# Department of Civil Engineering

B.Tech. curriculum (W.E.F. 2018-2019)

# Vision

[1]. To impart knowledge, advanced skills, excellence in scientific and technical education and research with global perspectives in infrastructural developments with modern trends.

[2]. To encourage students to imbibe the engineering ethics to serve India and World.

[3]. To serve as a valuable resource for societal needs and economic growth of the country.

# Mission

[1]. To provide quality education with ethical values in commensuration with balanced curriculum

[2]. To provide advanced skills and knowledge in design, construction, consultancy and develop the state-of-the-art research facilities

[3]. To serve as a knowledge base and create professional expertise for the community

[4]. To promote innovative and original thinking in the minds of civil engineering graduates

# PEOs (Program Educational Objectives) for B. Tech Program of Civil Engineering Department:

**PEO #1: Knowledge of Basic Science and Engineering**

To establish confidence in basic/fundamental knowledge, problem solving skills, engineering experimental abilities, and design capabilities for a successful civil engineering career.

**PEO #2: Engineering Design and Skills**

To impart knowledge and skills necessary for identifying and assessing Civil Engineering design solutions and the related social, economic and public safety impacts.

**PEO #3: Encouraging Lifelong Learning**

To encourage engineering graduates for obtaining professional license, assuming leadership roles, engaging in life-long learning.

**PEO #4: Incubating Professional and Ethical Attitude**

To nurture students' ability to deal effectively with ethical and professional issues, taking into account the broader societal implications of Civil Engineering.

# Program Outcomes (POs):

Undergraduate engineering programmes are designed to prepare graduates to attain the following program outcomes:

| PO | PO Description |
|---|---|
| **PO #1** | **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |

| | |
|---|---|
| **PO #2** | **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| **PO #3** | **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| **PO #4** | **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| **PO #5** | **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. |
| **PO #6** | **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| **PO #7** | **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| **PO #8** | **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO #9** | **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO#10** | **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| **PO#11** | **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| **PO#12** | **Life-long learning:** Recognize the need for,and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

# Program Specific Outcomes (PSOs):

**PSO #1:** Develop the ability to plan, analyze, design and prepare cost estimates of various civil engineering projects.

**PSO #2:** Apply computer aided skill and tools, execute various civil engineering projects.

**PSO #3:** Implement various codal provisions/guidelines as applicable to design and civil engineering profession.

**NB.: COs will be as per the Faculty concerned… and the Correlation Level of Co vs PO as below**
"1" – Slight (Low) Correlation
"2" – Moderate (Medium) Correlation
"3" – Substantial (High) Correlation

**Total Course Credit points: 164**

| SEMESTER - I | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | MAC01 | Mathematics - I | 2 | 1 | 0 | 3 | 3 |
| 2 | PHC01 | Physics | 2 | 1 | 0 | 3 | 3 |
| 3 | CYC01 | Chemistry | 2 | 1 | 0 | 3 | 3 |
| 4 | XEC01 | Engineering Mechanics | 2 | 1 | 0 | 3 | 3 |
| 5 | ESC01 | Environmental Science | 2 | 0 | 0 | 2 | 2 |
| 6 | BTC01 | Life Science | 2 | 0 | 0 | 2 | 2 |
| 7 | PHS01 | Physics Laboratory | 0 | 0 | 2 | 1 | 2 |
| 8 | CYS01 | Chemistry Laboratory | 0 | 0 | 2 | 1 | 2 |
| 9 | WSS01 | Workshop Practice | 0 | 0 | 2 | 1 | 2 |
| 10 | XES01 | Co-curricular Activities - I | 0 | 0 | 2 | 0 | 2 |
| 11 | HSC01 | Values and Ethics | 0 | 0 | 0 | 0 | 0 |
| | | **TOTAL** | **12** | **4** | **8** | **19** | **24** |

| SEMESTER - II | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | MAC02 | Mathematics - II | 2 | 1 | 0 | 3 | 3 |
| 2 | CSC01 | Introduction to Computing | 2 | 1 | 0 | 3 | 3 |
| 3 | ECC01 | Basic Electronics | 2 | 1 | 0 | 3 | 3 |
| 4 | EEC01 | Electrical Technology | 2 | 1 | 0 | 3 | 3 |
| 5 | MES01 | Engineering Graphics | 1 | 0 | 2 | 2 | 3 |
| 6 | CSS01 | Computing Laboratory | 0 | 0 | 2 | 1 | 2 |
| 7 | ECS01 | Basic Electronics Laboratory | 0 | 0 | 2 | 1 | 2 |
| 8 | EES01 | Electrical Technology Laboratory | 0 | 0 | 2 | 1 | 2 |
| 9 | HSS01 | Professional Communication | 1 | 0 | 2 | 2 | 3 |
| 10 | XES02 | Co-curricular Activities - II | 0 | 0 | 2 | 0 | 2 |
| | | **TOTAL** | **10** | **4** | **12** | **19** | **26** |

SOME OF THE SUBJECTS ABOVE ARE GROUPED FOR INTERCHANGE BETWEEN FIRST AND SECOND SEMESTER FOR HALF OF THE STUDENT HAVING TOTAL CREDIT UNIT 38 IN FIRST YEAR (1ST AND 2ND SEMESTER COMBINED)

**2017-18 (1st Year Credit = 38)**

**Total Course Credit points: 170**

| SEMESTER - I | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | MAC01 | Mathematics - I | 3 | 1 | 0 | 4.0 | 4 |
| 2 | PHC01 | Engineering Physics | 2 | 1 | 0 | 3.0 | 3 |
| 3 | CYC01 | Engineering Chemistry | 2 | 1 | 0 | 3.0 | 3 |
| 4 | XEC01 | Engineering Mechanics | 2 | 1 | 0 | 3.0 | 3 |
| 5 | ESC01 | Environmental Science | 2 | 0 | 0 | 2.0 | 2 |
| 6 | XES51 | Engineering Graphics | 1 | 0 | 3 | 2.5 | 4 |
| 7 | HSS51 | Professional Communication Laboratory | 1 | 0 | 2 | 2.0 | 3 |
| 8 | PHS51 | Physics Laboratory | 0 | 0 | 2 | 1.0 | 2 |
| 9 | CYS51 | Chemistry Laboratory | 0 | 0 | 2 | 1.0 | 2 |
| 10 | WSS51 | Workshop Practice | 0 | 0 | 3 | 1.5 | 3 |
| 11 | XXS51 | Co-curricular Activities - I | 0 | 0 | 2 | 1.0 | 2 |
| | | **TOTAL** | **13** | **4** | **14** | **24.0** | **31** |

| SEMESTER - II | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | MAC02 | Mathematics - II | 3 | 1 | 0 | 4.0 | 4 |
| 2 | CSC01 | Introduction to Computing | 2 | 1 | 0 | 3.0 | 3 |
| 3 | ECC01 | Basic Electronics | 2 | 1 | 0 | 3.0 | 3 |
| 4 | EEC01 | Electrical Technology | 2 | 1 | 0 | 3.0 | 3 |
| 5 | BTC01 | Life Science | 2 | 0 | 0 | 2.0 | 2 |
| 6 | XES52 | Graphical Analysis using CAD | 0 | 0 | 2 | 1.0 | 2 |
| 7 | CSS51 | Computing Laboratory | 0 | 0 | 2 | 1.0 | 2 |
| 8 | ECS51 | Basic Electronics Laboratory | 0 | 0 | 2 | 1.0 | 2 |
| 9 | EES51 | Electrical Technology Laboratory | 0 | 0 | 2 | 1.0 | 2 |
| 10 | XXS52 | Co-curricular Activities - II | 0 | 0 | 2 | 1.0 | 2 |
| | | **TOTAL** | **11** | **4** | **10** | **20.0** | **25** |

**2018-19 (1st Year Credit = 44)**

| SEMESTER - III | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | MAC331 | Mathematics - III | 3 | 1 | 0 | 4 | 4 |
| 2 | CEC301 | Solid Mechanics | 3 | 1 | 0 | 4 | 4 |
| 3 | CEC302 | Fluid Mechanics | 3 | 0 | 0 | 3 | 3 |
| 4 | CEC303 | Building Construction & Concrete Technology | 3 | 1 | 0 | 4 | 4 |
| 5 | ESC331 | Engineering Geology for Civil Engineering | 3 | 0 | 0 | 3 | 3 |
| 6 | ESS381 | Engineering Geology Laboratory for Civil Engineering | 0 | 0 | 3 | 1.5 | 3 |
| 7 | CES351 | Fluid Mechanics & Strength of Material Laboratory | 0 | 0 | 3 | 1.5 | 3 |
| 8 | XXS381 | Co-curricular Activities - III (Optional) | 0 | 0 | 0 | 0 | 0 |
| | | **TOTAL** | **15** | **3** | **6** | **21** | **24** |

N.B.: Although XXS381 is non-credit, participation will enrich individual grade card.

| SEMESTER - IV | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEC401 | Structural Analysis-I | 3 | 1 | 0 | 4 | 4 |
| 2 | CEC402 | Design of Concrete Structures | 3 | 1 | 0 | 4 | 4 |
| 3 | CEC403 | Surveying | 3 | 0 | 0 | 3 | 3 |
| 4 | CSC432 | Data Structure | 3 | 0 | 0 | 3 | 3 |
| 5 | CEO44*<br>HSC431 | Open Elective - I<br>Psychology | 3 | 0 | 0 | 3 | 3 |
| 6 | CES451 | Structural Analysis Sessional-I | 0 | 0 | 3 | 1.5 | 3 |
| 7 | CES452 | Design of concrete Structures Sessional | 0 | 0 | 3 | 1.5 | 3 |
| 8 | CSC482 | Data Structure Sessional | 0 | 0 | 3 | 1.5 | 3 |
| 9 | XXS481 | Co-curricular Activities - IV (Optional) | 0 | 0 | 0 | 0 | 0 |
| | | **TOTAL** | **15** | **2** | **9** | **21.5** | **26** |

N.B.: Although XXS481 is non-credit, participation will enrich individual grade card.

| SEMESTER - V | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEC501 | Structural Analysis-II | 3 | 1 | 0 | 4 | 4 |
| 2 | CEC502 | Design of Steel Structures | 3 | 1 | 0 | 4 | 4 |
| 3 | CEC503 | Soil Mechanics | 3 | 0 | 0 | 3 | 3 |
| 4 | CEC504 | Transportation Engineering | 3 | 1 | 0 | 4 | 4 |
| 5 | CEO54* | Open Elective - 2 | 3 | 0 | 0 | 3 | 3 |
| 6 | CES551 | Structural Analysis Sessional-II | 0 | 0 | 3 | 1.5 | 3 |
| 7 | CES552 | Design of Steel Structures Sessional | 0 | 0 | 3 | 1.5 | 3 |
| 8 | CES553 | Transportation Engineering & Soil Mechanics Laboratory | 0 | 0 | 3 | 1.5 | 3 |
| 9 | CES554 | Surveying Laboratory & Estimation Sessional | 1 | 0 | 3 | 2.5 | 4 |
| 10 | XXS581 | Co-curricular Activities - V (Optional) | 0 | 0 | 0 | 0 | 0 |
| | | **TOTAL** | **16** | **3** | **12** | **25** | **31** |

N.B.: Although XXS581 is non-credit, participation will enrich individual grade card.

