**Bansilal Ramnath Agarwal Charitable Trust's**

# Vishwakarma Institute of Technology

*(An Autonomous Institute affiliated to Savitribai Phule Pune University)*

**NEP Compliant Structure & Syllabus**

**of**

## Department of Civil Engineering

**S. Y. B. Tech. (Pattern 2025)**

**For Academic Year 2026-27**

**by: - Board of Studies in Civil Engineering**

**Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune**

# Contents

## Program Outcomes

**PO1: Engineering Knowledge**: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively 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)

**Academic Information – Please visit www.vit.edu**

**Program Specific Outcomes (PSO):**

**PSO1:** Engineering graduates will be able to plan and execute the activities of construction projects

**PSO2:** Engineering graduates will be able to analyze and design components of Civil Engineering Systems.

**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 in 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.

## Vishwakarma Institute of Technology

Issue 1 : Rev No. 00: Dt. 03/07/26

**Title : Course Structure**

FF No. 653_A

**Branch : Civil Engineering** **Year: S.Y.** **Academic Year : 2026-27** **Semester: I** **Module: 3 & 4** **Pattern: 2025**

| Level 5 | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | NEP Course Category | Course Name | Teaching Scheme (Hrs./week) | | | Examination Scheme and Marks | | | | | | | | | | | | | Credits | | | |
| | | | Theory | Tutorial | Practical | CVV | CP | LAB/ TUT | GD/ PPT | HA | MSE (W) | MSE (R) | MSE (O) | ESE (R) | ESE (W) | ESE (O) | PRACT+ CVV | ESE-Direct Evaluation | Theory | Tutorial | Practical | Total |
| **Semester III** | | | | | | | | | | | | | | | | | | | | | |
| **Courses in Semester 1 Irrespective of Module** | | | | | | | | | | | | | | | | | | | | | |
| CV2003 | PCC | Fluid Mechanics | 2 | - | 2 | 20 | 30 | 10 | - | - | - | - | - | - | 40 | - | - | - | 2 | 0 | 1 | 3 |
| CV2004 | PCC | Water Supply Engineering | 2 | - | 2 | 20 | 30 | 10 | - | - | - | - | - | - | 40 | - | - | - | 2 | 0 | 1 | 3 |
| CV2005 | PCC | Concrete Technology* | 3 | - | 2 | - | 20 | - | - | - | - | - | - | - | 40 | - | 40 | - | 3 | 0 | 1 | 4 |
| CV2006 | PCC | Mechanics of Solids | 2 | - | 2 | 20 | 30 | 10 | - | - | 40 | - | - | - | - | - | - | - | 2 | 0 | 1 | 3 |
| MM0204 | MDC | Statistics and Probability | 2 | 1 | - | 20 | 20 | - | - | 20 | 40 | - | - | - | - | - | - | - | 2 | 1 | 0 | 3 |
| HS2002 | HSSM | From Campus to Corporate 1 | 2 | - | - | - | - | - | - | - | - | 50 | - | 50 | - | - | - | - | 2 | 0 | 0 | 2 |
| HS2001 | AEC | Reasoning and Aptitude Development 3 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 100 | 0 | 1 | 0 | 1 |
| **Module 3** | | | | | | | | | | | | | | | | | | | | | |
| CV2015 | VSEC | Practical Skill Training Program | 1 | - | 4 | - | - | - | - | - | - | 30 | | 70 | - | - | - | 100 | 1 | 0 | 2 | 3 |
| **Module 4** | | | | | | | | | | | | | | | | | | | | | |
| CV2016 | VSEC | Construction Management Practice | 2 | - | 2 | - | - | - | - | - | - | 30 | | 70 | - | - | - | 100 | 2 | 0 | 1 | 3 |
| **Total** | | | **15/14** | **2** | **12/10** | **80** | **130** | **30** | **-** | **20** | **80** | **80** | **-** | **120** | **120** | **-** | **40** | **200** | **14/15** | **2** | **6/5** | **22** |

* External Pract+CVV

| Abbreviations Used | |
|---|---|
| PPT | Powerpoint Presentation |
| GD | Group Discussion |
| CVV | Comprehensive Viva Voce |
| LAB | Laboratory |
| TUT | Tutorial |
| CP | Course Project |
| PR | Practical |
| HA | Home Assignment |
| MSE | Mid Semester Examination |
| ESE | End Semester Examination |
| R /W/O | Review /Written/Online |

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## Vishwakarma Institute of Technology

Issue 1 : Rev No. 00: Dt. 03/07/26

FF No. 653_A

**Title : Course Structure**

**Branch : Civil Engineering** **Year: S.Y.** **Academic Year : 2026-27** **Semester: II** **Module: 3 & 4** **Pattern: 2025**

| Level 5 | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Code | NEP Course Category | Course Name | Teaching Scheme (Hrs./week) | | | Examination Scheme and Marks | | | | | | | | | | | | | Credits | | | |
| | | | Theory | Tutorial | Practical | CVV | CP | LAB/ TUT | GD/ PPT | HA | MSE (W) | MSE (R) | MSE (O) | ESE (R) | ESE (W) | ESE (O) | PRACT+ CVV | ESE-Direct Evaluation | Theory | Tutorial | Practical | Total |
| **Semester IV** | | | | | | | | | | | | | | | | | | | | | | |
| **Courses in Semester 1 Irrespective of Module** | | | | | | | | | | | | | | | | | | | | | | |
| CV2008 | PCC | Structural Analysis | 2 | - | 2 | 20 | 30 | 10 | - | - | - | - | - | - | 40 | - | - | - | 2 | 0 | 1 | 3 |
| CV2009 | PCC | Geomatics Engineering | 2 | - | 2 | 20 | 30 | 10 | - | - | - | - | - | - | 40 | - | - | - | 2 | 0 | 1 | 3 |
| CV2010 | PCC | Wastewater Engineering | 2 | - | 2 | 20 | 30 | 10 | - | - | 40 | - | - | - | - | - | - | - | 2 | 0 | 1 | 3 |
| CV2011 | PCC | Geotechnical Engineering* | 3 | - | 2 | - | 20 | - | - | - | - | - | - | - | 40 | - | 40 | - | 3 | 0 | 1 | 4 |
| MM0205 | MDC | Optimization Techniques | 2 | 1 | - | 20 | 20 | - | - | 20 | 40 | - | - | - | - | - | - | - | 2 | 1 | 0 | 3 |
| HS2003 | HSSM | From Campus to Corporate - 2 | 2 | - | - | - | - | - | - | - | - | 50 | - | 50 | - | - | - | - | 2 | 0 | 0 | 2 |
| HS2004 | AEC | Reasoning and Aptitude Development - 4 | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | 100 | 0 | 1 | 0 | 1 |
| **Module 3** | | | | | | | | | | | | | | | | | | | | | | |
| CV2015 | VSEC | Practical Skill Training Program | 1 | - | 4 | - | - | - | - | - | - | 30 | | 70 | - | - | - | 100 | 1 | 0 | 2 | 3 |
| **Module 4** | | | | | | | | | | | | | | | | | | | | | | |
| CV2016 | VSEC | Construction Management Practice | 2 | - | 2 | - | - | - | - | - | - | 30 | | 70 | - | - | - | 100 | 2 | 0 | 1 | 3 |
| **Total** | | | 14/15 | 2 | 12/10 | 80 | 130 | 30 | - | 20 | 80 | 80 | - | 120 | 120 | - | 40 | 200 | 14/15 | 2 | 6/5 | 22 |

* External Pract+CVV

| Abbreviations Used | |
|---|---|
| PPT | Powerpoint Presentation |
| GD | Group Discussion |
| CVV | Comprehensive Viva Voce |
| LAB | Laboratory |
| TUT | Tutorial |
| CP | Course Project |
| PR | Practical |
| HA | Home Assignment |
| MSE | Mid Semester Examination |
| ESE | End Semester Examination |
| R /W/O | Review /Written/Online |

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# CV2003: Fluid Mechanics

| Teaching Scheme | Examination Scheme |
|---|---|
| Credits: 3 | CP: 30 Marks |
| Lectures: 2 Hrs/week | CVV: 20 Marks |
| Practical: NA | LAB (CA): 10 Marks |
| Tutorial: 1 Hrs/week | ESE (W): 40 Marks |

| **Prerequisites:** | |
|---|---|
| ● | Basic mathematics, Basic physics /mechanics |

| **Course Objectives:** | |
|---|---|
| ● | To introduce the fundamental concepts of properties of fluid, measurement of fluid pressure and dimensional analysis |
| ● | To develop an understanding about fluid statics by virtue of pressure acting on surfaces and buoyancy |
| ● | To introduce the fundamental equation of fluid mechanics namely continuity equation, energy equation and momentum equation and understand their applications |
| ● | To study laminar and turbulent flow through pipes |
| ● | To impart knowledge about boundary layer and flow around submerged bodies |

| **Course Outcomes:** | |
|---|---|
| | After completion of the course, student will be able to |
| 1. | Determine fluid density, Specific Weight, viscosity, compressibility surface tension, capillary rise and establish relation between various fluid, flow, geometrical properties using Buckingham Pi Theorem |
| 2. | Determine fluid pressure at a point, total pressure, centre of pressure, metacentric height using principles of fluid statics |
| 3. | Determine velocity, acceleration, discharge of fluid flow using principles of fluid kinematics. |
| 4. | Determine velocity, acceleration, discharge of fluid flow using energy equation and momentum equation. |
| 5. | Determine velocity, discharge, shear stress for laminar flow through circular pipes |
| 6 | Determine velocity, discharge, for turbulent flow through pipes, pipes in series, pipes in parallel. |
| 7 | Determine drag, lift forces on flat plate, cylinder and air foil by applying boundary layer theory |

| **Section1:** |
|---|
| Properties of Fluid, Fluid pressure analysis and measurement; Hydrostatic forces on plane and curved surfaces, Buoyancy and flotation, stability conditions, metacentric height, Dimensional analysis using Buckingham's π theorem. |

| **Section2:** |
|---|
| Types of flow, Equation of Continuity, momentum equation, Energy equation, Bernoulli's principle, Venturimeter, orifice meter, flow visualization, Potential function, and stream function, Potential function, flow net. |

| **Section 3** |
|---|
| Laminar Flow through pipes, Hagen Poiseuille equation, Turbulent flow through pipes, Darcy-Weisbach equation for flow through pipes, friction factor, friction factor, Moody diagram, pipes in series and parallel, minor losses |

| **Section 4** |
|---|
| Boundary layer concept, Development of boundary layer on flat plate, boundary layer separation, drag and lift on sphere and cylinder, drag on flat plate, Magnus effect, lift on air foil, Polar diagram. |

| **Text Books:** *(As per IEEE format)* | |
|---|---|
| 1 | *F.M. White, Fluid Mechanics, McGraw Hill, 1994* |
| 2 | *V.L. Streeter and E.B. Wylie, Fluid Mechanics, McGraw Hill, 1997* |
| 3 | *P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics, Standard Book House, 1998* |
| **Reference Books:** *(As per IEEE format)* | |
| 1 | *M.K. Goyal, Fluid Mechanics and Hydraulic Machines, PHI Learning, 2015* |
| 2 | *K. S. Massey, Mechanics of Fluids, Van Nostrand Reinhold Co., 1979* |
| 3 | *J. Frabzini, Fluid Mechanics with Engineering Applications, McGraw Hill, 1997* |

**List of Practical's: (any 8)**

1. Measurement of surface tension in a given liquid
2. Determination of metacentric height.
3. Drawing of flow net by electrical analogy for flow below weir (with / without sheet pile)
4. Experimental verification of Bernoulli's theorem with reference to loss of energy
5. Calibration of Venturimeter
6. Study of laminar flow using Heleshaw's apparatus

7. Determination of friction factor for a given pipe
8. Flow around a Circular Cylinder
9. Flow around an aerofoil

**List of Project areas:**

Fluid pressure analysis and measurement, Buoyancy and flotation, metacentric height, Dimensional analysis, Bernoulli's principle and its applications, flow visualization, flow net, Laminar and Turbulent flow through pipes, friction factor, pipes in series and parallel, minor losses, Boundary layer theory, drag and lift on submerged bodies, Fluid Mechanics Applications in Civil Engineering using advanced techniques and or AI techniques, energy Conservation and Optimization in Fluid Systems.

## CO – PO / PSO Articulation Matrix

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | -- | -- | -- | -- | 1 | -- | 1 | 1 | -- | 2 | -- | 2 |
| CO2 | 3 | -- | -- | -- | -- | 1 | -- | 1 | 1 | -- | 2 | -- | 2 |
| CO3 | 3 | -- | -- | -- | -- | 1 | -- | 1 | 1 | -- | 2 | -- | 2 |
| CO4 | 3 | -- | -- | -- | -- | 1 | -- | 1 | 1 | -- | 2 | -- | 2 |
| CO5 | 3 | -- | -- | -- | -- | 1 | -- | 1 | 1 | -- | 2 | -- | 2 |
| Avg | 3 | -- | -- | -- | -- | 1 | -- | 1 | 1 | -- | 2 | -- | 2 |

## CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | |
| CO2 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | |
| CO3 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | |
| CO4 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | |
| CO5 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | |

## CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | | | ✓ |
| CO2 | ✓ | ✓ | ✓ | | | | ✓ |
| CO3 | ✓ | ✓ | ✓ | | | | ✓ |
| CO4 | ✓ | ✓ | ✓ | | | | ✓ |
| CO5 | ✓ | ✓ | ✓ | | | | ✓ |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | |
| CO2 | ✓ | ✓ | ✓ | | |
| CO3 | ✓ | ✓ | ✓ | | |
| CO4 | ✓ | ✓ | ✓ | | |
| CO5 | ✓ | ✓ | ✓ | | |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | 6,11,13 | Helps in understanding basic principles of fluid mechanics which are required for water purification process (SDG 6) and to study of effect of climate on water resources basic principles of fluid mechanics are required (SDG 13) |
| CO2 | 6,11,13 | Helps in understanding basic principles of fluid mechanics which are required for water purification process (SDG 6) and to study of effect of climate on water resources basic principles of fluid mechanics are required (SDG 13) |
| CO3 | 6,11,13 | Helps in understanding basic principles of fluid mechanics which are required for water purification process (SDG 6) and to study of effect of climate on water resources basic principles of fluid mechanics are required (SDG 13) |
| CO4 | 6,11,13 | Helps in understanding basic principles of fluid mechanics which are required for water purification process (SDG 6) and to study of effect of climate on water resources basic principles of fluid mechanics are required (SDG 13) |
| CO5 | 6,11,13 | Helps in understanding basic principles of fluid mechanics which are required for water purification process (SDG 6) and to study of effect of climate on water resources basic principles of fluid mechanics are required (SDG 13) |
| CO6 | 6,11,13 | Helps in understanding basic principles of fluid mechanics which are required for water purification process (SDG 6) and to study of effect of climate on water resources basic principles of fluid mechanics are required (SDG 13) |

