor control
    c. Interrupt-based event detection.
7. IoT Security Case Study. Identify security threats in smart home system. Suggest countermeasures.
8. Design complete IoT solution for Smart parking.
9. Design complete IoT solution for Weather monitoring.

10. Industrial IIoT Monitoring Plan. Design a predictive maintenance node with: Vibration analysis, Data transmission, Dashboard planning.
11. Smart Campus IoT Design. Complete architecture including: Sensors, Networking, Cloud, Security, Cost estimation.
12. Sensor Signal Conditioning Design. Design amplifier gain for low-voltage sensor. Select filter type for noise removal.

Course Code: 170605E	Course Name: Governing Policies	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 50 Marks**

Expected Prerequisite Courses:

- Business Economics.

Course Objectives:

- To explain the principles of infrastructure systems, governance frameworks, and policy implementation in urban and rural contexts.
- To examine economic evaluation tools, including demand forecasting, cost–benefit analysis, financing options, and PPP models.
- To interpret national infrastructure programs, policies, and regulations for effective development planning.
- To apply sustainable, inclusive, and technology-driven approaches to plan and manage urban and rural infrastructure.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand infrastructure, governance, and policy implementation in urban and rural development.

CO2: Analyze economic aspects of infrastructure, apply demand forecasting, cost–benefit analysis, financing mechanisms, and PPP models.

CO3: Apply national infrastructure programs, policies, and regulations to plan and assess urban and rural development projects.

CO4: Implement planning and management tools for urban and rural infrastructure projects.

CO5: Apply concepts of sustainable and inclusive infrastructure by integrating climate resilience, risk reduction, resource efficiency, digital governance, and global case insights.

Course Contents:

Unit-I: Infrastructure Governance **08 Hours**

Concept, scope, and components of urban & rural infrastructure, Infrastructure lifecycle and asset management, Principles of good governance, Role of central, state, and local governments, Urban Local Bodies (ULBs), Panchayati Raj Institutions (PRIs), National

policies on housing, transport, water, sanitation, energy, rural development, Policy formulation, implementation, monitoring.

Unit-II: Economics of Urban and Rural Infrastructure 08 Hours

Economic characteristics of infrastructure (public goods, externalities, natural monopoly), Demand forecasting & cost–benefit analysis (CBA), Budgetary allocations, grants, and intergovernmental transfers, Municipal finance and rural development financing, PPP models, Case studies, Life-cycle costing, Economic impact assessment, social cost–benefit analysis.

Unit-III: Policies, Acts and Regulatory Frameworks 08 Hours

AMRUT, Smart Cities Mission, Swachh Bharat Mission, National Urban Housing Policy, PMAY, National Transport Policies, PMGSY, NRLM, MGNREGA, Rural drinking water, sanitation, electrification programs, Environmental regulations (EIA, Water/Air Acts, Waste Management Rules), Land acquisition and R&R policies, Infrastructure concession frameworks.

Unit-IV: Planning, Implementation and Monitoring of Infra. Projects 08 Hours

Master planning, regional planning, Integrated urban/rural planning approaches, GIS-based infrastructure planning, DPR preparation, feasibility studies, Procurement methods, contract management, Risk management, KPIs for urban and rural services, Service level benchmarks (SLBs), Digital governance & monitoring systems.

Unit-V: Sustainable, Inclusive and Resilient Infrastructure Governance 08 Hours

Green and climate-resilient infrastructure, Disaster risk reduction, Energy efficiency, circular economy, Infrastructure for marginalized groups, Rural–urban linkages for balanced development, E-governance tools IoT, AI, and data analytics, UN SDGs and infrastructure governance, international case studies.

Learning Resources:

Text Books:

1. Town Planning, G. K. Hiraskar, Dhanpat Rai Publications
2. Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.
3. Rural Development: Planning Strategy & Policy Imperatives — Vivek Saurath & Manoj Agarwal.

Reference Books:

1. Urban Planning by Chris Couch.
2. Urban Infrastructure and Governance by G. Ramesh, Vishnu Prasad Nagadevara, Gopal Naik, Anil Suraj.