| SEMESTER - VI | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | HSC631 | Economics and Management Accountancy | 3 | 0 | 0 | 3 | 3 |
| 2 | CEC601 | Water Resource Engineering | 3 | 1 | 0 | 4 | 4 |
| 3 | CEC602 | Foundation Engineering | 3 | 0 | 0 | 3 | 3 |
| 4 | CEC603 | Environmental Engineering | 3 | 1 | 0 | 4 | 4 |
| 5 | CEE610-619 | Depth Elective - 1 | 3 | 0 | 0 | 3 | 3 |
| 6 | CEE620-629 | Depth Elective - 2 | 3 | 0 | 0 | 3 | 3 |
| 7 | CES651 | Environmental Engineering Laboratory & Computational Laboratory- I | 0 | 0 | 3 | 1.5 | 3 |
| 8 | CES652 | Concrete Technology Laboratory | 0 | 0 | 3 | 1.5 | 3 |
| 9 | XXS681 | Co-curricular Activities - VI (Optional) | 0 | 0 | 0 | 0 | 0 |
| | | **TOTAL** | **18** | **2** | **6** | **23** | **26** |

N.B.: Although XXS681 is non-credit, participation will enrich individual grade card.

| SEMESTER - VII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | MSC731 | Principles of Management | 3 | 0 | 0 | 3 | 3 |
| 2 | CEE710-719 | Depth Elective - 3 | 3 | 0 | 0 | 3 | 3 |
| 3 | CEE720 -729 | Depth Elective - 4 | 3 | 0 | 0 | 3 | 3 |
| 4 | CEE730 -739 | Depth Elective - 5 | 3 | 0 | 0 | 3 | 3 |
| 5 | CEO74* | Open Elective - 3 | 3 | 0 | 0 | 3 | 3 |
| 6 | CES751 | Project - I | 0 | 0 | 4 | 2 | 4 |
| 8 | CES752 | Structural Engineering Laboratory & Computational Laboratory -II | 0 | 0 | 3 | 1.5 | 3 |
| 9 | CES753 | Vocational Training / Summer Internship and Seminar | 0 | 0 | 2 | 1 | 2 |
| | | **TOTAL** | **15** | **0** | **9** | **19.5** | **24** |

| SEMESTER - VIII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEE810-819 | Depth Elective - 6 | 3 | 0 | 0 | 3 | 3 |
| 2 | CEO84* | Open Elective - 4 | 3 | 0 | 0 | 3 | 3 |
| 3 | CEO85* | Open Elective - 5 | 3 | 0 | 0 | 3 | 3 |
| 4 | CES851 | Project - II | 0 | 0 | 15 | 5 | 15 |
| 5 | CES852 | Project Seminar | 0 | 0 | 0 | 1 | 0 |
| 6 | CES853 | Viva Voce | 0 | 0 | 0 | 1 | 0 |
| | | **TOTAL** | **9** | **0** | **15** | **16** | **24** |

# OPEN ELECTIVES

The students can opt from elective subject(s) that are offered in a particular semester, except the subjects with his /her own department code.

| OPEN ELECTIVE – 1 : SEMESTER-IV | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEO440 | Introduction to Earthquake Engineering | 3 | 0 | 0 | 3 | 3 |
| 2 | CEO441 | Elementary Civil Engineering | 3 | 0 | 0 | 3 | 3 |
| 3 | CEO442 | Experimental Methods & Analysis | 3 | 0 | 0 | 3 | 3 |

| OPEN ELECTIVE – 2 : SEMESTER-V | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEO540 | Numerical Methods in Engineering | 3 | 0 | 0 | 3 | 3 |
| 2 | CEO541 | Engineering Computing and Simulation with Scilab | 3 | 0 | 0 | 3 | 3 |
| 3 | CEO542 | Introduction to Random Vibrations | 3 | 0 | 0 | 3 | 3 |

| OPEN ELECTIVE – 3 : SEMESTER-VII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEO740 | Mechanics of Composite | 3 | 0 | 0 | 3 | 3 |
| 2 | CEO741 | Optimization in Engineering Design | 3 | 0 | 0 | 3 | 3 |
| 3 | CEO742 | Theory of Elasticity and Plasticity | 3 | 0 | 0 | 3 | 3 |

| OPEN ELECTIVE – 4 : SEMESTER-VIII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEO840 | Finite Element Analysis and Applications | 3 | 0 | 0 | 3 | 3 |
| 2 | CEO841 | Disaster Management and Mitigation | 3 | 0 | 0 | 3 | 3 |
| 3 | CEO842 | Experimental Methods in Engineering | 3 | 0 | 0 | 3 | 3 |

| OPEN ELECTIVE – 5: SEMESTER-VIII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEO850 | Watershed Planning and Management | 3 | 0 | 0 | 3 | 3 |
| 2 | CEO851 | Elementary Structural Design | 3 | 0 | 0 | 3 | 3 |
| 3 | CEO852 | Reliability Engineering | 3 | 0 | 0 | 3 | 3 |

# DEPTH ELECTIVES

The students primarily will opt from elective subject(s) that are offered in a particular semester by his /her own department. However, a student can opt for elective subject(s) that are offered by other department in a particular semester, with the permission/ consent from his/her Head of the Department and the concerned teacher of that subject.

| **DEPTH ELECTIVE – 1 : SEMESTER-VI** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEE610 | Advanced Design of Concrete Structures | 3 | 0 | 0 | 3 | 3 |
| 2 | CEE611 | Advanced Structural Analysis | 3 | 0 | 0 | 3 | 3 |
| 3 | CEE612 | Mechanics of Composite Structures | 3 | 0 | 0 | 3 | 3 |
| 4 | CEE613 | Material Technology | 3 | 0 | 0 | 3 | 3 |
| 5 | CEE614 | Applied Numerical Methods | 3 | 0 | 0 | 3 | 3 |
| 6 | CEE615 | Bridge Engineering | 3 | 0 | 0 | 3 | 3 |
| | | | | | | | |

| **DEPTH ELECTIVE – 2 : SEMESTER-VI** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEE620 | Analysis and Design of Pavement | 3 | 0 | 0 | 3 | 3 |
| 2 | CEE621 | Finite Element Method | 3 | 0 | 0 | 3 | 3 |
| 3 | CEE622 | Ground Improvement | 3 | 0 | 0 | 3 | 3 |
| 4 | CEE623 | Remote sensing and GIS | 3 | 0 | 0 | 3 | 3 |
| 5 | CEE624 | Traffic Engineering and Management | 3 | 0 | 0 | 3 | 3 |
| 6 | CEE625 | System Approach to Civil Engineering | 3 | 0 | 0 | 3 | 3 |
| | | | | | | | |

| DEPTH ELECTIVE – 3 : SEMESTER-VII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEE710 | Structural Dynamics | 3 | 0 | 0 | 3 | 3 |
| 2 | CEE711 | Advanced Design of Steel Structures | 3 | 0 | 0 | 3 | 3 |
| 3 | CEE712 | Theory of Plates and Shells | 3 | 0 | 0 | 3 | 3 |
| 4 | CEE713 | Theory of Elasticity and Plasticity | 3 | 0 | 0 | 3 | 3 |
| 5 | CEE714 | Structural Health Monitoring | 3 | 0 | 0 | 3 | 3 |
| | | | | | | | |

| DEPTH ELECTIVE – 4 : SEMESTER-VII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEE720 | Soil Dynamics | 3 | 0 | 0 | 3 | 3 |
| 2 | CEE721 | Environmental Pollution and control | 3 | 0 | 0 | 3 | 3 |
| 3 | CEE722 | Construction Planning and Management | 3 | 0 | 0 | 3 | 3 |
| 4 | CEE723 | Open Channel Hydraulics | 3 | 0 | 0 | 3 | 3 |
| 5 | CEE724 | Ground Water | 3 | 0 | 0 | 3 | 3 |
| 6 | CEE725 | Hydrology & Irrigation Engineering | 3 | 0 | 0 | 3 | 3 |
| | | | | | | | |

| DEPTH ELECTIVE – 5 : SEMESTER-VII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEE730 | Principles of Reliability | 3 | 0 | 0 | 3 | 3 |
| 2 | CEE731 | Offshore Structural Dynamics | 3 | 0 | 0 | 3 | 3 |
| 3 | CEE732 | Pre-stressed Concrete | 3 | 0 | 0 | 3 | 3 |
| 4 | CEE733 | Advanced Concrete Technology | 3 | 0 | 0 | 3 | 3 |
| 5 | CEE734 | Advanced Structural Mechanics | 3 | 0 | 0 | 3 | 3 |
| | | | | | | | |