**FF No.: 654-A**

## CV2004: Water Supply Engineering

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Credits: 3 | CP: 30 Marks |
| Lectures: 2 Hrs/week | Lab Exam: 10 Marks |
| Practical: 2 Hrs/week | CVV: 20 Marks |
| Tutorial: NA | ESE(W): 40 Marks |
| | |
| | |

| | |
|---|---|
| **Prerequisites:** | |
| ● | Basic Civil Engineering |
| **Course Objectives:** | |
| ● | Understand basic process of domestic water treatment plant |
| **Course Outcomes:** | |
| | After completion of the course, student will be able to |
| 1. | Explain water supply system, characteristics of water and estimate water requirements along with its conveyance. |
| 2. | Explain the process of aeration, coagulation, flocculation, sedimentation.. |
| 3. | Understand the process of filtration and disinfection |
| 4. | Explain advanced treatment systems through Membrane filtration, adsorption, Ion Exchange Process, and packaged drinking water plant and to explain the water distribution system, leakage, and maintenance. |
| **Section1:** | Water demand, quality, quantity and Conveyance |
| Water supply system: Introduction, components Water demand: Usage and rates, governing factors, variation, estimation (present, intermediate, and ultimate) Water Quality: Physical, chemical, and biological parameters, IS 10500-2012, quantity of water required, population forecasting Source works: Intake (types and location), types of river intake, jack well, pumping system, power and capacity of pump, conveyance system, forces acting, materials (Ductile Iron, Mild steel, and Plastic), laying of pipes, hydraulic analysis. Appurtenances: Valves type, thrust block concept. | |
| **Section2:** | Water treatment (Aeration, mixing and settling) |
| Treatment: Philosophy, unit processes and operations Aeration: process, types of aerators, design of cascade aerator Coagulation: Physics and chemistry, practice, design of rapid mixer Flocculation: Theory, design of clariflocculator. Settling: Theory, types of settling tanks, design of rectangular and circular types sedimentation tank. Concept of for type 1 and 2 settling. | |
| **Section 3** | Water treatment (Filtration and disinfection) |
| Granular Filtration: Classification, theory of deep mono and dual bed filter, components of deep bed filter, clean filter bed head loss, filter operation, problems in filtration. Disinfection: Types, kinetics, chlorination, chemistry of chlorination, Chicks law, chlorine demand, chlorination practice, UV and Ozone disinfection. | |
| **Section 4** | Advanced water treatment, Water distribution and Operation-Maintenance |
| Membrane filtration: Types, basic concepts, applications. Adsorption: Introduction, basics of carbon Adsorption. Ion Exchange: Theory and principal of softener, package drinking water plant concept, concept of 24x7 water supply and SCADA system. Water distribution: Methods, system configurations, hydraulic and functional requirements. Service reservoirs: Necessity, components, location, head, and capacity Leakage: Causes, detection and control Water quality in distribution, Operation and maintenance: Water supply system | |

**Text Books:** ***(As per IEEE format)***

| | |
|---|---|
| 1 | S.K. Garg, Water Supply Engineering Vol. -1, Khanna Publication, New Delhi. |
| 2 | B C Punmia, Environmental Engineering Vol. -1, Laxmi Publication, New Delhi |

**Reference Books:** ***(As per IEEE format)***

| | |
|---|---|
| 1 | G.S. Birdi -, Water supply & Sanitary Engg. Laxmi publications (p) Ltd. New Delhi |
| 2 | Mark J., Water & waste Water technology. Hammer, Prentice – Hall of India, New Delhi |
| 3 | H.S. Paeavy& D.R. Rowe, Environmental Engineering. McGraw Hill Book Co. New Delhi |
| 4 | G.M. Fair & J.C. Geyer, 1968, Water & Waste Water Technology. New York, NY, John Wiley &Sons Incorporated |

**List of Practical's:** – (Any Six of the following)

1. Determination of pH and Alkalinity from water.
2. Determination of Hardness from water.
3. Determination of chlorides from water
4. Determination of optimum dose of alum.
5. Determination of chlorine dose and chlorine demand.
6. Determination of Iron or Manganese from water.
7. Determination of sulphate from water.
8. Determination of fluoride from water.
9. Design of 1MLD WTP in spread sheet or any software.
10. Site Visit on WTP describing Unit Operations in Water Treatment.
11. List of Assignments
    a) Study of Plumbing fixture and accessories.
    b) Types of Intake Structures
    c) Automation in Water Supply.

**List of Project areas:**

1. Assessment of drinking water quality in a local area.
2. Analysis of physical, chemical, and biological water quality parameters.
3. Water quality monitoring using IoT sensors.
4. Seasonal variation in water quality of rivers or lakes.
5. Rainwater harvesting with treatment for potable use.
6. Solar-powered water purification systems.
7. Low-cost household water purification methods.
8. Natural treatment systems using bio-sand filters.
9. Sustainable treatment technologies for rural communities.
10. Smart water distribution and monitoring using IoT.
11. Leak detection in water supply networks.
12. Evaluation of municipal drinking water treatment efficiency.
13. Laboratory model of a water treatment plant.
14. Effectiveness of natural coagulants (e.g., moringa seeds, alum, cactus extract).
15. Removal of turbidity using locally available materials.
16. Comparative study of different filter media (sand, activated carbon, gravel).
17. Artificial intelligence for water quality prediction.

## CO – PO / PSO Articulation Matrix

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 2 | – | 2 | – | 2 | 1 | – | – | – | 1 | 1 | – |
| CO2 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | – | ----- | – | 1 | 1 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | – | ---- | – | 1 | 1 | 2 |
| CO4 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | – | – | – | 1 | 1 | 2 |
| Avg | 3 | 2 | 2 | 2 | 1 | 2 | 1 | -- | ----- | -- | 1 | 1 | 2 |

## CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | | ✓ | ✓ | | | ✓ | | | |
| CO2 | | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ |
| CO3 | | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ |
| CO4 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |

## CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| CO2 | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| CO3 | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| CO4 | ✓ | | ✓ | ✓ | | ✓ | ✓ |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | | | ✓ | |
| CO2 | ✓ | | | ✓ | |
| CO3 | ✓ | | | ✓ | |
| CO4 | ✓ | | | ✓ | |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | SDG 3, 6, | Water demand, quality, quantity and Conveyance of water to people leads to Health & Well-being, Clean Water and Sanitation |
| CO2 | SDG 3,6,11,12 | Water treatment process of aeration, coagulation, flocculation, sedimentation leads to Health & Well-being, Clean Water and Sanitation, Sustainable Urban Development, Sustainable Consumption on land |
| CO3 | SDG 3,6,11,12,13 | Water treatment process of filtration and disinfection leads to Health & Well-being, Clean Water and Sanitation, Sustainable Urban Development, Sustainable Consumption on land and climate mitigation |
| CO4 | SDG 3,6,11,12,13,14 | Advanced treatment systems of water leads to Health & Well-being, Clean Water and Sanitation, Sustainable Urban Development, Sustainable Consumption on land , climate mitigation and conservation of life below water |

**FF No.: 654-A**

## CV2005: Concrete Technology

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Credits : 4 | CP: 20 Marks |
| Lectures : 3 Hrs/week | GD/PPT/HA: Marks |
| Practical : 2 Hrs/week | PRACT+CVV: 40 Marks |
| Tutorial : NA Hrs/week | ESE (W): 40 Marks |

| | |
|---|---|
| **Prerequisites:** | Basic civil Engineering, Engineering Materials |
| • | |
| **Course Objectives:** | |
| 1. | To prepare the students to understand various types of cements their properties and applications.<br>To prepare the students to understand aggregate, water and admixtures. |
| 2. | To prepare the students to learn how to decide the quality of concrete based on various tests. |
| 3. | To prepare students to understand and conduct test on hardened and understand types of special concrete in construction. |
| 4. | To prepare students to understand concrete equipment and special concrete techniques. |
| 5. | To train the students to design of concrete various grades for desire strength and durability. |
| 6. | To prepare the students to understand causes of deterioration and its repair method. |
| **Course Outcomes:** | |
| | After completion of the course, student will be able to |
| 1. | **Explain** the properties, characteristics, applications, and selection criteria of cement, aggregates, water, and admixtures used in concrete production |
| 2. | **Perform** laboratory tests on fresh concrete and **interpret** the test results to assess its quality and workability. |
| 3. | **Conduct** tests on hardened concrete and **evaluate** its strength, and other engineering properties as per relevant standards. **Explain** the properties, applications, and advantages of special concretes used in construction. |
| 4. | **Describe** the various concrete equipments and special concrete techniques |
| 5. | **Design** concrete mixes of different grades to achieve the specified strength, workability, and durability requirements in accordance with IS code provisions. IS 10262:2019, IS 456:2000 |
| 6. | **Assess** the causes of concrete deterioration and **recommend** appropriate repair and rehabilitation techniques for damaged concrete structures. |
| **Section1** | **Unit I – Introduction to Concrete as a Construction Material** Cement – manufacture of Portland cement, basic chemistry of cement, hydration of cement, classification of cement, types of cement, tests on cement-field tests & laboratory tests, Fly Ash: Classification of fly ash , properties of fly ash, tests on fly ash.<br>Aggregate and water – Different classifications, fine aggregate, coarse aggregate , mechanical properties, physical properties, deleterious materials, soundness, alkali-aggregate reaction, sieve analysis, fineness tests on aggregates, artificial and recycled aggregate, mixing water, curing water, tests on water.<br>Admixtures – functions, classification, types: mineral and chemical, IS: specifications (9103 and 456), compatibility of admixtures. |
| **Section1** | **Unit II – Properties, Production and Placement of Concrete**<br>**Fresh concrete:** workability – factors affecting workability, cohesion and segregation, Bleeding, Laitance, workability tests, mixing- handling, placing and compaction of concrete, Influence of temperature, maturity rule.<br>**Hardened concrete:** strength of concrete, factors affecting strength, micro-cracking and stress-strain relationship, other strength properties, relation between tensile and compression strength, impact strength, abrasion resistance, elasticity and creep, shrinkage and swelling. |
| **Section1** | **Unit III – Testing of Concrete & Special Concretes**<br>**Testing of concrete**: Testing of fresh concrete, testing of hardened concrete compression test on cube and cylinder, flexural test, indirect tensile strength, core test.<br>**Non destructive testing:** Rebound hammer, ultrasonic pulse velocity, pullout test and impact echo test, rebar locator. |

| | |
|---|---|
| | **Special concretes:** Light weight concrete, cellular light weight concrete-Foam concrete and autoclave C.L.C, polymer concrete, types of fibers, fiber reinforced Concrete, ferrocement, high density concrete, self-compacting concrete and its applications, high strength concrete, high performance concrete |
| **Section2** | **Unit IV – Special Concreting Techniques**<br>Introduction to concrete related equipment: batching plants, hauling, pumps, Types of concrete mixers –Tilting, Non tilting and reversible drum mixer, types of vibrators<br>Special concreting techniques: pumping of concrete, under water concreting, ready mix concrete, roller compacted concrete cold weather concreting, hot weather concreting. |
| **Section2** | **Unit V – Concrete Mix Design**<br>Concepts of Mix Design, factors for proportioning of concrete. Factors to be considered, statistical quality control, laboratory trial mixes and guidelines to improve mix<br>Methods of mix design- IS (10262-2019, IS 456:2000), demonstration and application of concrete mix design software and on the base AI tools |
| **Section2** | **Unit VI – Deterioration and repairs**.<br>Deterioration: permeability and durability, chemical attack and sulphate attack by seawater, acid attack, chloride attack, carbonation of concrete and its determination, corrosion of reinforcement.<br>Repairs: Symptoms and diagnosis of distress, evaluation of cracks, selection of repair procedure, repair of defects, common types of repairs, shotcrete, Introduction of retrofitting by using FRP, carbon fibers etc, Corrosion monitoring techniques & preventive measures. |
| | |

| **Text Books:** | |
|---|---|
| 1 | M. S. Shetty, **Concrete Technology*: *Theory and Practice**, 8th ed. New Delhi, India: S. Chand Publishing, 2019. |
| 2 | A. R. Santhakumar, **Concrete Technology**, 2nd ed. New Delhi, India: Oxford University Press, 2018. |
| 3 | M. L. Gambhir, **Concrete Technology: Theory and Practice**, 6th ed. New Delhi, India: McGraw Hill Education (India) Pvt. Ltd., 2017. |
| **Reference Books:** | |
| 1 | A. M. Neville, *Properties of Concrete*, 5th ed. Harlow, U.K.: Pearson Education Limited, 2011. |
| 2 | R. S. Varshney, *Concrete Technology*, 2nd ed. New Delhi, India: Oxford & IBH Publishing Co. Pvt. Ltd., 2005. |
| 3 | A. M. Neville and J. J. Brooks, *Concrete Technology*, 2nd ed. Harlow, U.K.: Pearson Education Limited, 2010. |
| 4 | D. B. Divekar, *Ferrocement Construction Manual*. Pune, India: D. B. Divekar Publications, 2000. |
| 5 | A. P. Remedios, *Concrete Mix Design*. Mumbai, India: Himalaya Publishing House Pvt. Ltd., 2015. ISBN: 978-81-8318-996-5. |
| 6 | P. K. Mehta, *Concrete: Microstructure, Properties, and Materials*, 4th ed. New York, NY, USA: McGraw-Hill Education, 2014. |
| 7 | R. N. Raikar, *Learning from Failures: Deficiencies in Design, Construction and Service*. Mumbai, India: Raikar Bhavan Publications, 2007. |
| 8 | R. N. Raikar, *Structural Diagnosis*. Mumbai, India: Raikar Bhavan Publications, 1994. |
| 9 | G. Sabnis, *Concrete Mix Design*. Pune, India: Gajanan Book Publications, 2009 |
| **Handbooks:** | |
| 1 | Ambuja cement booklets on concrete |
| 2 | ACC booklets on concrete |
| **Codes:** | |
| 1 | IS 4031 all parts, IS 2386 all parts, IS 10262:2019, I.S. 456:2000 |
| **e – Resources:** | |
| 1 | Preview: Concrete Technology \| SWAYAM |

**List of Practical's:**

**A. List of Laboratory Experiment**

The term work shall consist of a journal giving details of all the following experiments.