3. Urban and Regional Planning Education: Learning for India (edited by Ashok Kumar, Diwakar S. Meshram, Krishne Gowda.
4. Swachh Bharat Mission Guidelines.
5. MRTP Act 1966: The director, government printing, stationary and publications, Maharashtra state, Mumbai
6. URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, Government of India.
7. Natural Infrastructure and Resilient Cities: Role of Green Infrastructure in Urban Planning for Adaptation to Climate Change in India (2025, by National Institute of Disaster Management, Delhi).
8. Role of Edge Analytics on Sustainable Smart City Development: Challenges and Solutions by G. R. Kanagachidambaresan.
9. Sustainable Smart Cities in India: Challenges and Future Perspectives (The Urban Book Series) by Poonam Sharma and Swati Rajput.
10. Rural Development: Principles, Policies and Development by Katar Singh and Anil Shishodia. Atlantic Publications.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.swayam2.ac.in/imb21_mg02/preview
2. https://onlinecourses.swayam2.ac.in/ugc23_ge04/preview
3. https://onl inecourses.nptel.ac.in/noc23_ce52/preview
4. https://onlinecourses.swayam2.ac.in/cec20_ar01/preview
5. https://www.coursera.org/learn/smart-cities
6. https://onlinecourses.nptel.ac.in/noc25_ar27/preview
7. https://onlinecourses.nptel.ac.in/noc26_ar08/preview
8. https://onlinecourses.nptel.ac.in/noc25_ar25/preview
9. https://onlinecourses.nptel.ac.in/noc26_ce48/preview

List of Practicals (Any 8):

1. Presentation on any national policy for housing and transport. (Group Activity)
2. Analyze the latest central/state government budget allocations for infrastructure sectors. (Individual Activity)
3. Comparison of Public-Private Partnership (PPP) models in infrastructure project (Individual Activity)
4. Conduct a sanitation or waste management study under Swachh Bharat guidelines with case study. (Individual Activity)

5. Prepare a compliance checklist for industries under Water Act, Air Act, and Waste Management Rules. (Group Activity)
6. Prepare a land use map and zoning proposal for a neighborhood. (Group work)
7. Conduct a basic energy audit of a building (college, hostel, home) and propose energy-saving measures. (Group Activity)
8. Suggest a small-scale circular economy project for rural or urban ward. (Group Activity)
9. Map how infrastructure projects (roads, water supply, housing, digital systems) contribute to SDGs 6, 7, 9, 11, and 13. (Individual Activity)
10. Identify and explain components of a tender document by referring to any online tender document related to infrastructure project.

Course Code: 170605F	Course Name: Application Development	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 50 Marks

Expected Prerequisite Courses:

- Web Development, Database Management Systems.

Course Objectives:

- To familiarize students with client-side scripting concepts.
- To provide knowledge of server-side development and backend processing in web applications.
- To enable students to understand basic database concepts.
- To understand and learn Web application deployment.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Apply the client-side technologies for web development.

CO2: Develop user interfaces using component-based design approaches.

CO3: Apply the server-side technologies for web development.

CO4: Create effective web applications for business functionalities using the latest web development platforms.

CO5: Deploy web applications in collaborative environments.

Course Contents:

Unit-I: Basics of Web Application Interactivity **08 Hours**

Introduction to JavaScript, JS Variables and Constants, JS Variable Scopes, JS Data Types, JS Functions, JS Array, JS Object, JS Events.

Unit-II: ReactJS **08 Hours**

Introduction to ReactJS, ReactJS Components Styling, Routing, Redux- Architecture, Hooks-Basic hooks, useState() hook, useEffect() hook, useContext() hook.

Unit-III: Backend Development Using NodeJS **08 Hours**

Role of backend in web applications, Introduction to NodeJS, Environment Setup, Node.JS Events, Node.JS Functions, Node.JS Built-in Modules, File System, Handling Data I/O in Node.JS, Create HTTP Server, Create Socket Server.

Unit-IV: Database Integration Using MongoDB 08 Hours

Introduction to databases, Need for databases in web applications, Types of databases: SQL vs NoSQL, MongoDB fundamentals, Data models and schemas, Basic CRUD operations.

Unit-V: Managing and Deploying Web Applications: GitHub 08 Hours

Deployment strategies, Overview of Git, Git Repositories: Public vs private repositories, Basic Git Workflow & commands, collaboration using GitHub.

Learning Resources:

Text Books:

1. Jeffrey C.Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035.
2. Kogent Learning Solutions Inc, Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Blackbook, Dreamtech Press, ISBN: 9788177228496.