| DEPTH ELECTIVE – 6 : SEMESTER-VIII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl No.** | **Code** | **Subject** | **L** | **T** | **S** | **C** | **H** |
| 1 | CEE810 | Sediment Transport | 3 | 0 | 0 | 3 | 3 |
| 2 | CEE811 | Slope Stability and Reinforced Earth | 3 | 0 | 0 | 3 | 3 |
| 3 | CEE812 | Soil Structure Interaction | 3 | 0 | 0 | 3 | 3 |
| 4 | CEE813 | Industrial Waste | 3 | 0 | 0 | 3 | 3 |
| 5 | CEE814 | Water Resources System Planning & Management | 3 | 0 | 0 | 3 | 3 |
| 6 | CEE815 | Machine Foundation | 3 | 0 | 0 | 3 | 3 |
| | | | | | | | |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEC-301 | Solid Mechanics | PCR | 3 | 1 | 0 | 4 | 4 |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Knowledge of Engineering Mechanics and Mathematics | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs): | • CO1: Development of skills for predicting structural behaviour of solids under different loads<br>• CO2: Knowledge of basics of analysis and design of structural components made of variety of materials<br>• CO3: Developing the requisite skill that helps in studying the advanced courses |
| Topics Covered (Hrs) | **Concept of stress and strain**: Normal and shear stresses and strains in axially loaded members, Elastic moduli and their inter-relationships, strain energy due to direct stresses, impact loads. **(4)**<br>**Beam Statics**: Definitions, support types and support reactions, concepts of redundancy, shear force and bending moment diagrams for beams. **(8)**<br>**Symmetric Beam Bending**: Basic kinematical assumptions, moment of inertia, elastic flexure formulae and its application, moment carrying capacity. **(3)**<br>**Bending stress and Shear stress distributions** in beam sections, Combined bending and direct stresses. **(8)**<br>**Strain energy**: Due to pure bending and shearing stress. **(2)**<br>**Deflection of beams**: Moment-curvature relationship, determination of deflection by direct integration method, moment area method and energy method. **(6)**<br>**Torsion**: Pure torsion, Torsion of circular solid shaft, closed coil helical spring. Combined bending and torsion. **(4)**<br>**Two dimensional stress problems**: Principal stresses, maximum shear stresses, Mohr's circle of stresses, construction of Mohr's circle. **(4)**<br>**Thin pressure vessels**: Hoop stress and meridional stress, volumetric changes **(2)**<br>**Columns**: Fundamentals, different types of equilibrium, column buckling theory, Euler's load for columns, limitations of Euler's theory – problems, eccentric load and secant formulae, empirical column formulae & IS code formulae. **(4)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Elements of Strength of Material by S. P. Timoshenko & D. H. Young<br>2. Strength of Materials by S SBhavikatti<br>3. Engineering Mechanics of Solids by E. P. Popov<br>***Reference Books:***<br>4. Strength of Material by Singer & Pytel<br>5. A Text Book of Strength of Materials by Ghosh & Datta, New Age International Publication Pvt. Ltd, New Delhi |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| CO2 | - | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 3 |
| CO3 | - | 3 | - | 2 | - | - | - | - | - | - | - | - | 3 | 2 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEC-302 | Fluid Mechanics | PCR | 3 | 0 | 0 | 3 | 3 |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Mechanics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Development of skills for predicting fluid behaviour<br>• CO2: Knowledge of basics of fluid flow measurement and model development<br>• CO3: Developing the requisite skill that helps in studying the advanced courses |
| Topics Covered (Hrs) | **Fluid Properties:** Equations of State, Units and Dimensions, Fluid Pressure, Pressure Gauges, Resultant Pressure on Plane and Curved Immersed Surfaces, Centre of Pressure, Equilibrium of Floating Bodies, Buoyancy and Meta Centre. **(9)**<br>**Types of Flow**: Definitions, Continuity Equation, Equation of Flow along a Stream Line, Energy Equation, Momentum Equation, Fluid Acceleration, Flow in a Curved Path, Forced and Free Vortex. **(7)**<br>**Dimensional Analysis**: Similitude of fluid flow, non-dimensional numbers. **(3)**<br>**Incompressible flow in closed conduits**: Laminar and Turbulent Flow, Critical Reynold's Number, Pipe Friction Law, Laminar Flow in Pipes, Friction Loss in Smooth and Rough Pipes, Minor Losses in Pipes, HGL and EGL, Empirical Formula for Pipe flow. **(6)**<br>**Flow measurement:** Orifice coefficient, External and Reentrant Mouth pieces, Measurement of Velocity and Discharge in Closed Conduits, Venturimeter, Orificemeter and Pitot Tube, Flow through Rectangular Weirs and V-Notch, Time of Emptying Tanks and Reservoirs. **(7)**<br>**Open Channels:** Equation of Uniform Flow, Chezy and Manning Formulae, Velocity Distribution and Economic Cross Section. **(4)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Fluid Mechanics by Frank M White, Tata McGraw-Hill<br>2. Introduction to Fluid Mechanics by Robert W Fox & Alan T McDonald, WILEY<br>3. Fluid Mechanics by V. L. Streeter & E B Wylie, McGraw-Hill<br>***Reference Books:***<br>4. Fluid Mechanics and Hydraulics by Jack B Evett & Cheng Liu, Tata McGraw-Hill |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 |
| CO2 | - | 2 | 3 | 1 | - | - | - | - | - | - | - | - | - | 2 | 1 |
| CO3 | - | 3 | - | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC303** | **Building Construction & Concrete Technology** | **PCR** | **3** | **1** | **0** | **4** | **4** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| No pre-requisites | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Acquire knowledge of selection and application of building materials<br>• CO2: Understand the building components and planning<br>• CO3: Gain an integrative idea on materials, preparation and mix design of concrete |
| Topics Covered (Hrs) | **A). Building planning and construction:** Planning and orientation of buildings, Introduction to different components and functions of a building in details: Foundation, Wall, Beam, Floor, Roof, Stair & Staircase, Door, Window, and etc. **(10)**<br>**B). Building Materials:** Brief idea on different building materials **(2)**<br>**Aggregates:** Classification, sampling, mechanical, physical properties of fine and coarse aggregates, standard tests, deleterious substances, Alkali-aggregate reaction, thermal properties, grading of aggregate. **(4)**<br>**Cement:** Introduction, chemical composition, major compounds, hydration, physical properties, testing, fineness, consistency, setting time, soundness, strength, heat of hydration, specific gravity, types of cement **(8)**<br>**Water:** Source, quality, impurities and effect of on concrete, sea water **(2)**<br>**Admixture:** Introduction, classification, specifications and functions of admixtures. **(2)**<br>**Other materials:** Brick, Timber, Lime, Cement mortar, Timber, Steel and Paint. **(8)**<br>**C). Concrete Technology:** Introduction, classification, properties, grades, advantage, disadvantages and quality control of concrete. **(2)**<br>**Fresh concrete:** Introduction, workability, factors, measurement, segregation, bleeding and manufacture of concrete – batching, mixing, transporting, placing, compaction, finishing and curing. **(6)**<br>**Hardened concrete:** Introduction, strength, stress–strain characteristics, destructive and non-destructive test, shrinkage, creep, permeability, durability, attack of sulphates, acid, efflorescence, thermal properties and fire resistance. **(4)**<br>**Concrete mix design:** Factors and mix design using Indian Standard code. **(4)**<br>**Special concrete:** Introduction of Light weight, High density, High strength, Fibre reinforced, Polymer concrete and Ferro cement. **(4)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Engineering Materials by S. C. Rangwala, K. S. Rangwala and P. S. Rangwala, Charotar Publishing House, Anand<br>2. Building Construction by S. C. Rangwala, Charotar Publishing House, Anand<br>3. Concrete Technology by M.S. Shetty, S. Chand Publisher, New Delhi<br>4. IS 10262: 2009, Concrete Mix Proportioning-Guidelines (1st Revision), BIS, New Delhi.<br>5. IS 383: 1970, Specification for Coarse and Fine aggregates from natural sources for concrete (2nd Revision) BIS, New Delhi.<br>***Reference Books:***<br>6. Concrete Technology by M. L. Gambhir, Tata McGraw Hill and www.nptel.ac.in |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | 2 | 1 | - | - | - | - | - | 2 | - | 1 |
| CO2 | 3 | - | - | - | - | 2 | 1 | - | - | - | - | - | 3 | 3 | 1 |
| CO3 | 3 | - | 3 | - | - | 2 | 1 | - | - | - | - | - | - | 1 | 2 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CES351** | **Fluid and Strength of Material Laboratory** | **PS** | **0** | **0** | **3** | **3** | **1.5** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| NIL | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Conduct experiments for the determining the properties of harden concrete and mild steel, and other construction materials.<br>• CO2: Perform different experiments on fluid mechanics related problems for determination of properties of flow through pipes and calibration of few flow rate measuring instruments.<br>• CO3: Use modern instruments and tools to determine the properties of harden concrete and other civil engineering materials and work in a group.<br>• CO4: Prepare the report on experimental results. |
| Topics Covered (Hrs) | Determination of compressive strength, split tensile strength & flexural strength of concrete.<br>To observe the behavior of a mild steel specimen while being tested and to determine (i) upper and lower yield points, (ii) ultimate strength, (iii) breaking strength, (iv) percentage elongation of length, (v) percentage reduction of cross-section.<br>To apply torsional load on circular rods and to determine the value of modulus of rigidity by measuring the angle of twist.<br>Experiment on Rockwell Hardness Test.<br>Determination of coefficient of bend loss in flow through pipes.<br>Experiment on friction loss in flow through pipes.<br>Calibration of Venturimeter.<br>Calibration of V-notch.<br>Calibration of Orifice meter.<br>Experiment on impact of jet. |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Concrete Technology by M. S. Shetty, S. Chand & Co<br>2. Concrete Technology by M. L. Gambhir, Tata McGraw Hill<br>3. Elements of Strength of Material by S. P. Timoshenko, and D. H. Young, Affiliated East-West Press.<br>***Reference Books:***<br>3. Fluid Mechanics by M White Frank, Tata McGraw-Hill<br>4. Introduction to Fluid Mechanics by W Fox Robert & T Alan McDonald, WILEY<br>5. Fluid Mechanics by V. L. Streeter, & E B, Wylie, McGraw-Hill. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | - | - | 3 | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | - | - | - | 3 | - | - | - | - | - | - | - | - | - | 3 | - |
| CO3 | - | - | - | 2 | 3 | - | - | - | 2 | - | - | - | - | 3 | - |
| CO4 | - | - | - | 1 | - | - | - | - | 1 | 3 | - | - | - | - | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEC-401 | Structural Analysis-I | PCR | 3 | 1 | 0 | 4 | 4 |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Engineering & Solid Mechanics | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Acquire the knowledge of structural systems, elements, joints, loads, stability, equilibrium, compatibility and indeterminacy<br>• CO2: Able to compute the internal forces in cable, arch, trusses, beams and frames<br>• CO3: Achieved the idea to apply geometric methods to obtain slope and deflections<br>• CO4: Gain the idea to apply Energy methods to obtain slope and deflections<br>• CO5: Evaluate & draw the influence lines for reactions, shears, & bending moments in beams & girders due to moving load. |
| Topics Covered (Hrs) | **Introduction:** Structural system, support condition different load and system **(2)**<br>**Shear force and bending moment:** Recapitulation of bending moment and shear force of determinate structures. **(4)**<br>**Slopes and deflections:** Slopes and deflections in beams and frames, elastic curve, application of elastic beam theory with Maculay's notation, moment area method, conjugate beam method. **(14)**<br>**Energy methods:** Strain energy, complementary energy, real work, virtual work, application of Castigliano's Theorems & virtual work methods to beams, frames, trusses, Maxwell's Reciprocal theorem, Betti's Law **(18)**<br>**Static and kinematic indeterminacy:** Application on different type of structures **(4)**<br>**Influence Lines:** Application of influence lines & rolling loads for determinate beams / girders **(10)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Basic Structural Analysis by C. S. Reddy, Tata McGraw Hill<br>2. Elementary Structural Analysis by Wilbur & Norris, Mcgraw-Hill College<br>3. Elements of structural analysis by N. C. Sinha, New Central book agency pvt. Ltd.<br>4. Structural Analysis by R. C. Hibbeler, Pearson Education<br>***Reference Books:***<br>5. Structural Analysis by G. S. Pandit & S. P. Gupta, Tata McGraw Hill<br>6. Theory of structures by S. P. Timoshenko and D. H. Young, Mc. Graw Hill book Co |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | - | - | - | - | - | - | - | - | 1 | - | - | 1 | 1 | 1 |
| CO2 | 3 | - | - | - | - | - | 1 | - | - | - | - | - | 3 | 2 | 1 |