1. Fineness and standard consistency of cement.
2. Initial and final setting time and soundness of cement.
3. Compressive strength of cement.
4. Moisture content, silt content, and Specific gravity of fine aggregate

5. Fineness modulus by sieve analysis of fine aggregate.
6. Moisture content , water absorption, and Specific gravity of coarse aggregate
7. Density of coarse aggregate and Fine Aggregate.
8. Fineness modulus by sieve analysis and gradation of coarse aggregates.
9. Concrete mix design by IS code method. concrete mix design on software and by using AI tools

Demonstration and application of

a. Workability of concrete by slump test, compaction factor, Vee Bee test, effect of admixture and retarders on setting time concrete.

b. Compressive strength test of concrete by crushing and Rebound hammer.

c. Indirect tensile strength and flexural strength of hardened concrete

**B.** Technical visits to Ready Mix Concrete Plant

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**List of Project areas:**

1. Concrete Materials Characterization and Sustainable Concrete
2. Fresh Concrete Properties and Production
3. Concrete Construction Technologies
4. Concrete Mix Design and Optimization
5. Mechanical and Durability Performance of Concrete
6. Concrete Construction Technologies
7. Concrete Repair, Rehabilitation and Retrofitting
8. AI, Machine Learning and Digital Technologies in Concrete Engineering

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## CO – PO / PSO Articulation Matrix

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO 1 | PSO 2 | |
| CO1 | 3 | 2 | – | – | 1 | – | 2 | – | – | – | – | 3 | 2 | – |
| CO2 | 3 | 3 | – | 2 | 2 | – | – | – | – | – | – | 3 | 2 | – |
| CO3 | 3 | 3 | 2 | 3 | 2 | – | 1 | – | – | – | – | 3 | 1 | – |
| CO4 | 2 | 2 | 2 | 1 | 2 | – | 2 | – | – | – | – | 2 | 1 | – |
| CO5 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | – | – | – | 1 | 3 | 2 | – |
| CO6 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | – | 2 | 2 | – |
| Avg | 3 | 2 | – | – | 1 | – | 2 | – | – | – | – | 3 | 2 | – |

## CO – WK Mapping (Knowledge & Attitude Profiles) `

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | – | – | – | – | – | – |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ | – | – | – | – |
| CO3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | – | – | – |
| CO4 | ✓ | ✓ | ✓ | ✓ | – | ✓ | ✓ | – | – |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | – |
| CO6 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## CO – WP Mapping (Complex Engineering Problems)

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | – | – | – | – | – | – |
| CO2 | ✓ | ✓ | ✓ | – | – | – | – |
| CO3 | ✓ | ✓ | ✓ | ✓ | – | – | – |
| CO4 | ✓ | ✓ | – | ✓ | ✓ | – | – |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO6 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | – | – | – | – |
| CO2 | ✓ | ✓ | – | – | – |
| CO3 | ✓ | ✓ | ✓ | – | – |
| CO4 | ✓ | ✓ | ✓ | ✓ | – |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO6 | ✓ | ✓ | ✓ | ✓ | ✓ |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | SDG 9, SDG 12 | Efficient selection and utilization of construction materials promotes sustainable industrial infrastructure and responsible consumption. |
| CO2 | SDG 9 | Quality control of fresh concrete enhances durability and reliability of infrastructure. |
| CO3 | SDG 9, SDG 11 | Testing and use of durable/special concretes improve resilient and sustainable infrastructure. |
| CO4 | SDG 9 | Efficient concreting equipment and modern construction technologies improve productivity and infrastructure quality. |
| CO5 | SDG 9, SDG 12 | Optimized concrete mix design minimizes material wastage and promotes sustainable construction through software and AI-based optimization. |
| CO6 | SDG 9, SDG 11, SDG 13 | Repair and rehabilitation extend the service life of structures, reduce demolition waste and lower embodied carbon. |

## CV2006: MECHANICS OF SOLIDS

| Teaching Scheme | Examination Scheme |
|---|---|
| Credits : 3 | CP: 30 Marks |
| Lectures : 2 Hrs/week | CVV: 20 Marks |
| Practical : 2 Hrs/week | MSE (W): 40 Marks |
| Tutorial : 0 Hrs/week | Lab CA:10 Marks |

| | |
|---|---|
| **Prerequisites:** | |
| | **Engineering Mechanics, Engineering Mathematics** |
| **Course Objectives:** | |
| | To prepare the students to draw Shear Force Diagram and Bending Moment Diagram for Simple, cantilever and Overhanging Beams |
| | To prepare the students to compute the shear stresses and flexural stresses in the simply supported and cantilever beam |
| | To prepare the students to compute the direct tresses and bending stresses induced in the short columns and buckling stresses in the long columns |
| | To prepare the students to identify the Principal Plane and Principal Stresses and also calculate the shear stress induced in the circular shaft due to torsion |
| **Course Outcomes:** | |
| | After completion of the course, student will be able to |
| 1. | Apply equilibrium equations to calculate the internal forces namely axial shear forces and bending moments for determinate beams and draw SFD and BMD |
| 2. | Determine and plot bending stress and shear stress distribution in determinate beams |
| 3. | Determine direct and bending stresses in the short columns and buckling stresses for long columns |
| 4. | Determine slope and deflection of determinate beams and compute the shear stresses induced in circular shaft due torsion |
| 5 | Compute the Tensile Strength/ Compressive Strength / Shear Strength / Flexural Strength/ Toughness of the materials by performing the experiments following BIS norms |

| | |
|---|---|
| **Section1:** | **Shear Force Diagram and Bending Moment Diagram** |

Calculation of Bending moment (BM) and shear force (SF) for statically determinate beams.BM and SF diagrams and salient features, Concept of axial force/thrust diagram

| | |
|---|---|
| **Section2:** | **Shear and Bending Stresses in Beams** |

**Bending Stresses in beams**: Theory of simple bending, Assumptions, Determination of bending stresses and its distribution, Section modulus of rectangular and circular sections (Solid and Hollow), I, T, L sections.
**Shear Stresses in beams**: Shear stress formula, Determination of shear stress and its distribution for beam sections of rectangular and circular sections (Solid and Hollow), I, T, L sections

| | |
|---|---|
| **Section 3** | **Direct and Bending Stresses and Introduction to Principal Stresses and Strains** |

**Short and Long Columns**: Direct and Bending Stresses Combined direct and bending stresses, eccentric load on short columns, kern of a section, eccentricity of load about both axes of section.
**Introduction to Principal Stresses and Strains**: Normal and tangential stresses, stress at a point on a plane, Principal stress, Principal planes, normal and shear stresses on oblique plane.

| | |
|---|---|
| **Section 4** | **Deflection due to Bending and Torsion of circular shafts** |

**Deflection of beams**: Relationship between moment, slope and deflection, Macaulay 's method, unit load method. Concept of Moment Area Method and Conjugate Beam Method.
**Torsion of circular shafts**: Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, transmission of power through circular shafts.

**Text Books:** ***(As per IEEE format)***


| | |
|---|---|
| 1 | *S.S. Rattan; Strength of Materials; Tata Mc Graw Hill Education Pvt. Ltd. New Delhi; 2011* |
| 2 | *S.Ramamrutham; Strength of Materials; Dhanapat Rai Publishing Company;2011* |
| 3 | *Dr. Sandhu Singh; Strength of Materials; Khanna Publishers;2013* |
| 4 | *S.B. Junnerkar and H.J. Shaha; Mechanics of Structures Vol. I; Charotar Publishing House;2012* |
| 5 | *Dr. R.K.Bansal ; Strength of Materials; Laxmi Publications (P) Ltd;2018* |


**Reference Books:** ***(As per IEEE format)***

| | |
|---|---|
| 1 | *S. Timoshenko and D.H.Young;Elements of Strength of Materials; East-West Press Ltd;2003* |
| 2 | *R.C.Hibbler; Structural Analysis", Pearson; 2017* |
| 3 | *E.P.Popov,; Mechanics of Materials; Prentice Hall Publishers;2017* |
| 4 | *F.L.Singer and Andrew Pytel; Strength of Materials; Harper and Row Publication;1987* |


**List of Practical's:**

Any 6 experiments from the following:

1) Tension Test on Mild steel and TMT Steel
2) Shear Test on Mild Steel and TMT Steel
3) Compression Test on Timber
4) Bending Test on Timber
5) Torsion test on mild steel and Aluminum
6) Izod and Charpy Impact test on mild steel, aluminum, brass and copper
7) Abrasion test on tile
8) Bending test on tile
9) Compression test on bricks
10) Experiment using Virtual Laboratory

**List of Project areas:**

1. Tension Test, Shear Test and Flexure Test on Cast Iron/Aluminum bar
2. Tension Test and Flexure Test on Mild Steel Flat bar
3. Shear Force, Bending Moment, Shear Stress and Bending Stress and Deflection at a point of a Simple Beam subjected to point loads, uniformly distributed load
4. Shear Force, Bending Moment, Shear Stress and Bending Stress and Deflection at a point of a Cantilever Beam subjected to point loads, uniformly distributed load
5. SFD and BMD for a simple beam, Cantilever beam, overhanging beam using any Software

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**CO – PO / PSO Articulation Matrix**

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 3 | 2 | - | - | 2 | - | - | 3 | 3 | | | | 2 | |
| CO2 | 3 | 2 | - | - | - | - | - | 3 | 3 | | | | 2 | |
| CO3 | 3 | 2 | - | - | - | - | - | 3 | 3 | | | | 2 | |
| CO4 | 3 | 2 | - | - | 2 | - | - | 3 | 3 | | | | 2 | |
| CO5 | 3 | - | - | - | - | - | 2 | 3 | 3 | - | - | 2 | - | |
| Avg | 3 | 2 | - | - | 1 | - | 1 | 3 | 3 | | | 1 | 2 | |

## CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | | ✓ | | | | | | |
| CO2 | ✓ | | ✓ | | | | | | |
| CO3 | ✓ | | ✓ | | | | | | |
| CO4 | ✓ | | ✓ | | | | | | |
| CO5 | ✓ | | ✓ | | | | | | |

## CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | | | | | | |
| CO2 | ✓ | | | | | | |
| CO3 | ✓ | | | | | | |
| CO4 | ✓ | | | | | | |
| CO5 | ✓ | | | | | | |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | | | | |
| CO2 | ✓ | | | | |
| CO3 | ✓ | | | | |
| CO4 | ✓ | | | | |
| CO5 | ✓ | | | | |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | 4 | COs are mapping with SDG 4 due to following learning outcomes:<br>• Develops analytical and problem-solving skills.<br>• Builds competency in engineering design and structural analysis.<br>• Prepares students for responsible engineering practice. |
| CO2 | 4 | |
| CO3 | 4 | |
| CO4 | 4 | |
| CO5 | 4,9 | In addition to SDG4, the CO is mapping with SDG 9 due to following additional learning outcome:<br>Promotes safe engineering practices |

**FF No.: 654-A**

## MM0204: Statistics and Probability

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Credits: 3 | CP: 20 Marks |
| Lectures: 2 Hrs/week | HA: 20 Marks |
| Practical: NA | MSE (W): 40 Marks |
| Tutorial: 1 Hrs/week | CVV: 20 Marks |

| | |
|---|---|
| **Prerequisites:** | |
| ● | Basic mathematics |
| **Course Objectives:** | |
| ● | To study the basics of statistics, measure central tendency. |
| ● | Develop statistical methods for correlation, regression analysis and curve fitting. |
| ● | Understand the principles of probability distribution. |
| ● | Explain the sampling theory, errors and chi distribution |
| **Course Outcomes:** | |
| | After completion of the course, student will be able to |
| 1. | Understand the basic concepts of Statistics and determine the basic statistical parameters |
| 2. | Interpret problems using concept of correlation and develop regression |
| 3. | Solve the problems related to probability and various probability distributions. |
| 4. | Apply the concept of sampling and carry out Hypothesis testing |
| 5. | Apply Chi-squared test to judge the goodness of fit |

| | |
|---|---|
| **Section1:** | **Basic Statistics** |
| Introduction, Measures of statistical parameters like central value (mean, median, mode), standard deviation, Skewness, moment, Kurtosis, coefficient of variation, measures of dispersion, quartile | |
| **Section2:** | **Correlation and Regression Analysis** |
| Correlation and regression –Karl Pearson's coefficient of correlation and rank correlation, problems, regression analysis-lines of regression | |
| **Section 3** | **Probability Distributions** |
| Basics of probability, Random variables (discrete and continuous), probability mass/density function, Binomial, Poisson, Exponential, and normal distributions- problems | |
| **Section 4** | **Sampling theory and Hypothesis testing** |
| Introduction, Population and Sample, Importance of sampling, Essentials of sampling, Methods of sampling, sample size determination, Introduction to sampling distributions, standard error, type-I and type-II errors. Level of Significance, Tests involving the Normal distribution, One-Tailed and Two-Tailed tests, P value. Special tests of significance for large samples and small samples (F test, chi- square, z, t- test) Chi-square distribution as a test of goodness of fit problems. | |

| **Text Books:** *(As per IEEE format)* | |
|---|---|
| 1 | *Gupta S.P., (2014), "Statistical Methods", 43rd edition, S. Chand Publication.* |
| 2 | *Gupta S.C., Kapoor V.K., (2002), "Fundamentals of Mathematical Statistics", 10th Edition, S. Chand Publication.* |
| 3 | *Grewal B.S., (2020), "Higher Engineering Mathematics ",42nd edition, Khanna Publishers.* |
| **Reference Books:** *(As per IEEE format)* | |
| 1 | *Johnson Richard A., Miller I., Freund J.E., (2016), "Probability and Statistics for Engineers", 9th edition, PHI publications* |
| 2 | *Rao G. S., (2018), "Probability and Statistics for Science and Engineering", 11th edition, Universities press publication – G Shankar Rao* |
| 3 | *Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Publishers, 9th Edition, 2014* |

**List of Practical's:**

Tutorial on:

1. central value
2. Central tendency, quartile
3. Correlation
4. Regression
5. Binomial and Poisson distribution

6. Normal distribution, exponential distribution
7. P value, F test
8. t test, Z test, Chi-square test

**List of Project areas:**

1. Statistical analysis of data pertaining to civil engineering
2. Correlation and regression analysis of various parameters involved in Civil Engineering
3. Fitting of distributions for various civil engineering data sets
4. Sampling and hypothesis testing for various civil engineering data

## CO – PO / PSO Articulation Matrix

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | -- | -- | 3 | -- | -- | -- | -- | -- | -- | 2 | -- | 1 |
| CO2 | 3 | -- | -- | 3 | -- | -- | -- | -- | -- | -- | 2 | -- | 1 |
| CO3 | 3 | -- | -- | 3 | -- | -- | -- | -- | -- | -- | 2 | -- | 1 |
| CO4 | 3 | -- | -- | 3 | -- | -- | -- | -- | -- | -- | 2 | -- | 1 |
| CO5 | 3 | -- | -- | 3 | -- | -- | -- | -- | -- | -- | 2 | -- | 1 |
| Avg | 3 | -- | -- | 3 | -- | -- | -- | -- | -- | -- | 2 | -- | 1 |

## CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | | ✓ | | | | | | | |
| CO2 | | ✓ | | | | | | | |
| CO3 | | ✓ | | | | | | | |
| CO4 | | ✓ | | | | ✓ | | | |
| CO5 | | ✓ | | | | ✓ | | | |

## CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | | ✓ | | | | |
| CO2 | ✓ | | ✓ | | | | |
| CO3 | ✓ | | ✓ | | | | |
| CO4 | ✓ | | ✓ | | | | |
| CO5 | ✓ | | ✓ | | | | |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | | | |
| CO2 | ✓ | ✓ | | | |
| CO3 | ✓ | ✓ | | | |
| CO4 | ✓ | ✓ | | | |
| CO5 | ✓ | ✓ | | | |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | 8,13 | Helps in understanding economic growth by analyzing data related to infrastructure (SDG 8) and study of effect of climate on various resources using the climatic data of past and future (SDG 13) |
| CO2 | 8,13 | Helps in understanding economic growth by analyzing data related to infrastructure (SDG 8) and study of effect of climate on various resources using the climatic data of past and future (SDG 13) |
| CO3 | 8,13 | Helps in understanding economic growth by analyzing data related to infrastructure (SDG 8) and study of effect of climate on various resources using the climatic data of past and future (SDG 13) |
| CO4 | 8,13 | Helps in understanding economic growth by analyzing data related to infrastructure (SDG 8) and study of effect of climate on various resources using the climatic data of past and future (SDG 13) |
| CO5 | 8,13 | Helps in understanding economic growth by analyzing data related to infrastructure (SDG 8) and study of effect of climate on various resources using the climatic data of past and future (SDG 13) |
| CO6 | 8,13 | Helps in understanding economic growth by analyzing data related to infrastructure (SDG 8) and study of effect of climate on various resources using the climatic data of past and future (SDG 13) |

**FF No.: 654-A**

## HS2002: From Campus to Corporate 1

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Credits: 2 | CP: - Marks |
| Lectures: Hrs/week | GD/PPT/HA: - Marks |
| Practical: Hrs/week | MSE (R): 50 Marks |
| Tutorial: Hrs/week | ESE (R): 50 Marks |

