# Final Year: 2019 Pattern

# Course Outcome and Program Outcome mapping using Competency and Performance Indicator

## Semester I

## Course Name: Foundation Engineering

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401001 | Foundation Engineering | CO1 | Perform subsurface investigations for foundations using different methods. |
| | | CO2 | Estimate the bearing capacity of shallow foundations. |
| | | CO3 | Calculate immediate and primary consolidation settlement of shallow foundations. |
| | | CO4 | Decide the capacity of a pile and pile group. |
| | | CO5 | Understand the steps in geotechnical design of shallow foundations and well foundations. |
| | | CO6 | Analyze problems related to expansive soil and overcome them using design principles, construction techniques in black cotton soil. |

**CO PO Matrix- Foundation Engineering**

| CO401001 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO No** | **EK** | **PA** | **DD** | **CPI** | **MTU** | **E&S** | **ES** | **Eth** | **TW** | **Com** | **PMF** | **LL** | | | |
| **C401001.1** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **C401001.2** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **C401001.3** | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **C401001.4** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **C401001.5** | 3 | 2 | 1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **C401001.6** | 2 | 2 | 1 | 1 | - | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| **Avg C401001** | **2.83** | **2.67** | **2.16** | **2.67** | **3.00** | **3.00** | **2.17** | **2.75** | **2.83** | **3.00** | **2.17** | **3.00** | **3.00** | **3.00** | **3.00** |

# Course Name: Transportation Engineering

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401002 | Transportation Engineering | CO1 | Understand Principles and practices of transportation planning |
| | | CO2 | Demonstrate knowledge of traffic studies, analysis and their interpretation |
| | | CO3 | Design geometric elements of road pavement |
| | | CO4 | Evaluate properties of highway materials as a part of road pavement |
| | | CO5 | Appraise different types of pavements and their design. |
| | | CO6 | Understand the fundamentals of bridge engineering and railway engineering. |

**CO PO Matrix- Transportation Engineering**

| CO401002 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401002.1 | 3 | 2 | 1 | 3 | - | 3 | 2 | 2 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401002.2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401002.3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | - | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401002.4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401002.5 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401002.6 | 2 | 1 | 2 | 2 | - | 3 | 3 | - | - | 3 | - | 3 | 3 | 3 | 3 |
| **Avg C401002** | **2.67** | **2.25** | **2.50** | **2.50** | **1.33** | **3.00** | **2.83** | **1.75** | **2.50** | **3.00** | **0.00** | **3.00** | **3.00** | **3.00** | **3.00** |

# Elective III

## Course Name: Coastal Engineering

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401003a | Coastal Engineering | CO1 | Understand basic of ocean waves including wave generation, classification, propagation, wave theories, wave diffraction, wave refection and wave breaking. |
| | | CO2 | Understand and apply short term and long-term wave analysis. |
| | | CO3 | Understand basic characteristics of tides, tide producing forces, dynamic theory of tides |
| | | CO4 | Understand coastal process of erosion/accretion due to waves, bed forms, long shore transport (Littoral drift) and estimation of wave induced sediment quantity. |
| | | CO5 | Understand the coastal structures and shore protection methods. |
| | | CO6 | Understand coastal zone management activities, issues related to integrated coastal zone management and regulation of coastal zone. |

**CO PO Matrix- Coastal Engineering**

| C 401003 a | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401003a.1 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401003a.2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401003a.3 | 3 | 2 | 2 | 1 | - | 2 | 1 | 2 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401003a.4 | 3 | 3 | 2 | 1 | - | 2 | 1 | 2 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401003a.5 | 3 | 2 | 2 | 1 | - | 2 | 2 | 2 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401003a.6 | 3 | 2 | 2 | 1 | - | 3 | 1 | 2 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| Avg C401003a | 3.00 | 2.50 | 2.00 | 1.33 | 1.00 | 2.17 | 1.17 | 2.00 | 3.00 | 3.00 | - | 3.00 | 3.00 | 3.00 | 3.00 |

# Elective III

## Course Name: Advanced Design of Concrete Structures

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401003b | Advanced Design of Concrete Structures | CO1 | Understand yield line theory and apply it to analyze and design slabs of different shapes having different edge conditions. |
| | | CO2 | Understand the concepts of ductile detailing |
| | | CO3 | Analyze and design of flat slab. |
| | | CO4 | Analyze and design of retaining walls. |
| | | CO5 | Analyze and design of liquid retaining structures. |
| | | CO6 | Analyze and design of RC frames and shear walls. |