| CO3 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| CO4 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| CO5 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | 2 | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC402** | **Design of Concrete Structures** | **PCR** | **3** | **1** | **0** | **1** | **4** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Solid Mechanics | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Apply knowledge of solid mechanics for design solutions.<br>• CO2: Understand basic design philosophies applicable to concrete structures.<br>• CO3: Formulate, analyze, and design basic components of Civil Engineering Reinforced Concrete structures. |
| Topics Covered (Hrs) | **Properties** of concrete and reinforcing steel, Characteristic strengths, Stress strain curves, Shrinkage and creep phenomenon, I.S. specification **(4)**<br>**Design philosophies** – working stress method and limit state method of design. **(8)**<br>**Analysis and design** of sections in flexure by working stress and limit state method, Single and doubly reinforced sections, T and L sections **(8)**<br>**Behaviour of beams** in shear and bond, Design for shear, Anchorage and curtailment of reinforcement, Detailing of reinforcement. **(4)**<br>**Serviceability**, Limit states of deflection and cracking, Calculation of deflections. **(4)**<br>**Design of columns**: Short and long columns, Eccentrically loaded columns **(8)**<br>**Design of one-way and two-way slabs, Staircases. (6)**<br>**Isolated and combined footings (6)**<br>**Design of cantilever type retaining walls (6)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Reinforced Concrete Design, 2nd Edition, by S. Unnikrishna Pillai and Devdas Menon, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003.<br>2. IS 456: 2000, Indian Standard Plain and Reinforced Concrete – Code of Practice (4th Revision), BIS, New Delhi.<br>3. SP-16, Design Aids for Reinforced Concrete to IS: 456 – 1978, BIS, New Delhi<br>4. www.nptel.iitm.ac.in/courses/<br>***Reference Books:***<br>5. Reinforced Concrete, 6th Edition, by S. K. Mallick and A.P. Gupta, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, 1996.<br>6. Reinforced Concrete Design, 1st Revised Edition, by S.N. Sinha, Tata McGraw-Hill Publishing Company. New Delhi, 1990. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | 3 | - | 2 |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | - | 2 | - |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | 2 | 1 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC 403** | **Surveying** | **PCR** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisites | | Course Assessment methods | | | | | |
| None | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes | • CO1: Learn basic principles of surveying and handling of various surveying instruments.<br>• CO2: Learn to conduct engineering surveys.<br>• CO3: Data entry in field books and level books.<br>• CO4: Make and interpret maps.<br>• CO5: Compute area and volumes. |
| Topics Covered (Hrs) | **Introduction:** Definition, primary division, classification and Principles of surveying, Basic measurements. **(2)**<br>**Linear measurements:** Instruments, Ranging, Chaining, Tape corrections. **(3)**<br>**Chain surveying:** Principles, Basic definitions, Equipment, Field work, Obstacles, Plotting & accuracy. **(3)**<br>**Compass surveying:** Instruments, Traverse, Bearings and their designations, Magnetic declination, Magnetic & true bearings, Field work, Plotting & adjustment of a closed traverse**.(3)**<br>**Levelling:** Basic definitions, Instruments and their adjustments, Principles of levelling, Fieldwork and writing level books, Profile levelling & cross-sectioning, Reciprocal levelling, Difficulties in levelling, Errors. **(4)**<br>**Contouring:** Basic definitions, Methods of locating contours, Characteristic of contours, Use of contour maps. **(2)**<br>**Plane Table surveying:** Introduction and basic definitions, Instruments and their uses, Principles of plane tabling, Methods of plane tabling, Three point problems and its solutions, Two-point problem and its solution, Errors in plane tabling, Advantages and disadvantages. (3)<br>**Theodolite:** Different parts, Temporary adjustments, Fundamental lines, Permanent adjustments, Measurement of horizontal and vertical angles. **(4)**<br>**Theodolite Traversing:** Introduction and basic definitions, Field work, Angular measurements, Traverse computations, Balancing of the traverse, Accuracy of traverse surveying. **(5)**<br>**Measurement of areas:** Area of a tract with irregular boundaries, Different methods, Planimeter and its uses. **(5)**<br>**Measurement of volumes:** Computation of area of cross sections for different sections, Computation of volumes by different methods, Volume from contour map, Capacity of reservoir, Volume from spot levels, Mass-Haul diagram – its characteristics and uses. **(4)**<br>**Electromagnetic distance measurements:** Working principle of EDM equipment, Uses, Range, Accuracy, Corrections to be applied to horizontal distances. **(4)** |
| Text Books, and/or reference material | ***Text Books:***<br>1. Surveying and Levelling Part I & II by T. P. Kanetkar and S. V. Kulkarni, Pune Vidyarthi Griha Prakashan Pune – 30, 1979<br>2. Surveying Vol. I & II. by, B. C. Punmia, A. K. Jain and A. K. Jain A.K., Laxmi Publications (P) Ltd., 2005<br>***Reference Books:***<br>***3.*** Surveying Vol. I. & II by K. R. Arora, Standard Book House, P.B.-1074, Delhi<br>***4.*** Surveying courses available in http://nptel.iitm.ac.in/ |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |
| CO2 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |
| CO3 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |
| CO4 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |
| CO5 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC-451** | **Structural Analysis Sessional-I** | **PS** | **0** | **0** | **3** | **3** | **1.5** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Engineering & Solid Mechanics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Acquire the knowledge of structural systems, elements, joints, loads, stability, equilibrium, compatibility and indeterminacy<br>• CO2: Able to compute the internal forces in cable, arch, trusses, beams and frames<br>• CO3: Achieved the idea to apply geometric methods to obtain slope and deflections<br>• CO4: Gain the idea to apply Energy methods to obtain slope and deflections<br>• CO5: Evaluate & draw the influence lines for reactions, shears, & bending moments in beams / girders due to moving load. |
| Topics Covered (Hrs) | **Introduction:** Structural system, support condition different load and system **(1)**<br>**Shear force and bending moment:** Recapitulation of bending moment and shear force of determinate structures. **(2)**<br>**Slopes and deflections:** Slopes and deflections in beams and frames, elastic curve, application of elastic beam theory with Maculay's notation, moment area method, conjugate beam method. **(12)**<br>**Energy methods:** Strain energy, complementary energy, real work, virtual work, application of Castigliano's Theorems & virtual work methods to beams, frames, trusses, Maxwell's Reciprocal theorem, Betti's Law **(12)**<br>**Static and kinematic indeterminacy:** Application on different type of structures **(3)**<br>**Influence Lines:** Application of influence lines & rolling loads for determinate beams / girders **(9)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Basic Structural Analysis by C. S. Reddy, Tata McGraw Hill<br>2. Elementary Structural Analysis by Wilbur & Norris, Mcgraw-Hill College<br>3. Elements of structural analysis by N. C. Sinha, New Central book agency pvt. Ltd.<br>4. Structural Analysis by R. C. Hibbeler, Pearson Education<br>***Reference Books:***<br>5. Structural Analysis by G. S. Pandit & S. P. Gupta, Tata McGraw Hill<br>6. Theory of structures by S. P. Timoshenko and D. H. Young, Mc. Graw Hill book Co |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO 3 |
| CO1 | - | - | - | - | - | - | - | - | - | 1 | - | - | 1 | 1 | 1 |
| CO2 | 3 | - | - | - | - | - | 1 | - | - | - | - | - | 3 | 2 | 1 |
| CO3 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| CO4 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| CO5 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | 2 | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CES452** | **Design of Concrete Structures sessional** | **PS** | **0** | **0** | **3** | **3** | **1.5** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Solid Mechanics | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Apply knowledge of solid mechanics for design solutions.<br>• CO2: Understand basic design philosophies applicable to concrete structures.<br>• CO3: Formulate, analyze, and design basic components of Civil Engineering Reinforced Concrete structures. |
| Topics Covered (Hrs) | **Properties** of concrete and reinforcing steel, Characteristic strengths, Stress strain curves, Shrinkage and creep phenomenon, I.S. specification **(4)**<br>**Design philosophies** – working stress method and limit state method of design. **(8)**<br>**Analysis and design** of sections in flexure by working stress and limit state method, Single and doubly reinforced sections, T and L sections **(8)**<br>**Behaviour of beams** in shear and bond, Design for shear, Anchorage and curtailment of reinforcement, Detailing of reinforcement. **(4)**<br>**Serviceability**, Limit states of deflection and cracking, Calculation of deflections. **(4)**<br>**Design of columns**: Short and long columns, eccentrically loaded columns **(8)**<br>**Design of one-way and two-way slabs, Staircases. (6)**<br>**Isolated and combined footings (6)**<br>**Design of cantilever type retaining walls (6)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Reinforced Concrete Design, 2nd Edition, by S. Unnikrishna Pillai and Devdas Menon, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003.<br>2. IS 456: 2000, Indian Standard Plain and Reinforced Concrete – Code of Practice (4th Revision), BIS, New Delhi.<br>3. SP-16, Design Aids for Reinforced Concrete to IS: 456 – 1978, BIS, New Delhi<br>4. www.nptel.iitm.ac.in/courses/<br>***Reference Books:***<br>5. Reinforced Concrete, 6th Edition, by S. K. Mallick and A.P. Gupta, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, 1996.<br>6. Reinforced Concrete Design, 1st Revised Edition, by S.N. Sinha, Tata McGraw-Hill Publishing Company. New Delhi, 1990. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | 3 | - | 2 |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | - | 2 | - |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | 2 | 1 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEC-501 | Structural Analysis-II | PCR | 3 | 1 | 0 | 4 | 4 |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Solid Mechanics & Structural Analysis-I | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Analyse indeterminate beams and frames by displacement methods (Slope deflection method, Moment distribution method, Kane's method)<br>• CO2: Analyse indeterminate beams and frames by force methods (Three moment Equation, column Analogy method, consistent deformation method)<br>• CO3: Apply matrix analysis using stiffness and flexibility methods- computer-based analysis of structure.<br>• CO4: Evaluate and draw the influence lines for reactions, shears, and bending moments in indeterminate beams / girders and frames.<br>• CO5: Apply approximate methods (Substitute Frame method, Portal and cantilever methods) to solve multi-storeyed building frames |
| Topics Covered (Hrs) | **Displacement methods**: Application of Slope deflection, Moment distribution & Kani's method to indeterminate beams, frames & portals **(16)**<br>**Force methods**: Application of Three moment equations to continuous beam, execution of Column analogy & Consistent deformation method to beams & frames **(12)**<br>**Influence lines:** Indeterminate structures, Muller Breslau principle with application to redundant beams **(8)**<br>**Matrix Method:** Matrix formulation of flexibility & stiffness methods of structures-application for simple loading cases **(10)**<br>**Approximate methods:** Substitute frames, Portal & Cantilever methods on multi-storeyed building frames **(6)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Basic Structural Analysis by C. S. Reddy, Tata McGraw Hill<br>2. Elementary Structural Analysis by Wilbur & Norris, Mcgraw-Hill College<br>3. Structural Analysis L. S. Negi & R. S. Jangid, Tata McGraw Hill<br>4. Structural Analysis by R. C. Hibbeler, Pearson Education<br>***Reference Books:***<br>5. Structural Analysis by G. S. Pandit & S. P. Gupta, Tata McGraw Hill<br>6. Intermediate structure analysis by C K Wang Mc. Graw Hill |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | 2 | - | - | - | - | - | 3 | - | 3 | 2 | 1 |
| CO2 | 3 | - | - | - | 2 | - | - | - | - | - | 3 | - | 3 | 2 | 1 |
| CO3 | 3 | - | - | - | 2 | - | - | - | - | 1 | 3 | - | 3 | 3 | 1 |
| CO4 | 3 | - | - | - | 2 | - | - | - | - | - | 3 | - | 3 | 2 | 1 |
| CO5 | 3 | - | 1 | - | - | - | - | - | - | - | 3 | - | 3 | 1 | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEC502 | Design of Steel Structures | PCR | 3 | 1 | 0 | 4 | 4 |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Solid Mechanics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Apply knowledge of solid mechanics for design solutions.<br>• CO2: Understand basic design philosophy applicable to steel structures.<br>• CO3: Formulate, analyze, and designbasic components of Civil Engineering Steel structures. |