**FF No.: 654-A**

**HS2001: Reasoning and Aptitude Development 3**

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Credits: 1 | CP: 0 Marks |
| Lectures: 0 Hrs/week | GD/PPT/HA: 0 Marks |
| Practical: 0 Hrs/week | MSE (W/O): 0 Marks |
| Tutorial: 1 Hrs/week | ESE- Direct Evaluation: 100 Marks |

| | |
|---|---|
| **Prerequisites:** | Reasoning and Aptitude Development 1 & 2 |
| ● | |
| **Course Objectives:** | |
| ● | To develop effective reading, writing, listening, and verbal communication skills for academic, professional, and interpersonal interactions. |
| ● | To enhance logical reasoning, analytical thinking, and problem-solving abilities for making informed and rational decisions. |
| ● | To strengthen quantitative aptitude, mathematical reasoning, and data interpretation skills required for solving real-world and competitive examination problems. |
| ● | To cultivate effective time management, planning, prioritization, and decision-making skills for improving productivity and accuracy. |
| ● | To enable students to integrate communication, reasoning, and quantitative skills for critical thinking and solving practical engineering and real-world problems. |
| **Course Outcomes:** | |
| | After completion of the course, student will be able to |
| 1. | Improve the reading, writing and verbal skills, and enhance comprehension and articulation abilities |
| 2. | Develop logical reasoning abilities, enabling them to make sound decisions in problem solving scenarios |
| 3. | Develop mathematical aptitude as well as data interpretation abilities and use them in test cases and real-world problems |
| 4. | Learn to apply approaches for optimum time-management, prioritization maximizing the accuracy |
| 5. | Learn data interpretation, apply mathematical skills to draw accurate conclusions |
| 6. | Apply their knowledge of English, reasoning and quantitative skills for planning, critical thinking and real-world problems |

| | |
|---|---|
| **Section1:** | **English Language** |

Familiarity with English Language, Ability to understand written text, spoken word and effective communication through written documents; Coverage of vocabulary to cope up with general and specific terminology, syntax and sentence structure, prevention of incorrect use leading to distortion in communication; synonyms, antonyms and contextual vocabulary, Grammar – Error identification, sentence improvement and construction, Reading Comprehension

| | |
|---|---|
| **Section2:** | **Logical Ability** |

Objective interpretation of things, ability to perceive and interpret trends to make generalizations; ability to analyze assumptions behind an argument or statement; Deductive reasoning: Assessment of ability to synthesize information and derive conclusions - Coding deduction logic, Data Sufficiency, Directional Sense, Logical word sequence, Objective reasoning, Selection and decision tables, puzzles; Inductive reasoning: Assessment of ability to learn by example, imitation or by trial – Analogy pattern recognition, Classification pattern recognition, Coding pattern recognition, Number series pattern recognition; Abductive reasoning: Critical thinking ability of seeing through logical weak links or loopholes in an argument or a group of statements; Critical reasoning: assessment of ability to think through and analyze logical arguments, assessment of ability to use logical constructs to offer reasoning in unfamiliar situations; Information Gathering and synthesis: Ability of locating information, information ordering, rule based selection and data interpretation, order and classify data, interpret graphs, charts, tables and make rule based deductions. Application of these approaches for using visual, numerical and textual data from single or multiple sources

| | |
|---|---|
| **Section3:** | **Quantitative Ability** |

Basic numbers – decimals and fractions, factorization, divisibility: HCF, LCM, Odd, even, prime and rational numbers. Application of algebra to real world, direct and inverse proportion, common applications – Speed-time - distance, Profit-loss, percentage, age relations, mixtures, other miscellaneous quantitative combination, exponentials and logarithms, permutations and combinations, probability. Spatial reasoning: Inductive – Missing portions, Sequence and series; Deductive analysis.

| | |
|---|---|
| **Section4:** | **Automata Module:** |

Automata is a path breaking tool to evaluate programming skills in a simulated environment. With capability to evaluate programming code beyond correctness and ability to rate code quality, efficiency of execution and provide

objective norm-based scores.
Scientifically designed question bank consisting of a wide range of easy to hard programming problems with smartly designed corner and generic tests cases, Knowledge of algorithms, data structures, concepts like recursion, dynamic memory allocation and modular programming. The compiler supports multiple programming languages such as C, C++, Java, etc. The question bank includes distinct problem sets for IT Product and IT Services companies. B asic, advanced and edge test cases designed for a problem, the code is
checked thoroughly for correctness and completeness. It can evaluate the time complexity or simply the efficiency of the code. The code is scored on quality of the code based on industry defined best practice

| **Section5:** | **Automata Pro** |
|---|---|

It can be effectively used for fresher hiring as well as hiring lateral programmers. The assessment allows evaluation of actual programming skills of a candidate, giving the candidate an opportunity to write the program in an editor, compile and run test cases, all in the assessment environment itself.

| **Section6:** | **Automata Fix** |
|---|---|

Automata fix assesses the candidate's skill to diagnose and identify any bugs in code and fix them.

**Reference Books:** ***(As per IEEE format)***


| | |
|---|---|
| 1 | "English Grammar in Use" by Raymond Murphy, Cambridge University Press. |
| 2 | "Word Power Made Easy" by Norman Lewis, Goyal Publishers & Distributors. |
| 3 | "Objective General English" by S.P. Bakshi, Arihant Publications. |
| 4 | "English for Competitive Examinations" by K. Sinha, S. Chand Publishing. |
| 5 | "Essential English Grammar" by Philip Gucker, Wiley. |
| 6 | "English Idioms and Phrasal Verbs" by M.A. Yadav, Vikas Publishing House. |
| 7 | "The Oxford English Grammar" by Sidney Greenbaum, Oxford University Press. |
| 8 | "A Modern Approach to Verbal & Non-Verbal Reasoning" by R.S. Aggarwal, S. Chand Publishing, ISBN: 978-8121903409. |
| 9 | "Logical Reasoning and Data Interpretation for the CAT" by Nishit K. Sinha, Pearson India, ISBN: 978-8131709117. |
| 10 | "Logical Reasoning and Data Interpretation for the CAT" by Arun Sharma, McGraw Hill Education, ISBN: 978-0070709642. |
| 11 | "A New Approach to Reasoning Verbal and Non-Verbal" by B.S. Sijwali & Indu Sijwali, Arihant Publications, ISBN: 978-9311124692. |
| 12 | "Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal, S. Chand Publishing, ISBN: 978-8121900637. |
| 13 | "How to Prepare for Quantitative Aptitude for the CAT" by Arun Sharma, McGraw Hill Education, ISBN: 978-0070709642. |
| 14 | "The Pearson Guide to Quantitative Aptitude for Competitive Examination" by Pearson, Pearson India, ISBN: 978-8131709117. |
| 15 | "Quantitative Aptitude for Competitive Examinations" by Abhijit Guha, Tata McGraw Hill Education, ISBN: 978-0070666653. |
| 16 | "Data Interpretation & Data Sufficiency" by R.S. Aggarwal, S. Chand Publishing ISBN: 978-8121903515. |
| 17 | "Quantitative Aptitude for Competitive Examinations" by S. Chand, S. Chand Publishing, ISBN: 978-8121903423. |


**Reference Books for Automata Module:** ***(As per IEEE format)***


| | |
|---|---|
| 1 | "Data structures using C and C++", Y. Langsam, M.J. Augenstein, A.M.Tenenbaum, Pearson Education, Second Edition. |
| 2 | Programming Pearls" by Jon Bentley, ISBN 13: 978 1449357162, O'Reilly Media. |
| 3 | "Introduction to the Theory of Computation" by Michael Sipser, ISBN 13: 978 1133187790, Cengage Learning. |
| 4 | "Algorithms" by Robert Sedge wick and Kevin Wayne, ISBN 13: 978 0321573513, Publisher: Addison Wesley. |
| 5 | "Data Structures and Algorithm Made Easy", Narasimha Karumanchi, Fifth Edition, CareerMonk publication. |
| 6 | "The Art of Computer Programming" by Donald E. Knuth, Addison Wesley. |
| 7 | "Operating System Concepts" by Abraham Silberschatz, Henry Korth, and S. Sudarshan, ISBN10:1119946005, Wiley. |


**List of Practical's:**
Practice Test on:

1. English Tenses
2. Grammar and Syntax
3. Reading Comprehension

4. Deductive Reasoning
5. Inductive Reasoning
6. Abductive & Critical Reasoning
7. Information Gathering, Interpretation & Synthesis
8. Number System & Arithmetic Foundations
9. Algebraic Applications & Proportional Reasoning
10. Applied Quantitative Problem Solving
11. Advanced Quantitative & Spatial Reasoning
12. Automata Module – Programming Skill Evaluation
13. Automata Pro IT
14. Automata Pro Max

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**List of Project areas:**

1. N/A
2.
3.

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## CO – PO / PSO Articulation Matrix

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | - | - | - | - | - | - | - | - | 2 | 3 | - | 2 | 1 | |
| CO2 | 2 | 3 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 | |
| CO3 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 3 | |
| CO4 | - | 2 | 2 | - | - | - | - | 2 | 2 | - | 3 | 3 | 1 | |
| CO5 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 3 | |
| CO6 | 2 | 3 | 3 | 2 | 2 | 2 | - | - | 2 | 3 | 2 | 3 | 2 | |
| Avg | 2.5 | 2.6 | 2.2 | 2.0 | 2.0 | 2.0 | - | 2.0 | 2.0 | 3.0 | 2.5 | 2.3 | 2.0 | |

## CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | ✓ | ✓ | - | - | - | ✓ | - |
| CO2 | - | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | - |
| CO3 | - | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | - |
| CO4 | - | - | - | ✓ | - | ✓ | - | ✓ | - |
| CO5 | - | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | - |
| CO6 | - | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✓ | - |

## CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | - | - | - | - | - | |
| CO2 | ✓ | ✓ | ✓ | - | - | - | |
| CO3 | ✓ | ✓ | ✓ | ✓ | - | - | |
| CO4 | ✓ | - | ✓ | - | ✓ | - | |
| CO5 | ✓ | ✓ | ✓ | ✓ | - | - | |

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO6 | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✓ |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | - | - | ✓ | - |
| CO2 | ✓ | ✓ | ✓ | - | - |
| CO3 | ✓ | ✓ | ✓ | ✓ | - |
| CO4 | - | ✓ | - | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | - |
| CO6 | ✓ | ✓ | ✓ | ✓ | ✓ |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | 4 | Enhances English communication, comprehension, reading, writing, and articulation skills that promote lifelong learning and employability. |
| CO2 | 4, 16 | Develops logical reasoning, analytical thinking, and informed decision-making, supporting effective problem-solving and responsible professional practices. |
| CO3 | 4, 8, 9 | Strengthens mathematical aptitude and data interpretation skills essential for engineering analysis, innovation, and industry readiness. |
| CO4 | 4, 8 | Builds time-management, planning, and prioritization skills that improve productivity, professionalism, and workplace efficiency. |
| CO5 | 4, 9 | Develops quantitative analysis and data interpretation skills required for evidence-based engineering decisions and technological advancement. |
| CO6 | 4, 8, 9, 16 | Integrates communication, reasoning, quantitative aptitude, and critical thinking for solving real-world problems, enhancing employability, innovation, and responsible decision-making. |

## CV2015: Practical Skill Training Program

| Teaching Scheme | Examination Scheme |
|---|---|
| Credits: 3 | Attendance: 20 Marks |
| Lecture: 1 Hrs/week | CIE: 30 Marks |
| Practical: 4 Hrs/week | PPT/HA: 50 Marks |
| Tutorial: NA | CVV (W/O): 50 Marks |
| | ESE(Report): 50 Marks |

| **Prerequisites:** | |
|---|---|
| ● | Basic Civil Engineering |

| **Course Objectives:** | |
|---|---|
| ● | Understand the fundamentals of building construction, construction materials, site practices, and quality control measures. |
| ● | Develop practical skills in construction site execution, material testing, quantity estimation, and billing through laboratory work and field visits. |
| ● | Apply building bye-laws, UDCPR regulations, and architectural drawing standards in planning residential and public buildings. |
| ● | Develop proficiency in AutoCAD for preparing accurate 2D drawings and basic 3D models for engineering applications. |

| **Course Outcomes:** | |
|---|---|
| | After completion of the course, student will be able to |
| 1. | Explain construction techniques for excavation, foundations, RCC works, masonry, plastering, and tiling while following quality and safety practices. |
| 2. | Describe the principles of MEP services, construction materials, Ready Mix Concrete production, and quality testing procedures used in building construction. |
| 3. | Interpret building bye-laws, provisions, and architectural drawing standards to prepare and evaluate residential and public building drawings. |
| 4. | Prepare professional engineering drawings using AutoCAD by applying drafting standards, drawing tools, dimensioning, layers, blocks, and basic 3D modeling techniques. |

**Section1: Building Construction Practices and Site Execution**

**1: Excavation & Lay outing** - Fundamentals of excavation methods; Conventional lay outing using boundary line, tape, and level; Drawing interpretation for site layout; Introduction to Total Station – setup and data usage; Quantity estimation from excavation drawings; Site demo with quantity calculation and billing format

**2: Foundation & Substructure Works** - Types of footings (isolated, combined, raft); Excavation depth control, PCC, RCC footing; Waterproofing techniques in footings and plinths; Quality checks in compaction and concreting; Field visit to observe active foundation site

**3: RCC Formwork & Reinforcement** - Shuttering materials: Timber, Steel, Aluminum, Plastic; Formwork de-shuttering time, safety norms; Reinforcement cutting, bending, and fixing techniques; Cover blocks, chair bars, binding wire; Site checklist and test requirements for concrete; Demo of formwork setup and checklist formats

**4: Masonry, Plastering & Tiling** - Brick vs block masonry, bonds and jointing; Mortar mix ratio, curing, alignment and leveling; Internal and external plaster types; Tiling – layout, adhesives, spacer use, leveling; Defects and repairs; Hands-on demo with measurement sheet prep

**Section2: Building Services, Materials, and Quality Control**

5: Introduction to MEP Services - Electrical conduit & wiring layout; Plumbing: CPVC, UPVC, and SWR systems; Fire safety: detectors, hydrants, pipe routing; Coordination with RCC and finishes; Site marking, installation demo; Site visit to active MEP service installation

6: Building Materials & Testing - Cement, sand, aggregates, bricks, blocks, steel; Field identification & test methods; Lab tests: fineness, silt content, specific gravity, impact; Understanding standards and specifications; Measurement units and billing format basics

7: Ready Mix Concrete (RMC) Plant Visit - RMC plant process: batching, mixing, loading; Admixtures and grade control; Slump test, cube casting at site; Transport time tracking, placement precautions; Visit to batching plant and transit mixer unloading

8: Site Quality Laboratory Visit - Cube compressive test, silt content, NDT tools; Rebound hammer, ultrasonic pulse velocity; Sampling and testing methods; Lab documentation and reports; Checklist and compliance registers overview