**CO PO Matrix- Advanced Design of Concrete Structures**

| C 401003 b | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401003b.1 | 3 | 3 | 3 | 1 | - | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| C401003b.2 | 3 | 3 | 3 | 1 | - | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| C401003b.3 | 3 | 3 | 3 | 1 | - | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| C401003b.4 | 3 | 3 | 3 | 1 | - | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| C401003b.5 | 3 | 3 | 3 | 1 | - | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| C401003b.6 | 3 | 3 | 3 | 1 | - | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Avg C401003b | 3.00 | 2.00 | 2.00 | 2.67 | 1.00 | 2.00 | 1.00 | 0.00 | 2.83 | 2.83 | 2.00 | 2.83 | 3.00 | 3.00 | 3.00 |

# Elective III

# Course Name: Integrated Water Resources Planning & Management

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401003c | Integrated Water Resources Planning & Management | CO1 | Understand concerned organizations, IWRP & M objectives, principles, challenges, application & analysis of IWRP&M approaches & principles in a case study. |
| | | CO2 | Understand PIM, WDS, WALMI, agriculture in the concept of integrated water resources, apply and analyse water requirements for food production |
| | | CO3 | Understand assessment of surface and ground water quality, EIA, CPCB regulations application & analysis of effluent quality standards as per CPCB |
| | | CO4 | Understand water economics and funding, application & analysis of planning for a sustainable water future |
| | | CO5 | Understand legal regulatory settings of IWRP & M, application & analysis of inter-basin water transfers and IWRP & M |
| | | CO6 | Understand flood control & power generation for IWRP & M, application QIGIS for analysis of a basin for IWRP & M |

## CO PO Matrix- Integrated Water Resources Planning & Management

| C 401003 c | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO No** | **EK** | **PA** | **DD** | **CPI** | **MTU** | **E&S** | **ES** | **Eth** | **TW** | **Com** | **PMF** | **LL** | | | |
| **C401003c.1** | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 |
| **C401003c.2** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 2 | 2 | - | 3 | 3 | 3 | 3 |
| **C401003c.3** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | - | 3 | 3 | 3 | 3 |
| **C401003c.4** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| **C401003c.5** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 2 | 2 | - | 3 | 3 | 3 | 3 |
| **C401003c.6** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 |
| **Avg C401003c** | **3.00** | **3.00** | **2.88** | **3.00** | **0.67** | **3.00** | **3.00** | **3.00** | **2.00** | **2.33** | **0.50** | **3.00** | **3.00** | **3.00** | **3.00** |

## Elective III

# Course Name: Finite Element Method

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401003d | Finite Element Method | CO1 | To understand the basics of solid mechanics prior to learn finite element analysis. |
| | | CO2 | To solve simple engineering problems using 1D, 2D and 3D elements. |
| | | CO3 | To write shape functions of 1D, 2D and 3D elements |
| | | CO4 | To determine the stresses in three dimensional finite elements using iroparametric formulation. |
| | | CO5 | To analyze the truss and beam elements using stiffness matric and finite element procedure. |
| | | CO6 | To evaluate the forces and stresses in rigid jointed portal frame and grid elements using stiffness matrix and finite element procedure. |

**CO PO Matrix- Finite Element Method**

| C 401003 d | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401003d.1 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 3 | - | 2 | 3 | 1 | 3 |
| C401003d.2 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | - | 1 | 3 | 1 | 3 |
| C401003d.3 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | - | 2 | 3 | 1 | 3 |
| C401003d.4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | - | 2 | 3 | 1 | 3 |
| C401003d.5 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | - | 2 | 3 | 1 | 3 |
| C401003d.6 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | - | 2 | 3 | 1 | 3 |
| Avg C401003d | 3.00 | 3.00 | 2.50 | 2.83 | 3.00 | 2.00 | 2.00 | 1.00 | 3.00 | 3.00 | 0.00 | 1.83 | 3.00 | 1.00 | 3.00 |

## Elective IV

# Course Name: Air Pollution and Control

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401004a | Air Pollution and Control | CO1 | Recall air pollution, legislation and regulations. |
| | | CO2 | Evaluate air pollutant concentrations as a function of meteorology. |
| | | CO3 | Interpret sampling results with prescribed standards. |
| | | CO4 | Assess emission inventory and air quality models. |
| | | CO5 | Compare the air pollution control equipment. |
| | | CO6 | Infer indoor air pollution and its mitigation. |