| Topics Covered (Hrs) | **Introduction**, Properties of structural steel, I.S. rolled sections, I.S. specifications **(2)**<br>**Design philosophy** of Limit State method for Steel Structures **(6)**<br>**Design of Tension members**, Compression members in truss **(6)**<br>**Design of Beams** (laterally supported /unsupported) : Simple beam using rolled sections, Built up sections /compound beams **(6)**<br>**Design of Gantry girders (4)**<br>**Design of Plate girders**, Connections, Stiffeners and curtailment of flange plates, Splicing – riveted and welded. **(2)**<br>**Design of Simple Connections**: Riveted, Bolted and welded connections, moment resisting connections**. (6)**<br>**Design of Struts and columns** including built-up columns under axial and eccentric loadings, Lacing and battens, Column splicing. **(6)**<br>**Design of Column bases** – slab base, Gusseted base. **(4)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Design of steel Structures by N. Subrhamanium (Oxford publications)<br>2. IS 800-2007: General Construction in Steel-Code of Practice<br>3. IS 808-1989: Dimensions of Hot Rolled Steel beam, column, channel and angle sections<br>4. www.nptel.iitm.ac.in/courses/<br>***Reference Books:***<br>5. Limit State Design of Steel Structures by S.K. Duggal (McGraw Hill publications)<br>6. Limit State Design of Steel structures by Virendra Gehlot & Dr. Ram Chandra (Scientific publisher)<br>7. Design of steel Structures by S. S. Bhavikatti (IK Intl Publishing House, N Delhi) |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | 3 | - | 2 |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | - | 2 | - |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | 2 | 1 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC-503** | **Soil Mechanics** | **PCR** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Engineering and Fluid Mechanics | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Acquire knowledge of classifying the soil from Civil Engg. Aspect<br>• CO2: Ability to conduct Experiment and Analyze the data with interpretation<br>• CO3: Ability to analyze Soil for Soil-Structure like Dams (Earthen/Rigid)<br>• CO4: Ability to Design Soil related Civil Engg. Structure<br>• CO5: Understanding need of the Professional Ethics & future studies |
| Topics Covered (Hrs) | **Introduction:** Type of soil, Mineralogical composition, Basic definitions of soil parameters, Inter-phase relationships, Problems **(4)**<br>**Index properties:** Index properties of soils and their determination, classification based on index properties. Problems **(4)**<br>**Classification:** Various classification systems, IS, MIT, US bureau and soil classification, PRA, Plasticity chart. Group Index. Problems. **(3)**<br>**Soil-Water Pressure:** Total, effective, and pore pressure in soil. Capillary rise, effect of seepage on pore pressure, Quick condition. Problems. **(3)**<br>**Permeability:** Permeability and seepage through soil, Darcy's law, Determination of permeability by laboratory methods and field methods. Factors affecting permeability. Flow through stratified soil. Problems. **(4)**<br>**Seepage analysis:** Laplace's equation for Isotropic & an-isotropic soils, Flow-nets, Seepage through sub-soil, earthen embankment & piping failure, Problems **(4)**<br>**Stress distribution:** Stress distribution in soils, point loads, line loads, strip loads, rectangular footings, circular footings, arbitrary footings. Boussineq's equation, Westtergards' equation, Newmarks's equation. Significant depth, pressure bulb, Newmark's influence coefficients, stress due to linearly varying loads. Problems. **(5)**<br>**Consolidation:** One-dimensional Consolidation theory, Oedometer test, e-log$_{10}$P curve, settlement & its time required, determination of $C_v$, $m_v$, $C_c$. Definition of Normally & Over consolidated soils. Problems. **(7)**<br>**Compaction:** Compaction, Standard Proctor Test, Modified Proctor Test, $\gamma_d$ vs $\omega$ curve. Field compaction tests and Field compaction. Problems. **(3)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Soil Mechanics and Foundation Engineering by V N S Murthy,CBS publisher and Distributor<br>2. Soil Mechanics and Foundation Engineering by S.K. Garg, Khanna Publishers<br>3. Basic and Applied Soil Mechanics by Gopal Ranjan & A.S.R. Rao, New Age International<br>***Reference Books:***<br>4. Advanced Soil Mechanics by B.M. Das, McGraw Hills Publishers |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | 3 | - | - | - | - | - | - | - | - | - | - | 1 | 2 | - |
| CO2 | - | 3 | - | 3 | - | - | - | - | - | - | - | - | 3 | - | 2 |
| CO3 | 1 | 3 | 3 | - | - | - | - | - | - | - | 1 | - | 2 | - | 2 |
| CO4 | - | 2 | 3 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| CO5 | - | - | - | - | - | - | - | - | 3 | - | - | 2 | - | 2 | 2 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC504** | **Transportation Engineering** | **PCR** | **3** | **1** | **0** | **4** | **4** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| None | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Apply knowledge of transportation engineering for planning & design solutions.<br>• CO2: Understand basic design philosophy applicable to components of transportation engineering.<br>• CO3: Formulate, analyze, & design basic components of transportation engineering. |
| Topics Covered (Hrs) | **Highway planning**, Geometric Design of elements. **(6)**<br>**Highway construction:** Materials - desirable properties and quality control tests; Design of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible pavement using IRC: 37-2012; Design of rigid pavements using IRC: 58-2011; Distresses in concrete pavements; Environmental impact, Highway maintenance. **(12)**<br>**Principle of Transportation**, Different modes of transportation and their characteristics, Scope and limitations. Traffic Engineering, Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, parking study, accident study and analysis, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Control devices, signal design by Webster's method; Types of intersections and channelization; Highway capacity and level of service of rural highways and urban roads. **(12)**<br>**Airport planning**, Site selection, Obstructions and zoning laws, Geometric standards of landing area, Runway orientations, Airport runway length, taxiway and exit taxiway design, Visual aids, Introduction to air-traffic control**. (10)**<br>**Development of railways** in India, Track components and materials, Geometric design elements, Tractive resistances, Layout of points and crossings, High speed track, Marshalling yards, Signaling and interlocking, Track materials and maintenance. **(10)**<br>**Requirements of good docks and harbours**, Types of docks, Whaff-walls, Lock-gates, Wave action, Littoral drift, Breakwaters, Jetties, Dredging. **(6)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Highway, Railway, Airport and Harbour Engg.by K.P. Subramanian, Scitech Publication<br>2. Airport Engineering by Rangwala, Chrotar Publishing<br>3. Railway Engineering by Saxena and Arora, Dhanapat Rai Publication<br>***Reference Books:***<br>4. Highway Engineering by S. K. Khanna, C.E.G. Justo and A. Veeraraghavan, Nemchand & Bros.<br>5. Harbour, Dock and Tunnel Engineering by R. Srinivasan, Charotar Publishing |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | 3 | - | 2 |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | - | - | 2 |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | - | 1 | 2 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC-551** | **Structural Analysis Sessional-II** | **PS** | **0** | **0** | **3** | **3** | **1.5** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Solid Mechanics & Structural Analysis-I | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Analyse indeterminate beams and frames by displacement methods (Slope deflection method, Moment distribution method, Kane's method)<br>• CO2: Analyse indeterminate beams and frames by force methods (Three moment Equation, column Analogy method, consistent deformation method)<br>• CO3: Apply matrix analysis using stiffness and flexibility methods- computer-based analysis of structure.<br>• CO4: Evaluate and draw the influence lines for reactions, shears, and bending moments in indeterminate beams / girders and frames.<br>• CO5: Apply approximate methods (Substitute Frame method, Portal and cantilever methods) to solve multi-storeyed building frames |
| Topics Covered (Hrs) | **Displacement methods**: Application of Slope deflection, Moment distribution & Kani's method to indeterminate beams, frames & portals **(12)**<br>**Force methods**: Application of Three moment equations to continuous beam, execution of Column analogy & Consistent deformation method to beams & frames **(9)**<br>**Influence lines:** Indeterminate structures, Muller Breslau principle with application to redundant beams **(6)**<br>**Matrix Method:** Matrix formulation of flexibility & stiffness methods of structures-application for simple loading cases **(6)**<br>**Approximate methods:** Substitute frames, Portal & Cantilever methods on multi-storeyed building frames **(6)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Basic Structural Analysis by C. S. Reddy, Tata McGraw Hill<br>2. Elementary Structural Analysis by Wilbur & Norris, Mcgraw-Hill College<br>3. Structural Analysis L. S. Negi & R. S. Jangid, Tata McGraw Hill<br>4. Structural Analysis by R. C. Hibbeler, Pearson Education<br>***Reference Books:***<br>5. Structural Analysis by G. S. Pandit & S. P. Gupta, Tata McGraw Hill<br>6. Intermediate structure analysis by C K Wang Mc. Graw Hill |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| CO2 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| CO3 | 3 | - | - | - | 2 | - | - | - | - | 1 | - | - | 3 | 3 | 1 |
| CO4 | 3 | - | - | - | 2 | - | - | - | - | - | - | - | 3 | 2 | 1 |
| CO5 | 3 | - | 1 | - | - | - | - | - | - | - | - | - | 3 | 1 | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CES552** | **Design of Steel Structures Sessional** | **PS** | **0** | **0** | **3** | **3** | **1.5** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Solid Mechanics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Apply knowledge of solid mechanics for design solutions.<br>• CO2: Understand basic design philosophy applicable to steel structures.<br>• CO3: Formulate, analyse, and design basic components of Civil Engineering Steel structures. |
| Topics Covered (Hrs) | **Introduction**, Properties of structural steel, I.S. rolled sections, I.S. specifications **(2)**<br>**Design philosophy** of Limit State method for Steel Structures **(6)**<br>**Design of Tension members**, Compression members in truss **(6)**<br>**Design of Beams** (laterally supported /unsupported): Simple beam using rolled sections, Built up sections /compound beams **(6)**<br>**Design of Gantry girders (4)**<br>**Design of Plate girders**, Connections, Stiffeners and curtailment of flange plates, Splicing – riveted and welded. **(2)**<br>**Design of Simple Connections**: Riveted, Bolted and welded connections, moment resisting connections**. (6)**<br>**Design of Struts and columns** including built-up columns under axial and eccentric loadings, Lacing and battens, Column splicing. **(6)**<br>**Design of Column bases** – slab base, Gusseted base. **(4)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Design of steel Structures by N. Subrhamanium, Oxford publications<br>2. IS 800-2007: General Construction in Steel-Code of Practice<br>3. IS 808-1989: Dimensions of Hot Rolled Steel beam, column, channel and angle sections<br>4. www.nptel.iitm.ac.in/courses/<br>***Reference Books:***<br>5. Limit State Design of Steel Structures by S.K. Duggal, McGraw Hill publications<br>6. Limit State Design of Steel structures by Virendra Gehlot & Dr. Ram Chandra, Scientific publisher<br>7. Design of steel Structures by S. S. Bhavikatti, IK Intl Publishing House, N Delhi |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | 3 | - | 2 |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | - | 2 | - |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | 2 | 1 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CES553 | Transportation Engineering & Soil Mechanics Lab | PS | 0 | 0 | 3 | 3 | 1.5 |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Transportation & Foundation Engineering | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Achieve Knowledge of Design and development of experimental skills.<br>• CO2: Understand the principles of design of experiments on materials<br>• CO3: Understand the principles of design of experiments on soil |
| Topics Covered (Hrs) | **A). Transportation Engineering**<br>1. Aggregate grading analysis.<br>2. Determination of flakiness index.<br>3. Determination of aggregate impact value.<br>4. Aggregate crushing value test.<br>5. Determination of softening point.<br>6. Determination of penetration value.<br>7. Ductility test.<br>8. Determination of consistency properties of soil<br>**B). Engineering Foundation**<br>1). Determination of specific gravity of soil<br>2). Mechanical analysis of soil (Fine fraction- Hydrometer method)<br>3). Mechanical analysis of soil (Sieve analysis)<br>4). Light compaction test (Proctor test)<br>5). Direct shear test<br>6). Los Angeles abrasion test. |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Highway Engineering by S. K. Khanna, C.E.G. Justo and A. Veeraraghavan, Nemchand & Bros.<br>2. Engineering Soil Testing by Shamsher Prakash, (1979), Nemichand, New Delhi<br>3. Soil Tsting for Engineers by William Lambe, (2003), MIT.<br>***Reference Books:***<br>4. Relevant IRC/IS codes.<br>5. Engineering Properties of soil and their measurements by Joesph E Bowles, McGraw hill<br>6. Geotechnical Laboratory Measurements by John T. Germaine, Amy V. Germaine, (2009), John Wiely |