**Section 3 Fundamentals of Building Planning**

Building Construction: Bye Laws, UDCPR (Unified Development Control and Promotion Regulations for

| |
|---|
| Maharashtra State)-Plot Sizes, Road Width, Open Spaces, Marginal Distances, Building Line, Control Line, Room Sizes, Area Calculations-Built-up Area, Carpet Area, Floor Space Index (F.S.I.), Transfer Development Rights (TDR), Norms for Ventilation, Lighting, Vertical Circulation, Sanitation, Parking Spaces of Vehicles. (Review)<br>**Building drawing:** Introduction to Architectural drawing: i) Line plan, ii) Developed Plan, iii) Elevation, iv) Section, Selection of scales for various drawings, dimensioning, abbreviations and conventions as per IS 962, Norms and Standards of Residential Building and Public Building, Planning Strategy includes Line Plan, Detailed Plan, Elevation, and Section (Teach Students to Draw Residential and Public Building Drawings – G+2 and Public buildings) |

| **Section 4** | **Introduction to AUTOCAD** |
|---|---|
| Introduction to AutoCAD Introduction to CAD, Function keys AutoCAD basics, Cartesian coordinate system, draw commands, modify commands, Annotate Dimension Style Manager, Text command Layers blocks, Parametric, 2D Fundamentals, Drawing Area Setup Visual reference, 2D drawings, Introduction to 3D drawings. CAD drawings of submission drawings. | |

| **Text Books:** ***(As per IEEE format)*** | |
|---|---|
| 1 | *All material will be provided by Industry* |
| 2 | *S. C. Rangwala, Building Construction, 35th ed. Anand, India: Charotar Publishing House, 2018.* |
| 3 | *M. G. Shah, C. M. Kale, and S. Y. Patki, Building Drawing with an Integrated Approach to Built Environment, New Delhi, India: Tata McGraw-Hill Education, 2002.* |
| 4 | *B. C. Punmia, A. K. Jain, and A. K. Jain, Building Construction, 11th ed. New Delhi, India: Laxmi Publications, 2016.* |
| 5 | *Autodesk, Mastering AutoCAD 2024 and AutoCAD LT 2024. Indianapolis, IN, USA: Sybex (Wiley), 2023.* |
| **Reference Books:** ***(As per IEEE format)*** | |
| 1 | *Indian Standards Institution, IS 962: Code of Practice for Architectural and Building Drawings. New Delhi, India: Bureau of Indian Standards.* |
| 2 | *Government of Maharashtra, Unified Development Control and Promotion Regulations (UDCPR) for Maharashtra State. Mumbai, India: Urban Development Department, Government of Maharashtra, 2020.* |
| 3 | *S. K. Duggal, Building Materials, 4th ed. New Delhi, India: New Age International Publishers, 2017.* |

**List of Practical's:**

1. Data drawing (for Load bearing/framed structure): Developed plan, elevation, section, site plan, schedule of openings, construction notes with specifications, area statement. – **Full imperial sheet**.
2. Assignment 1 drawing on AUTOCAD
3. Assignment on AUTOCAD- Foundation Plan/Column Plan
4. Assignment on AUTOCAD- Reinforcement detailing for columns, beams
5. 3D drawing of a Residential building
6. Line Plan of any two public buildings

### CO – PO / PSO Articulation Matrix

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 2 | 1 | 2 | 1 | 2 | 2 | – | – | – | 2 | 3 | 1 |
| CO2 | 3 | 2 | 2 | 3 | 2 | 1 | 2 | – | 1 | – | 2 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 3 | – | 2 | – | 1 | – | 2 | 3 | 2 |
| CO4 | 3 | 2 | 2 | 3 | 3 | – | 2 | – | – | – | 3 | 3 | 2 |
| **Avg** | **3** | **2** | **2** | **3** | **2** | **2** | **2** | **–** | **1** | **–** | **2** | **3** | **2** |

## CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | ✓ | – | – | – | – | – |
| CO2 | – | – | – | – | ✓ | ✓ | ✓ | ✓ | – |
| CO3 | – | – | – | – | – | ✓ | ✓ | ✓ | ✓ |
| CO4 | – | – | – | – | – | – | – | ✓ | ✓ |

## CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | – |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO3 | ✓ | ✓ | ✓ | ✓ | ✓ | – | ✓ |
| CO4 | ✓ | ✓ | ✓ | ✓ | ✓ | – | ✓ |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | – | – |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO3 | ✓ | ✓ | ✓ | ✓ | – |
| CO4 | ✓ | ✓ | ✓ | ✓ | ✓ |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | **SDG 8, 9, 11** | Construction practices, safe site execution, quality control, and modern construction techniques promote sustainable infrastructure, safe workplaces, and resilient urban development. |
| CO2 | **SDG 8, 9, 11, 12** | Building materials, MEP services, RMC production, and quality testing encourage efficient resource utilization, quality construction, reduced material wastage, and sustainable infrastructure. |
| CO3 | **SDG 9, 11, 12** | Building planning using UDCPR, bye-laws, ventilation, sanitation, parking, and space planning supports sustainable cities, efficient land use, and responsible development practices. |
| CO4 | **SDG 4, 8, 9** | AutoCAD skills enhance technical education, employability, and the use of modern engineering tools for accurate and efficient infrastructure planning and design. |

**FF No.: 654-A**

## CV2008: Structural Analysis

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Credits: 3 | CP: 30 Marks |
| Lectures: 2 Hrs/week | CVV: 20 Marks |
| Practical: 2 Hrs/week | ESE (W): 40 Marks |
| Tutorial: 0 Hrs/week | Lab CA (W):10 Marks |

| | |
|---|---|
| **Prerequisites:** | |
| | **Engineering Mechanics, Engineering Mathematics, Mechanics of Solids** |
| **Course Objectives:** | |
| | To prepare the students to apply Influence Line Diagram concept to determine the support reactions and Shear Force, Bending Moment at any section for Simple beam with or without overhang |
| | To prepare the students to analyse three hinged arches |
| | To prepare the students to analyse the Indeterminate Beams using Three Moment theorem, Slope Deflection Method, Moment Distribution Method, Stiffness Method, Flexibility Method |
| **Course Outcomes:** | |
| | After completion of the course, student will be able to |
| 1. | Analyze the determinate beams using the concept of Influence Line Diagram and analyze the three hinged arches |
| 2. | Analyze the indeterminate beams using Three Moment Theorem, Castigliano's II Theorem, |
| 3. | Analyze the indeterminate beams and frames using Slope-Deflection Method, Moment Distribution Method |
| 4. | Analyze the indeterminate beams and frames using matrix methods: Flexibility Method and Stiffness Method |

| | |
|---|---|
| **Section1:** | **Influence Line Diagram and Three Hinged Arches** |

Influence Line Diagram: Basic concepts, influence line diagram for reactions, shear and bending moment for simply supported and overhanging beams and Trusses Three Hinged Arches: Concept, analysis of parabolic and semi-circular arch with supports at same and different levels. Horizontal thrust, radial shear and normal thrust for parabolic and semi-circular arch

| | |
|---|---|
| **Section2:** | **Three Moment Theorem and Castigliano's Second Theorem** |

Static and Kinematic redundancy of beams, trusses and frames. Clapeyron's Theorem of Three Moments, Application of the theorem to indeterminate beams with settlement of supports having static indeterminacy not more than two (2). Castigliano's Second Theorem, Application of the theorem to indeterminate beams having static indeterminacy not more than two (2).

| | |
|---|---|
| **Section 3** | **Slope Deflection Method and Moment Distribution Method** |

Introduction to Slope Deflection Method, sign conventions, fixed end moments, development of slope deflection equations, Application to indeterminate beams and non-sway frames having degree of Indeterminacy not more than two (2).

Introduction to Moment Distribution Method, carry over moment, distribution factors, modification of stiffness for simple ends, Application to indeterminate beams and non-sway frames having degree of indeterminacy not more than two (2).

| | |
|---|---|
| **Section 4** | **Flexibility and Stiffness Method** |

Flexibility Method: Fundamental concepts, formulation of flexibility matrix, application to beams and sway and non-sway frames. (degree of Indeterminacy not more than two (2).

Stiffness Method: Fundamental concepts, formulation of stiffness matrix, application to indeterminate beams and non-sway frames using member approach. (degree of Indeterminacy not more than two (2)

**Text Books:** ***(As per IEEE format)***


| | |
|---|---|
| 1 | *S.B. Junnerkar and H.J. Shah;,Mechanics of Structures-Vol II; Charotar Publishing House,2015* |
| 2 | *B.C.Punmia, Ashok kumar Jain and Arun Kumar Jain; Theory of Structures; Laxmi Publications (P) Ltd.;2017* |
| 3 | *S.Ramamrutham and R. Narayan; Theory of Structures; Dhanpat Rai Publishing Company, 2017* |
| 4 | *S.S.Bhavikatti; Structural Analysis-II; Vikas Publishing House Pvt. Ltd.; 2018* |


**Reference Books:** ***(As per IEEE format)***

| | |
|---|---|
| 1 | *Devdas Menon; "Advanced Structural Analysis" Narosa Publishing House, Mumbai;2009* |
| 2 | *R.C.Hibbler;Structural Analysis; Pearson Publications; 2017* |
| 3 | *Dr. A.S.Meghre and S.K.Deshmukh; Matrix Methods of Structural Analysis; Charotar Publishing House;2016* |


**List of Assignments**

11) Calculation of support reactions, shear Force and bending moment at any section of simple beam using the concepts of Influence Line Diagram
12) Calculation of support reactions, normal thrust and radial shear at any section for a three hinged parabolic and semi-circular arch
13) Computation of support moments for a two-span and three span continuous beams with different types of supports using Three Moment Theorem
14) Computation of support moments for two-span continuous beams with different types of supports using Castigliano's II Theorem
15) Computation of support moments for a two-span and three span continuous beams/ non sway frames with different types of supports using Slope Deflection Method
16) Computation of support moments for a two-span and three span continuous beams/ non sway frames with different types of supports using Moment Distribution Method
17) Computation of support moments for a two-span and three span continuous beams/ non sway frames with different types of supports using Flexibility Method
18) Computation of support moments for a two-span and three span continuous beams/ non sway frames with different types of supports using Stiffness Method

**List of Project areas:**

1. Analysis of two or three span Indeterminate beams using any method and comparing the analysis results with those obtained using any software
2. Analysis of Indeterminate frames using any method and comparing the analysis results with those obtained using any software

**CO – PO / PSO Articulation Matrix**

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 3 | 2 | - | - | 2 | - | - | 3 | 3 | | | | 2 | |
| CO2 | 3 | 2 | - | - | 2 | - | - | 3 | 3 | | | | 2 | |
| CO3 | 3 | 2 | - | - | 2 | - | - | 3 | 3 | | | | 2 | |
| CO4 | 3 | 2 | - | - | 2 | - | - | 3 | 3 | | | | 2 | |
| Avg | 3 | 2 | - | - | 2 | - | - | 3 | 3 | | | | 2 | |

## CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | | ✓ | | | | | | |
| CO2 | ✓ | | ✓ | | | | | | |
| CO3 | ✓ | | ✓ | | | | | | |
| CO4 | ✓ | | ✓ | | | | | | |
| CO5 | ✓ | | ✓ | | | | | | |

## CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | | | | | | |
| CO2 | ✓ | | | | | | |
| CO3 | ✓ | | | | | | |
| CO4 | ✓ | | | | | | |
| CO5 | ✓ | | | | | | |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | | | | |
| CO2 | ✓ | | | | |
| CO3 | ✓ | | | | |
| CO4 | ✓ | | | | |
| CO5 | ✓ | | | | |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | 4 | COs are mapping with SDG 4 due to following learning outcomes:<br>• Develops analytical and problem-solving skills.<br>• Builds competency in engineering design and structural analysis.<br>• Prepares students for responsible engineering practice. |
| CO2 | 4 | |
| CO3 | 4 | |
| CO4 | 4 | |
| CO5 | 4 | |

**FF No.: 654-A**

**CV2009: Geomatics Engineering**

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Credits: 3 | CP: 30 Marks |
| Lectures: 2 Hrs/week | CVV: 20 Marks |
| Practical: 2 Hrs/week | Lab: 10 Marks |
| Tutorial: 0 Hrs/week | ESE (W): 40 Marks |

| **Prerequisites:** | |
|---|---|
| ● | Linear Algebra, Trigonometry, Physics |

| **Course Objectives:** | |
|---|---|
| ● | To impart knowledge about different methods of survey such as traversing, tachometry. |
| ● | To impart knowledge about elements of different types of curves and surveying applications in setting out of curves, buildings, drainage lines, canals. |
| ● | To impart knowledge about modern surveying techniques such as Total station, GPS, Remote sensing and GIS. |

| **Course Outcomes:** | |
|---|---|
| | After completion of the course, student will be able to |
| 1. | Perform traversing using a Theodolite. |
| 2. | Determine reduced level of points using Tacheometry and draw a contour map |
| 3. | Design and set out horizontal curve on ground. |
| 4. | Explain fundamentals of Space Based Positioning System, Remote Sensing and Geographical Information System |

| **Section1:** | **Theodolite Surveying** |
|---|---|

**Theodolite**: Study of theodolite (vernier and micrometer), uses of theodolite. Fundamental axes of theodolite: permanent adjustments of a transit theodolite.

**Traversing**: computation of consecutive and independent co-ordinates, adjustment of closed traverse by transit rule and Bowditch's rule, Gale's traverse table. Checks, omitted measurements, area calculation by independent coordinates.

| **Section2:** | **Tacheometry and Setting-Out** |
|---|---|

**Tachometry**: application and limitations, principle of stadia tachometry, fixed hair method with vertical staff to determine horizontal distances and elevations of points.

**Setting-Out Works** - buildings, maintaining verticality of tall buildings, bridges, and tunnels.

| **Section3:** | **Curves** |
|---|---|

Introduction, different forms of curves. Definitions and explanation of different terms: degree of curve, relation between radius and degree of curve, super elevation, centrifugal ratio. Types of horizontal curves. Notations used with circular curves. Properties of a simple circular curve. Horizontal curve setting by- a) offsets from chord produced and b) Rankine's method of deflection angles. Field procedure for setting out the curve (by deflection angle) by one and two theodolite methods. Compound curve- calculation of data and setting out in the field. Transition curves: objectives of providing transition curves, requirement of ideal transition curve. Notations used with combined curves. Vertical curves: definition, gradient, rate of change of grade, length of vertical curve, types of vertical curves.

| **Section4:** | **Modern Techniques in Surveying** |
|---|---|

**Total Station**: Construction, types, principle features, field equipment, method of use, introduction to various special functions available in a total station such as remote elevation measurements, remote distance measurements and co-ordinate stake out.

**Satellite based positioning systems (SBPS)**: SBPS systems - GPS, Glonoss, Galileo, Navic, Compass, etc. and their features, Segments of SBPS (Space, Control and User), their importance and role in SBPS, Positioning with SBPS - Absolute and Differential Methods, Use of SBPS in Surveying, SBPS Co-ordinates and heights, Different types of errors in SBPS Positioning.

**Remote Sensing & GIS**: Basic concepts in Remote Sensing, Basic Laws of electromagnetic radiation, Atmospheric effects on radiation, Interaction of EM energy with matter. Applications of remote sensing. Geographical Information System: Components (people, procedure, hardware, software & data) & functions of GIS. Coordinate systems and projections, Georeferencing, GIS data – spatial (Raster & vector) & aspatial data. Applications of GIS in civil engineering. Limitations of GIS.