**CO PO Matrix- Air Pollution and Control**

| C 401004 a | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401004a.1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| C401004a.2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 |
| C401004a.3 | 2 | 2 | 2 | 2 | - | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 3 |
| C401004a.4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 3 | 3 | 3 |
| C401004a.5 | 2 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| C401004a.6 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Avg C401004a | 2.33 | 2.50 | 2.38 | 2.50 | 2.60 | 2.50 | 2.33 | 2.50 | 2.50 | 2.67 | 2.17 | 2.50 | 2.83 | 2.83 | 3.00 |

## Elective IV

# Course Name: Design of Prestressed Concrete Structures

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401004e | Design of Prestressed Concrete Structures | CO1 | Know the prestressed members. |
| | | CO2 | Determining the stresses and various losses in prestressed concrete members. |
| | | CO3 | Design the prestressed concrete structures . |
| | | CO4 | Design the prestressed concrete slab |
| | | CO5 | Design the prestressed concrete flat slab |
| | | CO6 | Analysis and design the prestressed continuous beams . |

**CO PO Matrix- Design of Prestressed Concrete Structures**

| C 401004 e | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401004e.1 | 2 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 | 3 | 3 | 2 |
| C401004e.2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| C401004e.3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| C401004e.4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| C401004e.5 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 3 | 1 | 2 | 3 | 3 | 3 |
| C401004e.6 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| Avg C401004e | **2.8** | **2.8** | **2.8** | **3** | **2.5** | **3** | **2.7** | **3** | **1.67** | **3** | **1.67** | **2.67** | **3.00** | **3.00** | **2.83** |

# Semester- II

## Course Name: Dams and Hydraulic Structures

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401011 | Dams and Hydraulic Structures | CO1 | Understand the different types 0f dams & site selection criteria and different instruments required for dam construction. |
| | | CO2 | Evaluate the structural stability of gravity dam under different loading conditions and explain different types of arch dams, buttress dams. |
| | | CO3 | Illustrate different types of spillways, spillway gates and design ogee spillway with energy dissipation below spillway. |
| | | CO4 | Evaluate structural stability of homogeneous earthen dam and analyse, design the stability of weir on permeable foundation |
| | | CO5 | Explain different types of canals, canal structures and design of canal. |
| | | CO6 | Understand the classification and necessity of different types of cross drainage works |

**CO PO Matrix- Dams and Hydraulic Structures**

| CO401011 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401011.1 | 2 | 2 | 3 | 2 | - | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 |
| C401011.2 | 3 | 3 | 3 | 3 | 1 | 3 | 2 | 2 | 2 | 3 | - | 3 | 3 | 3 | 3 |
| C401011.3 | 3 | 3 | 3 | 3 | 1 | 3 | 2 | 2 | 2 | 3 | - | 3 | 3 | 3 | 3 |
| C401011.4 | 3 | 3 | 3 | 3 | 1 | 3 | 2 | - | 2 | 3 | - | 3 | 3 | 3 | 3 |
| C401011.5 | 3 | 3 | 3 | 3 | 1 | 3 | 2 | - | 2 | 3 | - | 3 | 3 | 3 | 3 |
| C401011.6 | 2 | 2 | - | 1 | - | - | 2 | - | 2 | 2 | - | 3 | 3 | 3 | 3 |
| Avg C C401011 | 2.67 | 2.50 | 3.00 | 2.50 | 1.00 | 3.00 | 2.00 | 2.00 | 2.17 | 2.83 | 1.00 | 3.00 | 3.00 | 3.00 | 3.00 |

# Course Name: Quantity Surveying, Contracts and Tenders

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401012 | Quantity Surveying, Contracts and Tenders | CO1 | Understand concept of estimates and prepare approximate estimate for various Civil Engineering works. |
| | | CO2 | Describe tendering process, construction contracts, and aspects of Arbitration and prepare tender documents. |
| | | CO3 | Prepare detailed estimate of various items of work by different methods and calculate quantity of steel from Bar bending schedule. |
| | | CO4 | Apply engineering knowledge to prepare estimate for roads, culverts, and water tank (Elevated storage tank) |
| | | CO5 | Apply concepts of specification to draft brief specification, detailed specification and prepare detailed rate analysis report. |
| | | CO6 | Evaluate depreciation and valuation of property on the basis of present condition, specifications and market trend. |