Reference Books:

1. Shama Hoque, Full-Stack React Projects: Learn MERN Stack Development by Building Modern Web Apps, Packt Publishing.
2. Dr. Hiren Joshi, Web Technology and Application Development, DreamTech, 1st Ed.

Web link for MOOC / NPTEL Links:

1. https://www.coursera.org/learn/programming-with-javascript
2. https://www.coursera.org/specializations/build-dynamic-website

List of Practicals:

1. Design responsive user registration and login which will do the following actions: Register user, login user functionality.
2. Create a To-Do List application where users can add tasks, mark tasks as completed, and delete tasks.
3. Develop a frontend using React JS which includes forms and navigation.
4. Create a Node.JS Application which serves a static website.
5. Develop a Node.js application with MongoDB to perform CRUD Operations.
6. Create version control account on GitHub and implement basic git commands and repository handling.
7. Mini Project: Develop a web application using front end and backend technologies in any of the domains: Social Media, E-commerce, Finance, Education, Any other.

Course Code: 170605G	Course Name: Data Visualization	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 50 Marks**

Expected Prerequisite Courses:

- Programming and Problem Solving.

Course Objectives:

- To introduce the fundamental concepts and importance of data visualization.
- To develop the ability to create basic graphical representations such as bar charts, line charts, etc.
- To enable students to explore and summarize datasets using filtering, aggregation, and basic statistical measures.
- To apply visualization techniques to analyze time-series and geospatial data commonly used in engineering applications.
- To develop skills for creating dashboards and communicating insights through visual storytelling and business analytics tools.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the importance, principles, and techniques of data visualization and perform basic data exploration using filtering and aggregation methods.

CO2: Apply appropriate visualization techniques to create basic and advanced charts.

CO3: Analyze time-series datasets to identify trends, seasonality, and noise using suitable visualization techniques.

CO4: Analyze geospatial data using mapping techniques to derive meaningful insights.

CO5: Develop interactive dashboards and visual reports using visualization tools to communicate data insights effectively.

Course Contents:

Unit-I: Overview of Data Visualization **08 Hours**

Importance and benefits of good data visualization– Design principles. Visualization ethics, misleading visualizations, accessibility considerations, and best practices for effective visual communication. Statistical Measures, Introduction to Python libraries for visualization,

Exploring Data – Reduce Items and Attributes: Filter and Aggregate.

Unit-II: Creation of Basic Visualization 08 Hours

Histogram, Bar (Vertical and Horizontal) and Line Chart, Box plot, Scatter plot (Examples and Exercises to be given for practice). Color palettes – Creation of 3D Charts. Creation of Advanced Visualization: Heat Map– Facet Grid – Interaction Techniques: Manipulate View – Creation of interactive Network topologies and Trees.

Unit-III: Visualization of Time Series Data 08 Hours

Summary statistics and plotting aggregated views - Visualization of seasonality, trends and noise– working with multiple time series data such as Power load variation, Machine temperature monitoring, Rainfall and water level data, Signal variation in electronics.

Unit-IV: Visualization of Geospatial Data 08 Hours

Spatial join - overlapping geospatial data to maps and adding special cues – Case Study-Visualization of multimodal data and analysis-case study sensor data and health care, genome and biomedical data.

Unit-V: Business Analytics and Visualization Tools 08 Hours

Creation of interactive dashboards, charts, and visual reports using data visualization tools, applying visualization principles and data storytelling techniques.

Learning Resources:

Text Books:

1. Python Data Visualization: An Easy Introduction to Data Visualization in Python, ISBN: 9780070087705, Tata McGraw-Hill Education, 2009.
1. Tamara Munzner, Visualization Analysis and Design, A K Peters Visualization Series, CRC Press, 2014.

Reference Books:

1. Hands-On Data Visualization: Interactive Storytelling from Spreadsheets to Code Jack Dougherty and Ilya Ilyankou 1st Edition, O'Reilly Media, 2021.
2. Alberto Cairo, The Functional Art: An Introduction to Information Graphics and Visualization, New Riders, 2012.