**Text Books:** ***(As per IEEE format)***


| | |
|---|---|
| 1 | Dr. B.C. Punmia, Ashok K. Jain, Arun K. Jain, (2005) "Surveying Vol. I and Vol. II", Laxmi Publications Pvt Limited |
| 2 | N.N. Basak, (2014), "Surveying and Levelling", McGraw Hill Education |

| | |
|---|---|
| 3 | R. Subramanian, (2012) "Surveying and Levelling", Oxford University Press |
| 4 | T. P. Kanetkar and S. V. Kulkarni, (2010) "Surveying and Levelling Vol I and Vol. II", Vidyarthi Griha Prakashan. |
| 5 | Basudeb Bhatta (2011) "Remote Sensing and GIS", Oxford University Press |
| **Reference Books:** ***(As per IEEE format)*** | |
| 1 | J. Uren, W.F. Price, (2010), "Surveying for Engineers", Palgrave Macmillan |
| 2 | S.K. Duggal, (2013), "Surveying Vol. I and Vol. II", McGraw Hill Education |
| 3 | James McMurry Anderson, James M Anderson, Edward M Mikhail, (1998), "Surveying: Theory and Practice", McGraw-Hill Education |
| 4 | Russell C. Brinker, (2013), "The Surveying Handbook", Springer US |
| 5 | Peter A. Burrough, Christopher D. Lloyd, Rachel A. Mcdonnell (2015) "Principles of Geographical Information System"' Oxford University Press |
| 6 | Satheesh Gopi, R. Sathikumar, N. Madhu (2014) "Advanced Surveying -Total Station, GIS and Remote Sensing", Pearson Publication |

**List of Practical's:**

Perform any 10:

1. Measurement of horizontal angles using 20" vernier Theodolite by repetition method.
2. Measurement of vertical angles using 20" vernier Theodolite.
3. Finding horizontal and vertical distance using Tachometer.
4. Radial contouring: Plotting of contours from one station
5. Setting out a building from a given foundation plan (minimum six co-ordinates).
6. Setting out a circular curve by Rankine's method of deflection angles.
7. Practical based on measurement with total station (angles and distance)
8. Practical based on measurement with total station (remote elevation measurements, and remote distance measurements)
9. Use of RS images and visual interpretation
10. Use of interface and tools in GIS software such as GRAM++ or QGIS or equivalent software.
11. Traversing: Plotting traverse and finding out its area using vernier/micrometer Theodolite
12. Field survey (500 sq.m.) using GPS (Control as well as mapping).
13. Radial contouring: Plotting of contours from two stations minimum 60m to 100m apart.--------

**List of Project areas:**

1. Topographic Survey and Contour Mapping
2. Traversing and Preparation of Campus Layout using Theodolite
3. Route Survey and Horizontal Curve Design for a Proposed Internal Road
4. Contour Survey for Rainwater Harvesting Site Selection
5. Playground Levelling and Contour Map Preparation
6. Design and Setting Out of Horizontal Curve for a Hill Road
7. Elevation Mapping of a Construction Site using Tacheometry
8. GIS-Based Mapping of College Infrastructure
9. Preparation of Digital Elevation Model (DEM) from Survey Data
10. Comparison of Conventional Surveying and GPS Survey
11. Remote Sensing-Based Land Use/Land Cover Mapping of the Local Area

**CO – PO / PSO Articulation Matrix**

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 3 | 3 | 2 | 2 | 2 | - | - | - | 1 | 1 | 1 | 3 | 2 | |
| CO2 | 3 | 3 | 2 | 3 | 2 | - | 1 | - | 1 | 1 | 1 | 3 | 3 | |
| CO3 | 3 | 3 | 3 | 2 | 2 | - | - | - | 1 | 1 | 1 | 3 | 3 | |
| CO4 | 2 | 2 | 1 | 2 | 3 | - | 1 | - | 1 | 2 | 2 | 2 | 2 | |
| Avg | 2.75 | 2.75 | 2.00 | 2.25 | 2.25 | - | 1.00 | - | 1.00 | 1.25 | 1.25 | 2.75 | 2.50 | |

## CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | | ✓ | ✓ | ✓ | | ✓ | | | ✓ |
| CO2 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| CO3 | | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| CO4 | | ✓ | ✓ | ✓ | | ✓ | ✓ | | |

## CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | | ✓ | ✓ | ✓ | | ✓ |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO4 | ✓ | | ✓ | ✓ | | ✓ | ✓ |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | | | ✓ |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO3 | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO4 | ✓ | ✓ | ✓ | ✓ | |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | 9, 11 | Traversing provides the fundamental survey control required for planning, construction, and maintenance of civil infrastructure and urban development projects. |
| CO2 | 6, 9, 11 | Contour mapping supports site planning, drainage design, watershed management, flood mitigation, and sustainable infrastructure development. |
| CO3 | 3, 9, 11 | Proper geometric design and setting out of roads improve transportation efficiency, road safety, and sustainable urban mobility. |
| CO4 | 9, 11, 13, 15 | Modern geomatics technologies enable spatial planning, environmental monitoring, disaster management, land-use analysis, and climate-resilient infrastructure planning. |

# CV2010: WASTEWATER ENGINEERING

| Teaching Scheme | Examination Scheme |
|---|---|
| Credits: 3 | CP: 30 Marks |
| Lectures: 2 Hrs/week | Lab Exam: 10 Marks |
| Practical: 2 Hrs/week | CVV: 20 Marks |
| Tutorial: NA | MSE(W): 40 Marks |

| | |
|---|---|
| **Prerequisites:** | |
| ● | Basic Civil Engineering |
| **Course Objectives:** | |
| ● | Understand basic process of domestic waste water treatment plant |
| **Course Outcomes:** | |
| | After completion of the course, student will be able to |
| 1. | Explain the process used in waste water treatment |
| 2. | Design preliminary and primary treatment units for sewage treatment and understand stream sanitation. |
| 3. | Design of Secondary Biological treatment unit |
| 4. | Develop Low-cost treatment and advance treatment methods of waste water |
| **Section1:** | Waste Water and Treatment Concept |
| Fundamentals of waste water, types of waste water, Characteristics of sewage: physical, chemical and biological, effluent standards as per CPCB/MPCB norms, unit operation and process, treatment system such as preliminary, primary, secondary and tertiary, functions of treatment plant. Flow rate concept of mass flow rate, types of reaction and reactors. Concept for HRT, SLR, WLR. | |
| **Section2:** | Stream Sanitation, Preliminary and Primary Treatment Units |
| Stream sanitation: Self-purification of natural streams, Oxygen Sag Curve, Streeter -Phelps equation and terminology (without derivation and numerical). Analysis of flow measurement, equalization basin, screen chamber, grit chamber, oil and grease trap. Design of circular sanitary sewers pipe system. Design of primary and secondary sedimentation tank. | |
| **Section 3** | Biological treatment of waste water |
| Secondary Biological treatment unit: Suspended growth process, consideration of HRT, MCRT,F/M ratio, OLR, Qty. of oxygen required, Power required, sludge production, sludge flow rate, recycling ratio. Secondary Biological treatment unit: Attach growth process. Tricking (NRC equation), introduction to bio- towers | |
| **Section 4** | Anaerobic Biological Treatment, sludge treatment and Low Cost Treatments |
| Anaerobic treatment process, anaerobic reactor types. Principle of anaerobic digestion, stages of digestion, factors governing anaerobic digestion, Dewatering of sludge by gravity thickener, sludge drying bed, decanters. Methods of sludge treatment and disposal. Up-flow Anaerobic Sludge Blanket (UASB) Reactor–Principle. Oxidation pond: Bacteria –algae symbiosis, oxidation pond as per the manual of CPHEEO, advantages and disadvantages of oxidation ponds. Aerated lagoons: Principle, aeration method, advantages and disadvantages of aerated Lagoons, Removal of nutrient process such as phosphate, nitrate from waste water. | |

**Text Books:** ***(As per IEEE format)***

| | |
|---|---|
| 1 | Rajgopalan-Environmental studies-Oxford University Press. |
| 2 | Metcalf and Eddy-Waste Water Treatment and Disposal-TMH publication. |
| 3 | Peavy, Rowe-Environmental Engg-McGraw Hill Publication. |

**Reference Books:** ***(As per IEEE format)***

| | |
|---|---|
| 1 | B.C. Punmia and Ashok Jain-Waste Water Engg--Arihant Publications. |
| 2 | B.S.N. Raju-Water Supply and Waste Water Engg.- TMH publication. |
| 3 | S. K. Garg-Sewage Disposal and Air Pollution Engg.- Khanna Publication. |
| 4 | Davis-Environmental Engg.- McGraw Hill Publication |
| **5** | Public Health Dept., Govt. of India.- Manual on sewerage and sewage treatment |

**List of Practical's:** – (Any Six of the following)

1. Determination of dissolved oxygen
2. Determination of biological oxygen demand
3. Determination of chemical oxygen demand
4. Determination of sludge volume index.
5. Determination of phosphate or nitrate

6. Determination of solids such as suspended, total, fixed
7. Determination of total dissolved solids by conductivity method
8. Visit to sewage treatment plant (STP)
9. Design of 1 MLD STP by using any software or excel sheet.
10. Determination of sulphate from water.
11. Determination of fluoride from water.
12. Design of 1MLD WTP in spread sheet or any software.
13. List of Assignments
    a) Assignment on Waste Water and Treatment Concept
    b) Assignment on Stream Sanitation, Preliminary and Primary Treatment Units
    c) Assignment on Biological treatment of waste water
    d) Assignment on Anaerobic Biological Treatment, sludge treatment and Low Cost Treatments

**List of Project areas:**

1. Wastewater Quality Monitoring Using IoT Sensors
2. Electroplating Wastewater Treatment
3. Wastewater Reuse for Irrigation
4. Resource Recovery from Wastewater
5. Biogas Production from Sewage Sludge
6. Energy-Efficient Wastewater Treatment Plants
7. Green Technologies for Wastewater Treatment
8. Solar-Powered Wastewater Treatment Systems
9. Circular Economy in Wastewater Management
10. Impact of Untreated Wastewater on Rivers
11. Wastewater Treatment and Public Health
12. Sludge Management and Disposal
13. Odor Control in Sewage Treatment Plants
14. Environmental Impact Assessment of STPs
15. Machine Learning for Effluent Quality Prediction
16. Cost Analysis of Different Wastewater Treatment Technologies
17. Carbon Footprint Assessment of Wastewater Treatment Plants
18. Odor Control in Sewage Treatment Plants
19. Optimization of Aeration Systems
20. Microplastics in Wastewater
21. Zero Liquid Discharge (ZLD) Systems

## CO – PO / PSO Articulation Matrix

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 2 | – | 2 | – | 2 | 1 | – | – | – | 1 | 1 | – |
| CO2 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | – | ----- | – | 1 | 1 | 2 |
| CO3 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | – | ---- | – | 1 | 1 | 2 |
| CO4 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | – | – | – | 1 | 1 | 2 |
| Avg | 3 | 2 | 2 | 2 | 1 | 2 | 1 | -- | ----- | -- | 1 | 1 | 2 |

## CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | | ✓ | ✓ | | | ✓ | ✓ | | |
| CO2 | | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ |
| CO3 | | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ |
| CO4 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |

## CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| CO2 | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| CO3 | ✓ | | ✓ | ✓ | | ✓ | ✓ |
| CO4 | ✓ | | ✓ | ✓ | | ✓ | ✓ |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | | | ✓ | |
| CO2 | ✓ | | | ✓ | |
| CO3 | ✓ | | | ✓ | |
| CO4 | ✓ | | | ✓ | |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | SDG 3, 6, | Waste Water and Treatment leads to Health & Well-being, Clean Water and Sanitation |
| CO2 | SDG 3,6,11,12 | preliminary and primary treatment units for sewage treatment and understanding stream sanitation leads to Health & Well-being, Clean Water and Sanitation, Sustainable Urban Development, Sustainable Consumption on land |
| CO3 | SDG 3,6,11,12,13 | Secondary Biological treatment unit of waste water leads to Health & Well-being, Clean Water and Sanitation, Sustainable Urban Development, Sustainable Consumption on land and climate mitigation |
| CO4 | SDG 3,6,11,12,13,14 | Anaerobic Biological Treatment, sludge treatment and Low Cost Treatments of waste water leads to Health & Well-being, Clean Water and Sanitation, Sustainable Urban Development, Sustainable Consumption on land , climate mitigation and conservation of life below water |

**FF No.: 654-A**

## CV2011: Geotechnical Engineering

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Credits: 04 | CP: 20 Marks |
| Lectures: 03 Hrs/week | GD/PPT: Marks |
| Practical: 02 Hrs/week | PRACT+CVV: 40 Marks |
| Tutorial: NA | ESE (W): 40Marks |

| **Prerequisites:** | |
|---|---|
| ● | Engineering Mechanics, Fluid Mechanics |

| **Course Objectives:** | |
|---|---|
| ● | To impart knowledge about the soil properties, classification, and its behavior under stress |
| ● | To impart knowledge about the methods for measurements and determination of index and engineering properties of soil |
| ● | To impart knowledge about the study of the interaction between water and its effect on engineering behavior of soil |

| **Course Outcomes:** | |
|---|---|
| | After completion of the course, student will be able to |
| 1. | Classify the different types of soil/rock and define their index properties. |
| 2. | Explain permeability and seepage through soil and determine permeability of different types of soils. |
| 3. | Determine compaction properties and stress, and methods to determine stress distribution in the soils. |
| 4. | Calculate shear strength parameters of soil and explain methods to determine shear strength of soils. |
| 5. | Compute the lateral thrust due to backfill on the retaining walls. |
| 6. | Describe soil slopes and their failure modes and explain methods to determine strength of rocks. |

| **Section1:** | **Index Properties of Soil** |
|---|---|

Need for soil mechanics studies, Soil as an engineering material - Scope of Geotechnical engineering. Major soil deposits of India, Index properties of soil and rock, three phase soil system, Soil minerals, Soil structures, Weight volume relationship, Index properties of soil and rock.

| **Section2:** | **Permeability and Seepage** |
|---|---|

Soil water, permeability definition and necessity of its study, Darcy's law, factors affecting permeability. Laboratory measurement of permeability – Constant head method and Falling head method as per IS 2720. Field test for determination of permeability test as per IS. Permeability of stratified soil deposits. Seepage and Seepage Pressure, quicksand phenomenon, critical hydraulic gradient, General flow equation for 2-D flow (Laplace equation), Flow Net, properties and application, Flow Net construction for flow under sheet
pile and earthen dam.

| **Section3:** | **Compaction and Stress Distribution** |
|---|---|

Introduction, Standard Proctor test, Modified Proctor test, Zero air void line. Factors affecting compaction. Effect of compaction on soil properties. Field compaction methods and compaction equipment's for different types of soil, Field compaction control
Geostatic stress, Boussinesq's theory with assumptions for point load (with numerical), equations for circular load, line load and strip load, Pressure Distribution diagram on a horizontal and vertical
plane, Pressure bulb and its significance. Westergaard's theory, equivalent point load method, Approximate stress distribution method.

| **Section4:** | **Shear Strength of soil** |
|---|---|

Mohr's stress circle, Mohr-Coulomb failure theory. The effective stress principle- Total stress, effective stress and neutral stress / pore water pressure. Peak and Residual shear strength, factors affecting shear strength. Stress-strain behavior of sands and clays. Direct Shear test, Tri-axial compression test, Unconfined
Compression test, Vane Shear test. (Different drainage conditions for shear tests). Sensitivity and thixotropy of cohesive soils.

| **Section5:** | **Earth Pressure theory** |
|---|---|

Earth Pressure – Introduction, Rankine's state of Plastic Equilibrium in soils- Active and Passive states due to wall movement, Earth Pressure at rest. Rankine's Theory : Earth pressure on Retaining wall due to submerged backfill. Backfill with uniform surcharge, backfill with sloping surface, layered backfill.
Coulomb's Wedge theory. Rebhann's and Culmann's graphical method of determination of earth pressure

| **Section6:** | **Stability of slopes and strength of rocks** |
|---|---|

| | |
|---|---|
| Classification and failure of slopes, Finite slope stability by Swedish circle method with slip circle and method of slices, Soil stabilization, its necessity and methods. Landslides- Causes and remedial measures. Rock quality designation, Rock mass classification, Laboratory methods to determine strength of rocks, Determination of Bearing capacity | |
| **Text Books:** | |
| 1 | Punmia B. C, (2017), "Soil Mechanics and Foundation Engineering". Laxmi Publications. |
| 2 | Shashi K. Gulati and Manoj Datta (2018), "Geotechnical Engineering", Tata McGraw Hill. |
| 3 | Murthy, V. N. S., (2000), "Principles of Soil Mechanics and Foundation Engineering", UBS Publishers |
| 4 | Mukherjee, P. K. (2013), "A Text Book of Geology", World press Publishers |
| **Reference Books:** | |
| 1 | Terzaghi and Peck (1996), "Soil mechanics and engineering Practice" John Wiley & Sons |
| 2 | Joseph. E. Bowles (2001),"Physical and Geotechnical Properties of Soils", International Students Edition |
| 3 | Das B. M. (2010), "Principles of Geotechnical Engineering", Cengage Learning |

**List of Practical's: List of Experiments: Any 8 + Sr. No 13 and 14 are compulsory.**

1. Determination of water content and specific gravity ofsoil
2. Sieve analysis, particle size determination and IS classification as per I. S. Codes.
3. Determination of Consistency limits and their use in soil classification. as per I. S. Codes.
4. Field density test by a) Core cutter b) Sand Replacement
5. Determination of coefficient of permeability by a) constant head and b) variable head method.
6. Direct shear test.
7. Unconfined compression test.
8. Vane Shear test.
9. Standard Proctor test / Modified Proctor test.
10. Differential free swell test.
11. Demonstration of Tri-axial test
12. Swelling Pressure test
13. Any one of the following assignments
    a) Review of any field geotechnical investigation report.
    b) Construction of pressure bulb by using any geotechnical engineering software.
14. Assignments on the following topics
    a) Rebhann's and Cullman's graphical method for determination of earth pressure.
    b) Solution of problems on shear strength parameters using graph.