## CO PO Matrix- Quantity Surveying, Contracts and Tenders

| CO401012 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO No** | **EK** | **PA** | **DD** | **CPI** | **MTU** | **E&S** | **ES** | **Eth** | **TW** | **Com** | **PMF** | **LL** | | | |
| **C401012.1** | 2 | 3 | 2 | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| **C401012.2** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **C401012.3** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **C401012.4** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **C401012.5** | 3 | 1 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 3 |
| **C401012.6** | 3 | 1 | 1 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 1 | 3 | 2 | 2 | 3 |
| **Avg C C401012** | **2.83** | **2.33** | **2.33** | **3.00** | **2.67** | **2.00** | **2.83** | **2.00** | **3.00** | **2.67** | **2.33** | **3.00** | **2.67** | **2.67** | **3.00** |

# Elective V

## Course Name: Earthquake Engineering

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401013a | Earthquake Engineering | CO1 | Define the concepts of earthquakes, seismology and vibrations |
| | | CO2 | Model physical structures and develop equations of motion |
| | | CO3 | Solve the equations of motion for SDOF systems. |
| | | CO4 | Solve the equations of motion for MDOF systems |
| | | CO5 | Perform static seismic analysis for buildings |
| | | CO6 | Perform dynamic seismic analysis for buildings |

**CO PO Matrix- Earthquake Engineering**

| CO401013a | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401013a.1 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | - | 2 | 1 | 2 | 3 | 3 | 3 |
| C401013a.2 | 3 | 3 | 3 | 3 | 3 | - | 2 | 3 | 1 | 2 | 1 | 1 | 3 | 3 | 3 |
| C401013a.3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 2 | 3 | 3 | 3 |
| C401013a.4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 3 | 3 | 3 |
| C401013a.5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 3 | 3 | 3 |
| C401013a.6 | 3 | 3 | 3 | 3 | 3 | - | 2 | 3 | 1 | 2 | 1 | 2 | 3 | 3 | 3 |
| Avg C C401013a | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 2.00 | 1.83 | 3.00 | 0.8 | 2.00 | 1.00 | 1.50 | 3.00 | 3.00 | 3.00 |

# Elective V

## Course Name: Hydropower Engineering

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401013e | Hydropower Engineering | CO1 | Do the planning of energy resource & find hydropower potential. |
| | | CO2 | Understand hydrological analysis and types of hydropower plant. |
| | | CO3 | Estimate electrical load on turbines, Understand Prediction of load & Thermal and Nuclear Power Plants. |
| | | CO4 | Understand Water Conductor System, Powerhouse & their components, equipment in power house |
| | | CO5 | Understand types of turbines, to design and select particular type of turbine. |
| | | CO6 | Understand Economics of Hydroelectric Power, carbon credits and pricing of electricity. |

**CO PO Matrix- Hydropower Engineering**

| CO401013e | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401013e.1 | 2 | 2 | 2 | 3 | 1 | 3 | 3 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 2 |
| C401013e.2 | 2 | 2 | 3 | 3 | 1 | 3 | 3 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 2 |
| C401013e.3 | 3 | 2 | 3 | 3 | 1 | 3 | 3 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 2 |
| C401013e.4 | 2 | 2 | 3 | 3 | 1 | 3 | 3 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 2 |
| C401013e.5 | 3 | 2 | 3 | 3 | 1 | 3 | 3 | 2 | 1 | 3 | 1 | 3 | 3 | 3 | 2 |
| C401013e.6 | 2 | 2 | 2 | 3 | 1 | 3 | 3 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 2 |
| Avg C C401013e | 2.67 | 2.0 | 2.67 | 3.00 | 1.00 | 3.00 | 3.00 | 2.00 | 1.00 | 3.00 | 1.83 | 3.00 | 3.00 | 3.00 | 2.00 |

# Elective V

## Course Name: Structural Audit and Retrofitting of Structures

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401013f | Structural Audit and Retrofitting of Structures | CO1 | Identify causes of deterioration in RC and steel structures. |
| | | CO2 | Explore entire process of structural audit. |
| | | CO3 | Explore necessity and methods of structural health monitoring. |
| | | CO4 | Explain method of retrofitting for RC, steel and historical structures. |
| | | CO5 | Design retrofitting using FRP for RC column. |
| | | CO6 | Design retrofitting using FRP for RC beams. |