Mapping of Course Outcomes Cos→Pos→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | - | - | - | - | - | - | - | 3 | - | - | - | 3 | - | 3 |
| CO2 | - | - | - | 3 | 1 | - | - | - | - | - | - | - | - | - | 3 |
| CO3 | - | - | - | 3 | 1 | - | - | - | - | - | - | - | - | - | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CES 554** | **Surveying laboratory and Estimation sessional** | **PCR** | **1** | **0** | **3** | **4** | **2.5** |
| Pre-requisites: | | Course Assessment methods: | | | | | |
| CEC 303 & CEC403 | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes | • CO1: learn the basic surveying techniques and the use of basic surveying instruments.<br>• CO2: learn the art of quantity estimation, preparation of Bill of Quantities, and writing specification.<br>• CO3: Learn rate analysis |
| Topics Covered | **A). Surveying Fieldwork**<br>1). Chain Survey.<br>2). Compass traverse work.<br>3). Uses of dumpy level, Profile levelling and cross-sectioning.<br>4). Plane table surveying work – using radiation and intersection methods.<br>5). Contouring by any method (Optional subject to availability of time).<br>6). Study of theodolite, function of its different parts, Measurement of horizontal and vertical angle **(7 laboratory classes)**<br>**B). Estimation**<br>Introduction to quantity surveying, Methods of measurement and units of measurement for various items of work, Procedures of computation, Use of proforma. **(2)**<br>Types of estimates, Data required for estimation. **(2)**<br>Preparing detailed estimates for various types of Civil Engineering works. **(7) + 5 sessional classes)**<br>Specifications of different items of work. **(1 hr. theory class lectures)**<br>Analysis of rates of different items of work, Schedule of rates, Cost of works, Overhead charges, Contingencies, Contractors' profit margin etc. **(2 + 1 sessional)**<br>Practical work on estimation as assigned by the teacher.<br>Total: (**14 hrs of theory classes + 7 sessional classes)** |
| Text Books, and/or reference material | ***Text Books:***<br>1. Surveying and Levelling Part I by T. P. Kanetkar, and S. V. Kulkarni, Pune Vidyarthi Griha Prakashan Pune – 30, 1979,<br>2. Engineering Materials by S. C. Rangwala Charotar Pub. House, Anand,<br>3. Building Construction by S. C. Rangwala, Charotar Pub. House, Anand,<br>4. Estimating and costing in civil engineering – theory and practice, 23rd edition by B. N. Dutta, UBPSD, New Delhi, 1991.<br>5. Estimating, costing and specification in civil engineering, 6th edition by M. Chakraborty, Kolkata, 1979.<br>***Reference Books:***<br>6. Text book of estimating and costing (civil engineering) by G. S. Birdie, Dhanpat Rai & Sons, Delhi, 1986.<br>7. Civil engineering Contracts and Estimates by B. S. Patil, Orient Longman, New Delhi, 1981. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |
| CO2 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |
| CO3 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEC601 | Water Resource Engineering | PCR | 3 | 1 | 0 | 4 | 4 |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Fluid mechanics | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs): | • CO1: Understanding of occurrence, distribution, storage & transmission of water in different form in the space, on the surface and below the surface of the earth.<br>• CO2: Understanding of tempo-spatial collection of data and preparation of hydro-meteorological information system.<br>• CO3: learning importance, requirement, method & infrastructure for imparting irrigation water to crop, development & conservation of water for its economic & efficient use |
| Topics Covered (Hrs) | **Hydrology:** Hydrologic cycle & system model, Hydro-meteorological Information System and its Definition, need, generation, maintenance, validation, calibration of data sets, estimation of missing data, retrieval of data **(5)**<br>**Precipitation:** Forms, types & measurement, Recording & non-recording gauges, Network, Analysis & Adjustment of data, Average depth, depth-area-duration analysis, Surface retention, Detention, Overland flow, Interception, Depression storage**. (6)**<br>**Evaporation & Transpiration**: Factors, Measurement, formula consumptive use **(2)**<br>**Stream flow:** Stage, discharge & relations, interpretation of stream flow records. Factors affecting the run off, yield, flow duration & mass curve **(4)**<br>**Infiltration**: Process, Capacity, Measurement, Estimation **(3)**<br>**Run-off:** Factors, Yield, Flow-duration curve, Flow mass curve. **(3)**<br>**Hydrograph**: Base flow separation, Unit hydrograph, Synthetic hydrograph **(3)**<br>**Irrigation:** Necessity, Advantages, Disadvantages, Types, Water distribution techniques, Quality of water, Duty, Delta, Base period, Indian crop seasons, Irrigation efficiencies, Soil-moisture –irrigation relationships, Estimating depth and frequency of irrigation. **(5)**<br>**Canal irrigation system:** Capacities, losses, Design & construction of unlined, lined & stable channels, Sediment transport, Economics of canal lining, Cross drainage works **(3)**<br>**Water-logging and control**: Causes, Control, Reclamation of saline and alkaline lands, Surface & Sub-surface drainage **(3)**<br>**Diversion head-works:** Definition of weirs, barrages & their classification, Layout of typical diversion head-works & function of its components. **(2)**<br>**Reservoirs:** Types, selection of site, Storage zones, Fixation of capacity, regulation. **(3)**<br>**Dam:** Earthen and concrete dam, selection criteria, design **(4)**<br>**Spillways and energy dissipaters:** Location, types, energy dissipation, stilling basin & spillway gate **(4)**<br>**Flood Forecasting:** Estimation, forecasting & mitigation, flood land management **(4)**<br>**Flood routing:** Reservoir & Channel routing (hydrological method only) **(2)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Engineering Hydrology by K. Subramanya, Fourth Edition, McGraw Hills Education (India)<br>2. Irrigation Engineering and Hydraulic Structures by S. K. Garg, Khanna Publishers, New Delhi<br>***Reference Books:***<br>3. Irrigation and Water Power Engineering by B. C. Punmia, B. B. Pande, A. K. Jain, A. Kumar,, 16th Edition, Laxmi Publications (P) Limited, New Delhi |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | investigations of complex | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | - | 3 | | 3 | | - | 3 | - | - | - | - | - | 2 | - | - |
| CO3 | - | - | 3 | - | 3 | 3 | - | 3 | 3 | 2 | 3 | 3 | 2 | - | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC602** | **Foundation Engineering** | **PCR** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Soil Mechanics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Calculate shear strength of soil<br>• CO2: Determine the earth pressures on foundations and retaining structures<br>• CO3: Analyse stability of finite and infinite soil & rock slopes<br>• CO4: Calculate the bearing capacity of soils and foundation settlements |
| Topics Covered (Hrs) | **Shear strength of soil**: Determination of shear strength in laboratory and in field, Mohr-Coulomb failure criterion, Failure envelopes and shear strength parameters for different test conditions, Problem. **(6)**<br>**Lateral earth pressure theories**: Analytical and graphical methods, Effect of surcharge, water table and stratification on earth pressure, Design of cantilever sheet pile, Problem. **(8)**<br>**Stability of slopes**, infinite slopes, Analysis of finite slopes by method of slices, modified method of slices, friction circle method, Taylor's stability number, Effect of pore water pressure, Problem **(8)**<br>**Bearing capacity of shallow foundations:** Selection of location and depth, Analytical method of using Terzaghi's equation, I.S. method, Skempton's equation, Field test method, Method based on SPT, Design of combined footings. **(8)**<br>**Bearing capacity of pile foundation**: Types of piles, Bearing capacity of single and group of piles, Problem. **(6)**<br>**Well foundation**: Elements of wells, Types. **(2)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Geotechnical Engineering: Principal and Practices of Soil Mechanics and foundation Engineering by V N S Murthy.<br>2. Basic and Applied Soil Mechanics by G. Ranjan and A. S. Rao<br>***Reference Books:***<br>3. Foundation analysis and Design by J. E. Bowles<br>4. Soil Mechanics and Foundation Engineering by S.K. Garg, Khanna Publishers<br>5. Advanced Soil Mechanics by B.M. Das, McGraw Hills Publishers |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | - | 1 | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO2 | 3 | 3 | 2 | - | - | - | - | - | - | 1 | - | - | 3 | 2 | - |
| CO3 | 2 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO4 | 3 | 2 | - | 1 | - | - | - | - | - | - | - | - | - | 2 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC603** | **Environmental Engineering** | **PCR** | **3** | **1** | **0** | **4** | **4** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| None | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Apply knowledge of water supply & wastewater engineering for design solutions.<br>• CO2: Understand basic design philosophies applicable to conveyance and treatment units of water & wastewater.<br>• CO3: Formulate, analyze, and design basic components of water supply & wastewater disposal. |
| Topics Covered (Hrs) | **Water – uses & requirement:** Sources, Quantity, Quality criteria, Intakes & transportation. **(9)**<br>**Conventional water treatment methods:** Aeration, Sedimentation, Coagulation & flocculation, Filtration, Disinfection – including design of units. Other miscellaneous water treatment processes**. (13)**<br>**Water storage & distribution systems**, Design of pipe networks. **(3)**<br>**Introduction to plumbing systems** in buildings. **(2)**<br>**Estimation of quantities** of sanitary wastewater & storm water runoff. **(3)**<br>**Sewerage system**, Design of sewers, Sewer appurtenances, Materials of sewer construction. **(5)**<br>**Quality & characterisation of domestic wastewater:** different parameters including oxygen demands, Standards of sewage disposal. **(4)**<br>**Principles of wastewater treatment**, Physical, chemical & biological treatment methods, Primary & secondary treatment, Bio-filter, Activated sludge process, Stabilisation pond, Septic tank. **(12)**<br>**Introduction to other treatment processes** including digestion & disposal of sludge. (3)<br>**Principles of stream sanitation**. (2) |
| Text Books, and/or reference material (s) | ***Text Book:***<br>1. Environmental Engineering (Vol. I & II) by Punmia, Jain & Jain, Laxmi Publications (P) Ltd, New Delhi<br>2. Environmental Engineering (Vol. I & II) by S. K. Garg, Khanna Publishers, Delhi<br>***Reference Book:***<br>3. Environmental Engineering by H. S. Peavy, D. R. Rowe & G. Tchobanoglous, McGraw Hill Education (India) Private Limited, New Delhi<br>4. Wastewater Engineering, Treatment & Reuse (4th Ed) by Metcalf & Eddy, Inc. (Revised by G. Tchobanoglous, F. L. Burton & H. D. Stensel, Tata McGraw Hill Education Private Limited, New Delhi |