**List of Project areas:**

1. Prediction of Soil Classification Using Machine Learning
2. Earth Pressure on Retaining Wall
3. Ground Improvement Techniques

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## CO – PO / PSO Articulation Matrix

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | 3 | 2 | - | - | 1 | - | - | - | - | - | - | 1 | 2 | |
| CO2 | 3 | 3 | - | 2 | 2 | - | 1 | - | - | - | - | 1 | 2 | |
| CO3 | 3 | 3 | 2 | 2 | 2 | - | 1 | - | - | - | - | 2 | 3 | |
| CO4 | 3 | 3 | 2 | 3 | 2 | - | - | - | - | - | - | 2 | 3 | |
| CO5 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | - | - | - | - | 2 | 3 | |
| CO6 | 3 | 3 | 2 | 2 | 1 | 2 | 3 | - | - | - | - | 2 | 3 | |
| Avg | 3 | 3 | 0.5 | 0.6 | 0.55 | 0.16 | 0.38 | - | - | - | - | 0.55 | 0.88 | |

## CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | ✓ | - | ✓ | - | - | - |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | - |
| CO3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | - |
| CO4 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | - |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - |
| CO6 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |

## CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | - | - | - | - | - | - |
| CO2 | ✓ | ✓ | ✓ | - | - | - | - |
| CO3 | ✓ | ✓ | ✓ | ✓ | - | - | - |
| CO4 | ✓ | ✓ | ✓ | ✓ | ✓ | - | - |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - |
| CO6 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | - | - | - | - |
| CO2 | ✓ | ✓ | -' | -' | -' |
| CO3 | ✓ | ✓ | ✓ | - | - |
| CO4 | ✓ | ✓ | ✓ | ✓ | -' |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO6 | ✓ | ✓ | ✓ | ✓ | ✓ |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | SDG 4 | Develops fundamental geotechnical engineering knowledge and technical competence. |
| CO2 | SDG 6, SDG 9 | Supports groundwater management, seepage control, and resilient infrastructure. |
| CO3 | SDG 9, SDG 11 | Enables safe earthworks, compaction, and durable infrastructure. |
| CO4 | SDG 9 | Supports safe and economical geotechnical design through shear strength evaluation. |
| CO5 | SDG 9, SDG 11 | Earth pressure analysis contributes to resilient retaining structures and transportation infrastructure. |
| CO6 | SDG 11, SDG 13, SDG 15 | Slope stability, landslide mitigation, and rock engineering promote resilient communities and environmental protection. |

## MM0205: Optimization Techniques

| Teaching Scheme | Examination Scheme |
|---|---|
| Credits : 3 | CP: 20 Marks |
| Lectures : 2 Hrs/week | HA: 20 Marks |
| Practical : NA | MSE (W): 40 Marks |
| Tutorial : 1 Hrs/week | CVV: 20 Marks |

| | |
|---|---|
| **Prerequisites:** | |
| ● | Basic mathematics |
| **Course Objectives:** | |
| ● | To introduce the students of Civil Engineering the concept of optimization Techniques. |
| ● | To make students familiar with linear and nonlinear optimization Problems |
| ● | To introduce students to sequencing problems and stochastics programming |
| **Course Outcomes:** | |
| 1 | Understand different approaches of optimization techniques and understand the concepts of local & global optima, unimodal function, convex and concave function. |
| 2 | Implement Gradient descent, Newton's method, Lagrange to solve Nonlinear programming problems |
| 3. | Apply stochastic programming techniques for queuing of jobs, sequencing of operations |
| 4. | Apply linear programming techniques to maximize the profit or minimizing the cost problems using simplex method, Big M method. |
| 5 | Solve transportation model and assignment model. |

| | |
|---|---|
| **Section1:** | **Non-Linear Programming** |
| Introduction to System approach, Operations Research and Optimization Techniques, Introduction to Linear and Nonlinear programming methods, Local & Global optima, unimodal function, convex and concave function, The gradient vector and Hessian Matrix, Gradient techniques, steepest ascent/decent technique, Newton's Method. Multivariable optimization with equality constraints - Lagrange Multiplier Technique | |
| **Section2:** | **Sequencing and Stochastic Programming** |
| 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//) | |
| **Section 3** | **Linear Programming (A)** |
| Formulation of Linear optimization models for Civil engineering applications. The simplex method, Method of Big M | |
| **Section 4** | **Linear Programming (B)** |
| The Transportation Model and its variants, Assignment Model, and its variants. | |

| | |
|---|---|
| **Text Books:** ***(As per IEEE format)*** | |
| 1 | *Engineering Optimization by S.S.Rao* |
| 2 | *Quantitative Techniques in Management by N.D. Vohra (McGraw Hill)* |
| 3 | *Operations Research by Premkumar Gupta and D.S.Hira, S. Chand Publications (2014).* |
| **Reference Books:** ***(As per IEEE format)*** | |
| 1 | *Topics in Management Science by Robert E. Markland (Wiley Publication)* |
| 2 | *An Approach to Teaching Civil Engineering System by Paul J. Ossenbruggen* |
| 3 | *Operations Research by Hamdy A. Taha* |

**List of Practical's:**

Tutorial on:

1. Local & Global optima, unimodal function, convex and concave function
2. Gradient techniques: steepest ascent/decent technique
3. Newton's Method, Lagrange Multiplier Technique
4. Sequencing– n jobs through 2, 3 and M machines
5. Queuing Theory: Kendall's notation, Model I (Single channel Poisson Arrival with exponential services times, Infinite population (M/M/1): (FCFS/)
6. Linear optimization: simplex method
7. Linear optimization: Method of Big M
8. Transportation Model and its variants

9. Assignment Model and Its variants

**List of Project areas:**

1. Applications of optimization techniques in construction, structural engineering, water resources engineering, transportation engineering, geo-technical engineering, environmental engineering

## CO – PO / PSO Articulation Matrix

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 1 | 1 | 1 | -- | 2 | -- | 1 | 1 | 2 | 1 | 2 | 1 |
| CO2 | 3 | 1 | 1 | 1 | -- | 2 | -- | 1 | 1 | 2 | 1 | 2 | 1 |
| CO3 | 3 | 1 | 1 | 1 | -- | 2 | -- | 1 | 1 | 2 | 1 | 2 | 1 |
| CO4 | 3 | 1 | 1 | 1 | -- | 2 | -- | 1 | 1 | 2 | 1 | 2 | 1 |
| CO5 | 3 | 1 | 1 | 1 | -- | 2 | -- | 1 | 1 | 2 | 1 | 2 | 1 |
| Avg | 3 | 1 | 1 | 1 | -- | 2 | -- | 1 | 1 | 2 | 1 | 2 | 1 |

## CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | -- | -- |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | -- | -- |
| CO3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | -- | -- |
| CO4 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | -- | -- |
| CO5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | -- | -- |

## CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | -- | ✓ | -- | -- |
| CO2 | ✓ | ✓ | ✓ | -- | ✓ | -- | -- |
| CO3 | ✓ | ✓ | ✓ | -- | ✓ | -- | -- |
| CO4 | ✓ | ✓ | ✓ | -- | ✓ | -- | -- |
| CO5 | ✓ | ✓ | ✓ | -- | ✓ | -- | -- |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | -- | ✓ | -- |
| CO2 | ✓ | ✓ | -- | ✓ | -- |
| CO3 | ✓ | ✓ | -- | ✓ | -- |
| CO4 | ✓ | ✓ | -- | ✓ | -- |
| CO5 | ✓ | ✓ | -- | ✓ | -- |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| **CO1** | 1,8,9, 12 | Optimization will always be targeted towards minimizing the cost and maximizing the profits which will help to reduce poverty (SDG 1), Helps in economic growth by following optimization techniques in use of men, material and money used in infrastructure development (SDG 8, SDG 9) and use of optimization techniques helps in responsible consumption and production as it involves minimizing the cost and maximizing the profits (SDG 12) |
| **CO2** | 1,8,9, 12 | Optimization will always be targeted towards minimizing the cost and maximizing the profits which will help to reduce poverty (SDG 1), Helps in economic growth by following optimization techniques in use of men, material and money used in infrastructure development (SDG 8, SDG 9) and use of optimization techniques helps in responsible consumption and production as it involves minimizing the cost and maximizing the profits (SDG 12) |
| **CO3** | 1,8,9, 12 | Optimization will always be targeted towards minimizing the cost and maximizing the profits which will help to reduce poverty (SDG 1), Helps in economic growth by following optimization techniques in use of men, material and money used in infrastructure development (SDG 8, SDG 9) and use of optimization techniques helps in responsible consumption and production as it involves minimizing the cost and maximizing the profits (SDG 12) |
| **CO4** | 1,8,9, 12 | Optimization will always be targeted towards minimizing the cost and maximizing the profits which will help to reduce poverty (SDG 1), Helps in economic growth by following optimization techniques in use of men, material and money used in infrastructure development (SDG 8, SDG 9) and use of optimization techniques helps in responsible consumption and production as it involves minimizing the cost and maximizing the profits (SDG 12) |
| **CO5** | 1,8,9, 12 | Optimization will always be targeted towards minimizing the cost and maximizing the profits which will help to reduce poverty (SDG 1), Helps in economic growth by following optimization techniques in use of men, material and money used in infrastructure development (SDG 8, SDG 9) and use of optimization techniques helps in responsible consumption and production as it involves minimizing the cost and maximizing the profits (SDG 12) |

**FF No.: 654-A**

## HS2003: From Campus to Corporate 2

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Credits: 2 | CP: - Marks |
| Lectures: Hrs/week | GD/PPT/HA: - Marks |
| Practical: Hrs/week | MSE (R): 50 Marks |
| Tutorial: Hrs/week | ESE (R): 50 Marks |

FF No.: 654-A

**HS2004: Reasoning and Aptitude Development 4**

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Credits: 1 | CP: 0 Marks |
| Lectures: 0 Hrs/week | GD/PPT/HA: 0 Marks |
| Practical: 0 Hrs/week | MSE (W/O): 0 Marks |
| Tutorial: 1 Hrs/week | ESE- Direct Evaluation: 100 Marks |

| | |
|---|---|
| **Prerequisites:** | Reasoning and Aptitude Development 1, 2, 3 |
| ● | |

| **Course Objectives:** | |
|---|---|
| ● | To develop effective reading, writing, listening, and verbal communication skills for academic, professional, and interpersonal interactions. |
| ● | To enhance logical reasoning, analytical thinking, and problem-solving abilities for making informed and rational decisions. |
| ● | To strengthen quantitative aptitude, mathematical reasoning, and data interpretation skills required for solving real-world and competitive examination problems. |
| ● | To cultivate effective time management, planning, prioritization, and decision-making skills for improving productivity and accuracy. |
| ● | To enable students to integrate communication, reasoning, and quantitative skills for critical thinking and solving practical engineering and real-world problems. |

| **Course Outcomes:** | |
|---|---|
| | After completion of the course, student will be able to |
| 1. | Improve the reading, writing and verbal skills, and enhance comprehension and articulation abilities |
| 2. | Develop logical reasoning abilities, enabling them to make sound decisions in problem solving scenarios |
| 3. | Develop mathematical aptitude as well as data interpretation abilities and use them in test cases and real-world problems |
| 4. | Learn to apply approaches for optimum time-management, prioritization maximizing the accuracy |
| 5. | Learn data interpretation, apply mathematical skills to draw accurate conclusions |
| 6. | Apply their knowledge of English, reasoning and quantitative skills for planning, critical thinking and real-world problems |

| **Section1:** | **English Language** |
|---|---|
| Familiarity with English Language, Ability to understand written text, spoken word and effective communication through written documents; Coverage of vocabulary to cope up with general and specific terminology, syntax and sentence structure, prevention of incorrect use leading to distortion in communication; synonyms, antonyms and contextual vocabulary, Grammar – Error identification, sentence improvement and construction, Reading Comprehension | |

| **Section2:** | **Logical Ability** |
|---|---|
| Objective interpretation of things, ability to perceive and interpret trends to make generalizations; ability to analyze assumptions behind an argument or statement; Deductive reasoning: Assessment of ability to synthesize information and derive conclusions - Coding deduction logic, Data Sufficiency, Directional Sense, Logical word sequence, Objective reasoning, Selection and decision tables, puzzles; Inductive reasoning: Assessment of ability to learn by example, imitation or by trial – Analogy pattern recognition, Classification pattern recognition, Coding pattern recognition, Number series pattern recognition; Abductive reasoning: Critical thinking ability of seeing through logical weak links or loopholes in an argument or a group of statements; Critical reasoning: assessment of ability to think through and analyze logical arguments, assessment of ability to use logical constructs to offer reasoning in unfamiliar situations; Information Gathering and synthesis: Ability of locating information, information ordering, rule based selection and data interpretation, order and classify data, interpret graphs, charts, tables and make rule based deductions. Application of these approaches for using visual, numerical and textual data from single or multiple sources | |

| **Section3:** | **Quantitative Ability** |
|---|---|
| Basic numbers – decimals and fractions, factorization, divisibility: HCF, LCM, Odd, even, prime and rational numbers. Application of algebra to real world, direct and inverse proportion, common applications – Speed-time -distance, Profit-loss, percentage, age relations, mixtures, other miscellaneous quantitative combination, exponentials and logarithms, permutations and combinations, probability. Spatial reasoning: Inductive – Missing portions, Sequence and series; Deductive analysis. | |

| **Section4:** | **Automata Module:** |
|---|---|
| Automata is a path breaking tool to evaluate programming skills in a simulated environment. With capability to | |

evaluate programming code beyond correctness and ability to rate code quality, efficiency of execution and provide objective norm-based scores.
Scientifically designed question bank consisting of a wide range of easy to hard programming problems with smartly designed corner and generic tests cases, Knowledge of algorithms, data structures, concepts like recursion, dynamic memory allocation and modular programming. The compiler supports multiple programming languages such as C, C++, Java, etc. The question bank includes distinct problem sets for IT Product and IT Services companies. B asic, advanced and edge test cases designed for a problem, the code is checked thoroughly for correctness and completeness. It can evaluate the time complexity or simply the efficiency of the code. The code is scored on quality of the code based on industry defined best practice

| **Section5:** | **Automata Pro** |
|---|---|

It can be effectively used for fresher hiring as well as hiring lateral programmers. The assessment allows evaluation of actual programming skills of a candidate, giving the candidate an opportunity to write the program in an editor, compile and run test cases, all in the assessment environment itself.

| **Section6:** | **Automata Fix** |
|---|---|

Automata fix assesses the candidate's skill to diagnose and identify any bugs in code and fix them.