**CO PO Matrix- Structural Audit and Retrofitting of Structures**

| CO401013f | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401013f.1 | 3 | 2 | 1 | 3 | - | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 |
| C401013f.2 | 3 | 3 | 2 | 3 | - | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 |
| C401013f.3 | 3 | 3 | 3 | 2 | - | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 |
| C401013f.4 | 3 | 3 | 3 | 2 | - | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 |
| C401013f.5 | 2 | 3 | 1 | 3 | - | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 |
| C401013f.6 | 2 | 3 | 3 | 2 | - | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 2 |
| Avg C C401013f | 2.67 | 2.75 | 2.00 | 2.50 | - | 3.00 | 3.00 | 1.50 | 2.00 | 2.00 | 3.00 | 2.50 | 3.00 | 3.00 | 2.00 |

# Elective VI

## Course Name: TQM and MIS

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401014a | TQM and MIS | CO1 | **Recognize** quality and contribution of quality gurus for evaluation of best practices. |
| | | CO2 | **Relate** the functioning and application of TQM & Six Sigma in the domain of construction sector. |
| | | CO3 | **Recommend** ISO 9001 principles in preparation of quality manual to construction business. |
| | | CO4 | **Apply** management control & certification systems for construction industry. |
| | | CO5 | **Choose** TQM process implementation and various quality awards for construction sector. |
| | | CO6 | **Propose** MIS for allied fields in construction sector. |

**CO PO Matrix- TQM and MIS**

| CO401014a | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401014a.1 | 2 | 3 | 2 | 2 | - | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| C401014a.2 | 2 | 3 | 2 | 2 | - | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| C401014a.3 | 2 | 3 | 2 | 1 | - | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| C401014a.4 | 2 | 2 | 2 | 1 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| C401014a.5 | 2 | 3 | 2 | 2 | - | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| C401014a.6 | 2 | 3 | 2 | 1 | 3 | 2 | - | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 |
| Avg C C401014a | **2.00** | **2.75** | **1.63** | **1.50** | **0.50** | **2.50** | **2.33** | **3.00** | **3.00** | **3.00** | **2.17** | **3.00** | **2.83** | **3.00** | **3.00** |

# Elective VI

## Course Name: Advanced Transportation Engineering

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401014b | Advanced Transportation Engineering | CO1 | Understand the transport system planning and transportation system management. |
| | | CO2 | Study the urban transport technology, intelligent transportation system. |
| | | CO3 | Discuss the concept of traffic economic evaluation and environmental impact assesment. |
| | | CO4 | Understand the concept of traffic engineering and suggest the control. |
| | | CO5 | Explaining the concept of design of flexible pavement and pavement management system. |
| | | CO6 | Summarize the concept of rigid pavement design and design of overlay |

**CO PO Matrix- Advanced Transportation Engineering**

| CO401014b | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401014b.1 | 3 | 2 | 2 | 3 | 1 | 3 | 2 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401014b.2 | 2 | 1 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401014b.3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |
| C401014b.4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401014b.5 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | - | 2 | 3 | 3 | 3 |
| C401014b.6 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| Avg C C401014b | 2.83 | 2.50 | 2.75 | 2.33 | 2.00 | 3.00 | 2.83 | 3.00 | 3.00 | 3.00 | 0.50 | 2.50 | 3.00 | 3.00 | 3.00 |

# Elective VI

## Course Name: Green Structures and Smart Cities

| Course Code | Course Name | Course Outcomes | |
|---|---|---|---|
| **At the end of the course, the learners will be able to** | | | |
| C401014e | Green Structures and Smart Cities | CO1 | Describe the importance of energy and minimization by altering the building materials. |
| | | CO2 | Understand the importance green construction and green rating system |
| | | CO3 | Students should be able to introduce the applications of energy conservation and efficiency practices in buildings. |
| | | CO4 | Understand phases and approval involved in smart city project. |
| | | CO5 | Assess the national and global experience of smart cities. |
| | | CO6 | Understand the importance of sustainable development and current protocol of sustainable development goals. |

**CO PO Matrix- Green Structures and Smart Cities**

| CO401014b | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO No | EK | PA | DD | CPI | MTU | E&S | ES | Eth | TW | Com | PMF | LL | | | |
| C401014e.1 | 3 | 2 | 2 | 3 | 1 | 3 | 2 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401014e.2 | 1 | 1 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| C401014e.3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 2 |
| C401014e.4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | - | 2 | 3 | 3 | 3 |
| C401014e.5 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | - | 2 | 3 | 3 | 3 |
| C401014e.6 | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| Avg C C401014e | 2.5 | 2.50 | 2.75 | 2.33 | 2.00 | 3.00 | 2.83 | 3.00 | 2.83 | 3.00 | 0.50 | 2.33 | 3.00 | 3.00 | 2.83 |