Mapping of Course Outcomes COs→POs→POs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PS01 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | 2 | - | - |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | 2 | - | - |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | 2 | - | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC651** | **Environmental Engineering Laboratory & Computational Laboratory- I** | **PCR** | **0** | **0** | **3** | **3** | **1.5** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Environmental Engineering | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Achieve Knowledge of design & development of experimental skills<br>• CO2: Understand the principles of design of experiments.<br>• CO3: To learn step by step procedure for modelling technique & analysis of civil engineering problems by finite element based software<br>• CO4: Analyse & solve for forces and deflection in trusses, beams and frames under static loading<br>• CO5: Analyse & solve for responses in trusses, beams and frames under dynamic loading |
| Topics Covered (Hrs) | **A). Environmental Engineering**<br>1. pH and temperature.<br>2. Turbidity.<br>3. Conductivity.<br>4. Total solids, Settle able solids and suspended solids.<br>5. Chloride.<br>6. Acidity.<br>7. Alkalinity.<br>8. Residual chlorine.<br>9. Dissolved oxygen.<br>10. Colony count of bacteria.<br>**B). Computational Laboratory- I**<br>Introduction of computer aided design and drafting, Solution of structural problems using commercial software |
| Text Books, and/or reference material (s) | ***Text Book:***<br>1. Chemistry for Environmental Engineering and Science, 5th edition by C. N Sawyer, P. L. McCarty and G.F. Perkin, McGraw-Hill Inc., 2002<br>2. Numerical Methods for Scientists and Engineers by R. W. Hamming, Dover Publications<br>***Reference Book:***<br>3. Standard methods for the examination of water and wastewater. (2012). 21st Edition, Washington: APHA.<br>4. Applied Numerical Methods for Engineers Using Matlab and C by Robert J. Schilling, Sandra L. Harris, Nelson Engineering; Har/Cdr edition |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modem tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | - | - | - | - | - | 1 | - | 3 | - | - | - | - | - | - |
| CO2 | - | - | - | 3 | 1 | - | - | - | - | - | - | - | - | - | - |
| CO3 | 2 | - | 3 | - | 2 | - | - | - | - | - | - | - | 2 | 3 | - |
| CO4 | 3 | - | 3 | - | 3 | - | - | - | - | 1 | - | 1 | 3 | - | - |
| CO5 | 3 | - | 3 | - | 3 | - | 1 | - | - | - | - | 1 | 3 | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CES652** | **Concrete Technology Laboratory** | **PS** | **0** | **0** | **3** | **3** | **1.5** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Building Construction & Concrete Technology | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) | • CO1: Conduct experiments for determining the properties of different engineering materials like cement, fine & coarse aggregates, concrete etc. and work in a group.<br>• CO2: Design concrete mix proportion based on the properties of concrete ingredients.<br>• CO3: Use modern instruments & tools for conducting the experiment on different engineering materials.<br>• CO4: Prepare the report on experimental results. |
| Topics Covered (Hrs) | To determine the (a) fineness of cement by sieving, (b) standard consistency of cement and (c) setting time of cement. **(6)**<br>To determine the (a) specific gravity of cement (b) compressive strength of cement and (c) soundness of cement. **(6)**<br>To determine the (a) particle size distribution, (b) specific gravity and water absorption and (c) bulk density and voids in coarse aggregate**. (6)**<br>To determine the (a) particle size distribution, (b) specific gravity and water absorption and (c) bulk density and voids in fine aggregate. **(6)**<br>Concrete mix design by I.S Method**. (6)**<br>(a) Preparation of concrete specimens to determine the compressive strength flexural strength and split tensile strength of concrete of a given mix proportions**. (6)**<br>(i) Compressive strength at 07 days - 3 nos cube + 3 nos cylinder<br>(ii) Compressive strength at 28 days - 3 nos cube + 3 nos cylinder<br>(iii) Split tensile strength at 28 days - 3 nos cylinder<br>(iv) Flexural strength at 28 days - 3 nos prism<br>(b) Test above specimen according to the proper testing day (7 days and 28 days) **(3)**<br>(c) To determine the consistency and workability of freshly mixed concrete by<br>i) Slump test and ii) Compacting factor test |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Concrete Technology by A. M. Neville and J. J. Brooks, Pearson Edu. Publication.<br>2. Concrete Technology by M. S. Shetty, S. Chand Publication.<br>***Reference Books:***<br>3. Concrete Technology by M. L. Gambhir, Tata McGraw Hill.<br>4. IS code of practice: 383-2016, 10262-2019, 456-2000 etc. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | - | - | 3 | - | - | - | - | 2 | - | - | - | - | - | - |
| CO2 | - | - | 3 | 2 | - | - | - | - | 2 | - | - | - | 3 | - | - |
| CO3 | - | - | - | 2 | 3 | - | - | - | 1 | - | - | - | - | 3 | - |
| CO4 | - | - | 2 | 1 | - | - | - | - | 1 | 2 | - | - | - | - | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CES751** | **Project I** | **PS** | **0** | **0** | **4** | **4** | **2** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Design of Concrete Structures along with Concrete Technology Laboratory | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Demonstrate a sound technical knowledge of their selected project topic.<br>• CO2: Undertake problem identification, formulation and solution.<br>• CO3: Design engineering solutions to complex problems utilising a systems approach.<br>• CO4: Conduct an engineering project. |
| Topics Covered (Hrs) | Any type of Civil Engineering problem either experimentally, analytically, and Numerically. |
| Text Books, and/or reference material(s) | ***Text Books:***<br>***Reference Books:*** |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CES752** | **Structural Engineering & Computational Lab-II** | **PS** | **0** | **0** | **3** | **3** | **1.5** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Design of Concrete Structures along with Concrete Technology Laboratory | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Design concrete mix proportion based on the properties of concrete ingredients and design and detailing of reinforced concrete beam under given conditions and work in a group.<br>• CO2: Use modern instruments and tools for experimenting on different engineering materials in a group.<br>• CO3: Prepare the report on experimental results.<br>• CO4: Ability to apply computational software to analyse and design of different civil engineering problems and apply in industries |
| Topics Covered (Hrs) | 1. Concrete mix design for different grades of concrete (as per Indian Standard guidelines).<br>2. Design, detailing and bar bending schedule for R.C. beam under given conditions.<br>3. Casting and study on the strength and deflection behavior of R.C. beams.<br>4. Application of commercial software for solving Civil Engineering problems |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Limit State Design of Reinforced Concrete by P. C. Varghese, Prentice Hall, Inc.<br>2. Concrete Technology by M. S. Shetty, S. Chand Publication.<br>3. Concrete Technology M. L. Gambhir, Tata McGraw Hill.<br>4. IS code of practice: 383-2016, 10262-2019, 456-2000 etc.<br>***Reference Books:***<br>5. Manuals of Commercial /Open source software related to Civil Engineering Applications (Eg. SAP, STAAD, ABAQUS,ETAB, LS DYNA, Plaxis, Geomedia, ERDAS …etc) |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | - | 3 | 3 | - | - | - | - | 2 | - | - | - | 3 | - | - |
| CO2 | - | - | 3 | 2 | 3 | - | - | - | 2 | - | - | - | - | 3 | - |
| CO3 | - | - | 2 | 1 | - | - | - | - | 1 | 2 | - | - | - | - | - |
| CO4 | - | 1 | 2 | - | 3 | - | - | - | - | - | - | - | 3 | 3 | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CES753** | **Vocational Training / Summer Internship and Seminar** | **PS** | **0** | **0** | **3** | **3** | **1.5** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Design of Concrete Structures along with Concrete Technology Laboratory | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Able to construct the company profile by compiling the brief history, management structure, products / services offered, key achievements and market performance for his / her organization of internship.<br>• CO2: For his / her organization of internship, the student is able to assess its Strengths, Weaknesses, Opportunities and Threats (SWOT).<br>• CO3: Able to determine the challenges and future potential for his / her internship organization in particular and the sector in general.<br>• CO4: Able to test the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period.<br>• CO5: Able to apply various soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship organization.<br>• CO6: Able to analyze the functioning of internship organization and recommend changes for improvement in processes. |
| Topics Covered (Hrs) | |
| Text Books, and/or reference material(s) | ***Text Books:***<br>***Reference Books:*** |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO6 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CES851** | **Project II** | **PS** | **0** | **0** | **15** | **5** | **15** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Design of Concrete Structures along with Concrete Technology Laboratory | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Demonstrate a sound technical knowledge of their selected project topic.<br>• CO2: Undertake problem identification, formulation and solution.<br>• CO3: Design engineering solutions to complex problems utilising a systems approach.<br>• CO4: Conduct an engineering project. |
| Topics Covered (Hrs) | Any type of Civil Engineering problem either experimentally, analytically, and Numerically. |
| Text Books, and/or reference material(s) | ***Text Books:***<br>***Reference Books:*** |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CES852** | **Project Seminar** | **PS** | **0** | **0** | **0** | **0** | **1** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Design of Concrete Structures along with Concrete Technology Laboratory | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Expressed a sound technical knowledge of their selected project topic.<br>• CO2: Present the problem identification, formulation and solution.<br>• CO3: Illustrate design engineering solutions to complex problems utilising a systems approach.<br>• CO4: Conduct an engineering project seminar. |
| Topics Covered (Hrs) | |
| Text Books, and/or reference material(s) | ***Text Books:***<br>***Reference Books:*** |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CES853** | **Viva Voce** | **PS** | **0** | **0** | **0** | **0** | **1** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Design of Concrete Structures along with Concrete Technology Laboratory | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1 Demonstrate knowledge in the program domain.<br>• CO2 Present his views cogently and precisely.<br>• CO3 Exhibit professional etiquette suitable for career progression |
| Topics Covered (Hrs) | |
| Text Books, and/or reference material(s) | ***Text Books:***<br>***Reference Books:*** |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO440** | **Introduction to Earthquake Engineering** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisites: | | Course Assessment methods | | | | | |
| No pre-requisites | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes | • CO1: Applying Engineering mathematics in solving vibration problem<br>• CO2: Ability to design a building earthquake resistive<br>• CO3: Learn basic of Earthquake engineering<br>• CO4: Ability to manage disaster |
| Topics Covered | **Seismology:** Engineering geology of earthquakes, plate tectonics, Seismicity of the world, Seismic waves, faults, plate boundaries, Intensity, Strong ground motion, Measuring of Earthquake, Earthquake Magnitude-Local (Richter) magnitude, surface wave magnitude, Moment magnitude. Spectral Parameters: Peak Acceleration, Peak Velocity, Peak Displacement, Frequency Content and duration. **(12)**<br>**Elementary Vibration:** Vibration of elementary system, Single degree and two-degree freedom systems, Earthquake analysis, Response spectrum concept **(10)**<br>**Earthquake Resistant Design:** Philosophy, Code based methods for seismic design for RC buildings. Behaviour of masonry structure during earthquake, bands & reinforcement in masonry **(10)**<br>**General Guidelines**: Efficient seismic resistant planning, selection of sites, importance of architectural features in earthquake resistant buildings, continuity of construction, projection special construction features like pounding, floating column, soft storey, stair case etc., role of engineers in the earth quake mitigations & disaster management **(10)** |
| Text Books, and/or reference material | ***Text Books:***<br>1. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande<br>2. Basics of Structural dynamics and aseismic Design by S. R. Damodarasamy and S. Kavitha<br>***Reference Books:***<br>3. Elements of Earthquake Engineering by Jai Krishna, A.R. Chandrasekharan, Brijesh Chandra |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | 1 | - | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| CO3 | 1 | - | - | - | - | 2 | - | - | - | - | - | - | - | - | - |
| CO4 | - | - | - | - | - | -- | - | - | 3 | - | - | - | - | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO 441** | **Elementary Civil Engineering** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisites: | | Course Assessment methods | | | | | |