Web link for MOOC / NPTEL Links:

1. https://www.coursera.org/learn/advanced-data-visualization-with-tableau-public

List of Practicals:

1. Load a dataset and perform basic data exploration by identifying attributes, data types, and displaying summary statistics.
2. Using a dataset, compute statistical measures (mean, median, standard deviation) and perform filtering and aggregation
3. Create Histogram, Bar Chart (vertical and horizontal), and Line Chart using a suitable dataset.
4. Using a dataset, create Box Plot and Scatter Plot to analyze data distribution and relationships between variables.
5. Using a dataset, generate advanced visualizations such as Heat Map and Facet Grid with appropriate color palettes.
6. Using a time-series dataset, create visualizations to identify trends, seasonality, and patterns.
7. Using a geospatial dataset, plot location-based data on a map and analyze spatial distribution.
8. Create an interactive dashboard using data visualization tools and present insights using data storytelling.

Course Code: 170605H	Course Name: Drives and Controls	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 50 Marks

Expected Prerequisite Courses:

- Power Electronics, Electric Machines.

Course Objectives:

- To understand the fundamentals, components, and control principles of electric drive systems.
- To analyze thermal models and select appropriate motor power ratings for different duty cycles.
- To study performance, speed control, and braking methods of DC motor drives.
- To understand operation, control techniques, and speed control methods of induction motor drives
- To understand the types, operation, and control of synchronous and special motor drives for fixed and variable speed applications.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the fundamentals, components, selection criteria, and control techniques of electric drives, including closed-loop and PLL control.

CO2: Analyze the thermal characteristics of motors to determine suitable motor power ratings under different duty cycles and load conditions.

CO3: Analyze performance, speed control, multi-quadrant operation, and closed-loop control of DC motor drives.

CO4: Explain starting, speed control methods, slip power recovery techniques, and closed-loop control of induction motor drives.

CO5: Analyze the operation and control of synchronous, Permanent Magnet Synchronous Motor, BLDC, stepper, and switched reluctance motor drives.

Course Contents:

Unit-I: Basics of Electric Drives and Control **08 Hours**

Definition, Advantages of electrical drives, Components of Electric drive system, Selection Factors, status of Electrical Drives (DC & AC), speed control and drive classifications, close

loop control of drives, phase locked loop (PLL) control.

Unit-II: Selection of Motor Power Rating 08 Hours

Thermal model of motor for heating and cooling-Relationship between temperature rise and time, Heating time constant, Cooling time constant. classes of motor duty- continuous duty, short time duty, intermittent periodic duty, intermittent periodic duty with starting, intermittent periodic duty with starting & braking, continuous duty with intermittent periodic loading, continuous duty with starting & braking, Continuous duty with periodic speed changes. Determination of motor ratings, Selection of power ratings of motor -continuous duty and constant load, continuous duty and variable load, Short time rating of motor.

Unit-III: DC Motor Drives 08 Hours

DC motors and their performance starting, transient analysis, speed control, Controlled rectifier fed drives, full controlled 3 phase rectifier control of dc separately excited motor, Multi quadrant operation, Chopper controlled drives closed loop speed control of DC motor.

Unit-IV: Induction Motor Drives 08 Hours

Induction motor analysis, starting and speed control methods- voltage and frequency control, current control, closed loop control of induction motor drives, rotor resistance control, Slip power recovery: Static Kramer and Scherbius Drive, Single phase induction motor starting, braking and speed control.

Unit-V: Special Purpose Motor Drives 08 Hours

Synchronous motor types, operation with fixed frequency, variable speed drives, Permanent Magnet Synchronous Motor and BLDC motor drives, Stepper motor drives, switch reluctance motor drives.

Learning Resources:

Text Books:

1. G. K. Dubey, Fundamentals of Electrical Drives, 2nd Edition (sixth reprint), Narosa Publishing House, 2001.
2. M. L. Soni, P.V. Gupta, U. S. Bhatnagar, “A course in Electrical Power”, 1999, Dhanpat Rai & Sons.

Reference Books:

1. M. H. Rashid, Power Electronics -Circuits, devices and Applications, 3rd Edition, PHI Pub. 2004.
2. B. K. Bose, Modern Power Electronics and AC Drives, Pearson Education, Asia, 2003.

Web link for MOOC / NPTEL Links:

1. http://nptel.ac.in/courses/108104140

List of Practicals:

1. Based on Basics of Electric Drives and Control.
2. Based on Selection of Motor Power Rating.
3. Based on DC Motor Drives.
4. Based on Induction Motor Drives.
5. Based on Special Purpose Motor Drives.
6. Mini project/case study on Electrical drives.
7. Seminar on Electrical drives.
8. Industrial Visit to electrical drive and control industry and prepare report..

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