**Reference Books:** ***(As per IEEE format)***


| | |
|---|---|
| 1 | "English Grammar in Use" by Raymond Murphy, Cambridge University Press. |
| 2 | "Word Power Made Easy" by Norman Lewis, Goyal Publishers & Distributors. |
| 3 | "Objective General English" by S.P. Bakshi, Arihant Publications. |
| 4 | "English for Competitive Examinations" by K. Sinha, S. Chand Publishing. |
| 5 | "Essential English Grammar" by Philip Gucker, Wiley. |
| 6 | "English Idioms and Phrasal Verbs" by M.A. Yadav, Vikas Publishing House. |
| 7 | "The Oxford English Grammar" by Sidney Greenbaum, Oxford University Press. |
| 8 | "A Modern Approach to Verbal & Non-Verbal Reasoning" by R.S. Aggarwal, S. Chand Publishing, ISBN: 978-8121903409. |
| 9 | "Logical Reasoning and Data Interpretation for the CAT" by Nishit K. Sinha, Pearson India, ISBN: 978-8131709117. |
| 10 | "Logical Reasoning and Data Interpretation for the CAT" by Arun Sharma, McGraw Hill Education, ISBN: 978-0070709642. |
| 11 | "A New Approach to Reasoning Verbal and Non-Verbal" by B.S. Sijwali & Indu Sijwali, Arihant Publications, ISBN: 978-9311124692. |
| 12 | "Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal, S. Chand Publishing, ISBN: 978-8121900637. |
| 13 | "How to Prepare for Quantitative Aptitude for the CAT" by Arun Sharma, McGraw Hill Education, ISBN: 978-0070709642. |
| 14 | "The Pearson Guide to Quantitative Aptitude for Competitive Examination" by Pearson, Pearson India, ISBN: 978-8131709117. |
| 15 | "Quantitative Aptitude for Competitive Examinations" by Abhijit Guha, Tata McGraw Hill Education, ISBN: 978-0070666653. |
| 16 | "Data Interpretation & Data Sufficiency" by R.S. Aggarwal, S. Chand Publishing ISBN: 978-8121903515. |
| 17 | "Quantitative Aptitude for Competitive Examinations" by S. Chand, S. Chand Publishing, ISBN: 978-8121903423. |


**Reference Books for Automata Module:** ***(As per IEEE format)***


| | |
|---|---|
| 1 | "Data structures using C and C++", Y. Langsam, M.J. Augenstein, A.M.Tenenbaum, Pearson Education, Second Edition. |
| 2 | Programming Pearls" by Jon Bentley, ISBN 13: 978 1449357162, O'Reilly Media. |
| 3 | "Introduction to the Theory of Computation" by Michael Sipser, ISBN 13: 978 1133187790, Cengage Learning. |
| 4 | "Algorithms" by Robert Sedge wick and Kevin Wayne, ISBN 13: 978 0321573513, Publisher: Addison Wesley. |
| 5 | "Data Structures and Algorithm Made Easy", Narasimha Karumanchi, Fifth Edition, CareerMonk publication. |
| 6 | "The Art of Computer Programming" by Donald E. Knuth, Addison Wesley. |
| 7 | "Operating System Concepts" by Abraham Silberschatz, Henry Korth, and S. Sudarshan, ISBN10:1119946005, Wiley. |


**List of Practical's:**

Practice Test on:

1. English Tenses

2. Grammar and Syntax
3. Reading Comprehension
4. Deductive Reasoning
5. Inductive Reasoning
6. Abductive & Critical Reasoning
7. Information Gathering, Interpretation & Synthesis
8. Number System & Arithmetic Foundations
9. Algebraic Applications & Proportional Reasoning
10. Applied Quantitative Problem Solving
11. Advanced Quantitative & Spatial Reasoning
12. Automata Module – Programming Skill Evaluation
13. Automata Pro IT
14. Automata Pro Max

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**List of Project areas:**

1. N/A
2.
3.

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### CO – PO / PSO Articulation Matrix

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO 1 | PSO 2 | PSO 3 |
| CO1 | - | - | - | - | - | - | - | - | 2 | 3 | - | 2 | 1 | |
| CO2 | 2 | 3 | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 | |
| CO3 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 3 | |
| CO4 | - | 2 | 2 | - | - | - | - | 2 | 2 | - | 3 | 3 | 1 | |
| CO5 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | 2 | 3 | |
| CO6 | 2 | 3 | 3 | 2 | 2 | 2 | - | - | 2 | 3 | 2 | 3 | 2 | |
| Avg | 2.5 | 2.6 | 2.2 | 2.0 | 2.0 | 2.0 | - | 2.0 | 2.0 | 3.0 | 2.5 | 2.3 | 2.0 | |

### CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | ✓ | ✓ | - | - | - | ✓ | - |
| CO2 | - | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | - |
| CO3 | - | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | - |
| CO4 | - | - | - | ✓ | - | ✓ | - | ✓ | - |
| CO5 | - | ✓ | ✓ | ✓ | ✓ | ✓ | - | - | - |
| CO6 | - | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✓ | - |

### CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | - | - | - | - | - | |
| CO2 | ✓ | ✓ | ✓ | - | - | - | |
| CO3 | ✓ | ✓ | ✓ | ✓ | - | - | |
| CO4 | ✓ | - | ✓ | - | ✓ | - | |

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO5 | ✓ | ✓ | ✓ | ✓ | - | - | |
| CO6 | ✓ | ✓ | ✓ | ✓ | ✓ | - | ✓ |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | - | - | ✓ | - |
| CO2 | ✓ | ✓ | ✓ | - | - |
| CO3 | ✓ | ✓ | ✓ | ✓ | - |
| CO4 | - | ✓ | - | ✓ | ✓ |
| CO5 | ✓ | ✓ | ✓ | ✓ | - |
| CO6 | ✓ | ✓ | ✓ | ✓ | ✓ |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | 4 | Enhances English communication, comprehension, reading, writing, and articulation skills that promote lifelong learning and employability. |
| CO2 | 4, 16 | Develops logical reasoning, analytical thinking, and informed decision-making, supporting effective problem-solving and responsible professional practices. |
| CO3 | 4, 8, 9 | Strengthens mathematical aptitude and data interpretation skills essential for engineering analysis, innovation, and industry readiness. |
| CO4 | 4, 8 | Builds time-management, planning, and prioritization skills that improve productivity, professionalism, and workplace efficiency. |
| CO5 | 4, 9 | Develops quantitative analysis and data interpretation skills required for evidence-based engineering decisions and technological advancement. |
| CO6 | 4, 8, 9, 16 | Integrates communication, reasoning, quantitative aptitude, and critical thinking for solving real-world problems, enhancing employability, innovation, and responsible decision-making. |

**FF No.: 654-A**

## CV2016: Construction Management Practice

| **Teaching Scheme** | **Examination Scheme** |
|---|---|
| Credits: 3 | CIE: 30 Marks |
| Lectures: 2 Hrs/week | CP: 50 Marks |
| Practical: 2 Hrs/week | GD/PPT/HA: 20 Marks |
| Tutorial: NA | Lab Exam: 30 Marks |
| | CVV (W/O): 30 Marks |
| | ESE(W): 40 Marks |

| **Prerequisites:** | |
|---|---|
| ● | Basic Civil Engineering |

| **Course Objectives:** | |
|---|---|
| ● | Understand the principles of project management, project identification, feasibility analysis, and organizational structures in the construction industry |
| ● | Develop project plans and schedules using modern planning, scheduling, monitoring, and control techniques. |
| ● | Understand material procurement, inventory management, and digital tools for effective construction materials management. |
| ● | Apply engineering economics principles to evaluate the financial feasibility and sustainability of construction projects. |

| **Course Outcomes:** | |
|---|---|
| | After completion of the course, student will be able to |
| 1. | Explain project management principles, project life cycle, project identification techniques, feasibility studies, and organizational structures in construction projects. |
| 2. | Develop and evaluate project plans using WBS, Gantt charts, CPM, PERT, resource optimization, and earned value management techniques. |
| 3. | Apply material management practices including procurement planning, inventory control, storage management, and digital tools such as Excel and ERP systems. |
| 4. | Evaluate the economic feasibility of construction projects using engineering economics principles and investment appraisal techniques such as BCR, NPV, IRR, Payback Period, and life-cycle costing. |

| **Section1:** | **Introduction to project management and project identification** |
|---|---|

Importance, objectives & functions of management, Categories of project, Project--- life cycle Concept and Cost Components, Project management Institute and Certified Project Management Professionals (PMP), PMBOK, Importance of organizational Structure in Management- Authority / Responsibility Relation. Role of construction industry in infrastructure development, BOT and BOLT techniques. Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point. Case study is preferred. Environmental impact assessment

| **Section2:** | **Project planning, scheduling, Monitoring and control** |
|---|---|

WBS – Work Breakdown, Gantt/Bar chart, 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. floats. Resource Allocation – Resource Smoothening and levelling, Network Crashing – Time- Cost –Resource optimization, Project Monitoring- Updating, Earned Value.

| **Section 3** | **Materials Management** |
|---|---|

Objectives of Materials management – Primary and secondary Material Procurement Procedures material requirement- raising of indents, receipts, Inspection, storage, delivery, record keeping– Use of Excel sheets, ERP software, Inventory control- ABC analysis, EOQ and its variation.

| **Section 4** | **Construction Economics** |
|---|---|

Principles of economics applied to construction projects, demand and supply in the construction industry, factors affecting construction costs, time value of money, simple and compound interest, present worth and future worth analysis, economic evaluation techniques including Benefit-Cost Ratio (BCR), Net Present Value (NPV), Internal Rate of Return (IRR) and Payback Period, project financing methods, life-cycle costing, depreciation, cost indices, economic feasibility studies.

**Text Books:** ***(As per IEEE format)***


| | |
|---|---|
| 1 | *Chitkara, K. K., (2014), Construction Project Management: Planning, Scheduling and Controlling, 3rd Edition, Tata McGraw-Hill Education, New Delhi.* |

| | |
|---|---|
| 2 | *Peurifoy, R. L., Oberlender, G. D., and Schexnayder, C. J., (2018), Construction Planning, Equipment, and Methods, 9th Edition, McGraw-Hill Education, New York.* |
| 3 | *Gopalakrishnan, P., and Sundaresan, M., (2015), Materials Management: An Integrated Approach, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi.* |
| 4 | *Project Management Institute (PMI), (2021), A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 7th Edition, Project Management Institute, Newtown Square, Pennsylvania, USA.* |
| **Reference Books:** ***(As per IEEE format)*** | |
| 1 | *Hendrickson, C., and Au, T., (2008), Project Management for Construction: Fundamental Concepts for Owners, Engineers, Architects and Builders, 2nd Edition, Prentice Hall, New Jersey.* |
| 2 | *Gould, F. E., and Joyce, N. E., (2014), Construction Project Management, 4th Edition, Pearson Education, Boston.* |
| 3 | *Bhattacharya, S. K., and Nand, T. H., (2014), Materials Management, Revised Edition, Sultan Chand & Sons, New Delhi.* |

**List of Practical's:**

14. Draw an organizational chart for construction of any infrastructure project
15. Project identification using feasibility studies
16. Assignment on WBS, CPM and PERT
17. Use of Project Management Software's – MS Project / Primavera for a Work break down structure
18. Use of Project Management Softwares-MSProject/Primavera for CPM and PERT or suitable available software
19. Assignment on network crashing
20. Assignment on resource allocation
21. Assignment on Project performance and Evaluation
22. Assignment of ABC Analysis
23. Assignment on EOQ Analysis
24. Assignment on Construction Economics-NPV Cost benefit analysis
25. Assignment on Construction economics- Deprecation analysis-Excel

**List of Project areas:**

22. Preparation of Work Breakdown Structure (WBS) for Construction Projects
23. Project Scheduling Using Gantt Charts
24. CPM-Based Planning and Scheduling of Building Projects
25. PERT Analysis for Projects with Uncertain Activity Durations
26. Material Procurement Planning for Building Projects
27. Inventory Control Using ABC Analysis
28. Economic Order Quantity (EOQ) Analysis for Construction Materials
29. Economic Feasibility Analysis of Construction Projects
30. Cost Estimation and Cost Control Techniques
31. Benefit-Cost Ratio (BCR) Analysis of Infrastructure Projects
32. Net Present Value (NPV) Analysis for Investment Decisions

## CO – PO / PSO Articulation Matrix

*Correlation: 1 = Low (Slight), 2 = Medium (Moderate), 3 = High (Substantial), '-' = no correlation.*

| CO | Program Outcome (PO) | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | 3 | 2 | – | 2 | – | 1 | 2 | – | – | – | 1 | 2 | – |
| CO2 | 3 | 2 | 2 | 3 | 2 | – | – | – | 1 | – | 2 | 3 | 1 |
| CO3 | 3 | 2 | 2 | 2 | 3 | – | 2 | – | 1 | – | 2 | 3 | 1 |
| CO4 | 3 | 2 | 2 | 2 | 2 | – | 2 | – | – | – | 3 | 2 | 1 |
| Avg | 3 | 2 | -2 | 2.5 | 2.33 | 1 | -2 | -- | -1 | -- | 2 | 2.5 | 1 |

## CO – WK Mapping (Knowledge & Attitude Profiles) Sample Table

*'✓' indicates the knowledge profile drawn upon by the CO.*

| CO | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | ✓ | ✓ | | ✓ | ✓ | | |
| CO2 | | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ |
| CO3 | | ✓ | ✓ | ✓ | | ✓ | | | ✓ |
| CO4 | | ✓ | ✓ | ✓ | ✓ | ✓ | | | |

## CO – WP Mapping (Complex Engineering Problems) Sample Table

| CO | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 |
|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| CO2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| CO3 | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| CO4 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

## CO – EA Mapping (Complex Engineering Activities)

*'✓' indicates the activity attribute addressed by the CO*

| CO | EA1 | EA2 | EA3 | EA4 | EA5 |
|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | | | |
| CO2 | ✓ | ✓ | | | |
| CO3 | ✓ | ✓ | | | |
| CO4 | ✓ | ✓ | | | |

## CO – SDG Mapping (Sustainable Development Goals) Sample Table

| CO | SDG(s) Addressed | Justification / Linkage |
|---|---|---|
| CO1 | SDG 8, 9, 11, 13 | Project planning and feasibility contribute to sustainable infrastructure, economic growth, and environmental assessment. |
| CO2 | SDG 8, 9, 11, 12, 13 | Efficient scheduling and resource optimization improve productivity, reduce waste, and support sustainable infrastructure. |
| CO3 | SDG 8, 9, 12, 13 | Materials management minimizes waste, improves resource efficiency, and supports sustainable construction practices. |
| CO4 | SDG 8, 9, 11, 12, 13 | Economic evaluation and life-cycle costing enable sustainable and financially viable infrastructure development. |