| No pre-requisites | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |
| Course Outcomes | • CO1: Gain knowledge about elementary level civil engineering<br>• CO2: To learn the use of survey instruments<br>• CO3: To learn about construction materials and technology | | | | | | |
| Topics Covered | **Measurement:** Measurement of lengths, heights, and angles using surveying equipment, chain, tape, Dumpy level, staffs, Theodolites. **(10)**<br>**Survey:** Different mapping methods, elements of chain surveying, compass surveying, plane table surveying, theodolite surveying, leveling and contouring. **(10)**<br>**Building Materials:** Common building materials, stone, brick, timbers, cement, concrete, lime concrete, their strength, characteristics and different types of each material. **(10)**<br>**Construction:** Elements of residential buildings, method of construction, miscellaneous temporary constructions, form work, timbering etc. **(12)** | | | | | | |
| Text Books, and/or reference material | ***Text Books:***<br>1. Surveying and Levelling Part I by T. P. Kanetkar, and S. V. Kulkarni, Pune Vidyarthi Griha Prakashan Pune – 30, 1979<br>2. Engineering Materials by S. C. Rangwala, Charotar Pub. House, Anand<br>3. Building Construction by S. C. Rangwala, Charotar Pub. House, Anand<br>***Reference Books:***<br>4. Building Construction by B. C. Punmia, A. K. Jain and A. K. Jain, Laxmi Publications (P) Ltd. | | | | | | |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |
| CO2 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |
| CO3 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO442** | **Experimental methods and Analysis** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Basic Engineering, statistics & probability | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs): | • CO1: Development of skills for predicting engineering system behaviour<br>• CO2: Knowledge of basics of data analysis for further applications.<br>• CO3: Developing the requisite skill that helps in the advanced courses related to experimental study |
| Topics Covered (Hrs) | **Types of measurements and errors**: Internal & external estimates of errors, Relative frequency distribution, Histogram, True value, Precision of measurement, Best estimate of true value & precision, Methods of calculating best estimate of true value & standard deviation **(7)**<br>**Combination of measurements**: Accuracy of mean, Significant digits. Method of least squares & its application for calculation of best estimate of true value, curve fitting, **(8)**<br>**General linear regression**: Comparison & combination of measurements. Extensions of least square method. Theory of errors, Binomial & Gaussian distribution, Confidence limits, Significance test, principle of maximum likelihood & goodness of fit, Chi-square test. **(9)**<br>**Displacement measurement**: Dial Gauge, Microcator, Optical Method, Pneumatic Transducer, Strain Gauges, Variable Inductance & Capacitance Transducer, Piezo-Electric, Electro-Kinetic, Photo-Electric, Ionization, Vibrating Wire & Vacuum Tube Transducer.<br>**Force & Torque:** Elastic Type, Fluid Load Cell, Dynamometers.<br>**Temperature:** Bi-Materials, Pressure & Resistance Thermometers, Thermocouples & Pyrometers.<br>**Pressure:** McLeod Gauge, Pirani Gauge, Ionization Gauge, Manometers, Bourdon Tube, Resistance Gauges.<br>**Fluid Velocity:** Pitot tube & Hot Wire Anemometer, LDA. Flow Measurement in Confined Passages & Open Channels. Miscellaneous measurements **(10)**<br>**Dynamic Response** of a Measuring Instrument, Response to Transient & Periodic Signals, First & Second order systems as well as their Dynamic Response Characteristics. (**8)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Instrumentation, Measurement and Analysis by B C Nakra and K K Chaudhary, Tata McGraw Hill, 1985.<br>2. Principles of Measurement, Precision, Error and Truth by N C Barford, Addison Wesley, 1967.<br>***Reference Books:***<br>3. Physical Measurement and Analysis by N N Cook and E Rabinowicz, Addison Wesley, 1963<br>4. Experimental Methods for Engineers by J P Holman and W J Gajda, McGraw Hill Co., 1978 |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | 2 | - | - | - | - | - | - | 2 | - | - | - | 2 | - | - |
| CO2 | 3 | - | 3 | - | - | - | - | - | 1 | 2 | - | 2 | 3 | - | - |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | 1 | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO540** | **Numerical methods in Engineering** | **PEL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Engineering Mathematics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Assess the error involved in a numerical method<br>• CO2: Solve problems in engineering and science with a required accuracy using appropriate numerical methods<br>• CO3: Write algorithm for the numerical methods for efficient coding of program<br>• CO4:Understand the mathematics concepts underlying the numerical methods |
| Topics Covered (Hrs) | **Fundamentals of numerical methods:** Need for Numerical methods in Civil Engineering, Sources of Errors, Absolute, Relative and Percentage, round off error, and stability of algorithms. **(4)**<br>**Linear system of algebraic equations:** Gauss elimination method, LU decomposition method; iterative methods, ill conditioned systems. Jacobi, Gauss Seidel method, Relaxation method. **(8)**<br>**Nonlinear equations:** Bisection method, Regula Falsi method, Newton Raphson method, Modified Newton-Raphson method, Higher order Newton's method Bairstow method, system of non-linear equations. **(8)**<br>**Interpolation and approximation**: Newton's, Lagrange and Hermite interpolating polynomials, cubic splines; least square and minimax approximations**. (6)**<br>**Numerical differentiation and integration:** Newton-Cotes and Gaussian type quadrature methods. **(6)**<br>**Ordinary differential equations:** Initial value problems: single step and multistep methods, stability and their convergence. Boundary value problems: functional approximation, finite difference method. **(8)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Numerical Methods for Scientists and Engineers by R. W. Hamming, Dover Publications; 2 edition<br>2. Numerical Methods: Problems and Solutions by Mahinder Kumar Jain (Author), S.R.K. Iyengar (Author), R. K. Jain, New age publishers<br>3. Numerical Methods for Engineers by Chapra, S. C., and Canale, R. P., McGraw Hill, Inc., 2007.<br>***Reference Books:***<br>4. Applied Numerical Methods for Engineers Using Matlab and C by Robert J. Schilling (Author), Sandra L. Harris, Nelson Engineering; Har/Cdr edition<br>5. Numerical Analysis for Scientists and Engineers: Theory and C Programs by Madhumangal Pal, Alpha Science Intl Ltd; 1 edition |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - |
| CO2 | 3 | - | 3 | - | 3 | - | - | - | - | - | - | - | - | 3 | - |
| CO3 | 3 | - | 3 | - | 3 | - | - | - | - | 1 | - | - | - | 3 | - |
| CO4 | 2 | - | - | - | 3 | - | 1 | - | - | - | - | - | - | 3 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO541** | **Engineering Computing & Simulation with Scilab** | **PEL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Engineering Mathematics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Understand the basic elements of scilab language.<br>• CO2: Compute different mathematic operations like scalars, vectors, matrix, statistics and probability, ordinary differential equations by using scilab.<br>• CO3: Use modern software tools scilab.<br>• CO4: Use scilab to simulate the different engineering problems. |
| Topics Covered (Hrs) | **Introduction:** Introduction to scilab, scilab environment, workspace, working directory. **(2)**<br>**Basic elements of the language:** Basic elements of the scilab language. **(2)**<br>**Basic mathematical operations or functions:** Scalars & vectors, matrix operations, ordinary differential equations, statistics, probability functions using scilab. **(10)**<br>**Plotting with scilab:** Plotting 2D and 3D graphs using scilab**. (4)**<br>**Simulation techniques:** Monte Carlo method, Latin Hypercube simulation, Variation reduction techniques. **(10)**<br>**Scilab functions:** script files and functions files, different functions in scilab. **(6)**<br>**Applications:** Programming with scilab and solve different engineering problems. **(6)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Engineering and Scientific Computing with Scilab by C. Bunks, J. P Chancelier, F. Delebecque, C. Gomez, M. Goursat, R. Nikoukhah, and S. Steer., Birkhäuser; 1999.<br>2. Modelling and Simulation in Scilab/Scicos by Stephen L. Campbell, Jean-Philippe Chancelier, and Ramine Nikoukhah, Springer. 2010.<br>3. A Practical Introduction to Programming and Problem Solving by Tejas Sheth, Scilab, Create Space Independent Publishing Platform, 2016.<br>***Reference Books:***<br>4. Scilab by Example by M. Allouf, Create Space Independent Publishing Platform, 2012. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | 1 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO3 | - | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 | - |
| CO4 | - | 1 | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO542** | **Introduction to Random Vibrations** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Basic Engineering vibrations, statistics and probability | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Development of skills for predicting engineering system behaviour under random vibrations<br>• CO2: Knowledge of basics of random vibration analysis for further applications.<br>• CO3: Developing the requisite skill that helps in the advanced courses related to random vibration study. |
| Topics Covered (Hrs) | **Review** of basic topics in probability theory and vibrations **(4)**<br>**Introduction** to the theory of random processes Time- and frequency-domain characteristics Stationary and nonstationary processes Continuity, differentiation and integration, Poisson, Gaussian processes. **(10)**<br>**Random vibration** of linear structures Unit-impulse and frequency-response functions Time- and frequency-domain analysis Single- and multi-degree-of-freedom systems Stationary and nonstationary responses State-space formulation Modal cross-correlations Response to multi-support excitation, coherency function **(12)**<br>**Crossings and reliability** analysis Threshold Crossings The envelope process First passage probability Distribution of local and extreme peaks **(8)**<br>**Response spectrum** methods Response spectrum methods (CQC, CQC3, MSRS) PSD consistent with response spectrum**. (8)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Probabilistic Theory of Structural Dynamics by Y. K. Lin, McGraw-Hill, New York, NY, 1967 Krieger Pub., Huntington, NY, 1976.<br>**2.** Probabilistic Structural Dynamics: Advanced Theory and Applications by Y. K. Lin and G.Q. Cai, McGraw-Hill, New York, NY, 1995.<br>***Reference Books:***<br>3. An Introduction to Random Vibrations, Spectral & Wavelet Analysis: Third Edition by D.E. Newland, Dover Publications, Mineola, NY, 2005.<br>4. Introduction to Random Vibrations by N. C. Nigam, MIT Press, Cambridge, MA, 1983.<br>5. Applications of Random Vibrations by N.C. Nigam and S. Narayanan, Narosa Pub., New Delhi,India, 1994. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | - | - | 2 | - | - | - | - | 2 | - | - | - | 1 | 1 | - |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | 2 | 2 | - |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | - | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO740** | **Mechanics of Composite** | **Program Elective (PEL)** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Knowledge of Solid Mechanics, Structural Analysis & Design | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Development of skills of finding out mechanical properties of composite materials as well as predicting structural behaviour of composites under different loads.<br>• CO2: Knowledge of basics of analysis and design of structural components, made of variety of composite materials.<br>• CO3: Knowledge of using numerical tools for modeling and analysis of simple structural components |
| Topics Covered (Hrs) | Introduction, Types of composite materials, Lamina and Laminate, Matrix and Fibre, Fibre-reinforced Composites, Comparison of strengths between bulk material and fibres. **(6)**<br>Co-ordinate systems, Effect of orientation of fibres on the strength and stiffness of Composites. **(6)**<br>Brief outline of manufacturing processes. **(4)**<br>Micromechanics and Macro mechanics, Constitutive relations, Stresses and Strains, Failure criteria of composites. **(8)**<br>Analysis of Composites: beams and plates **(12)**<br>Finite Element Method in analysis of Composite Structures **(6)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Mechanics of Composite Materials by Robert M. Jones: Taylor and Francis (2015)<br>2. Mechanics of Composite Structures by Autar K. Kaw, Taylor and Francis (2006)<br>***Reference Books:***<br>3. Mechanics Of Composite Materials and Structures by Madhujit Mukhopadhyay, University Press (2004) |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | 1 | - |
| CO2 | - | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | 1 | 1 |
| CO3 | - | 2 | - | - | 3 | - | - | - | - | - | - | - | 2 | 2 | 2 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO741** | **Optimization in Engineering Design** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisites: | | Course Assessment methods | | | | | |
| No pre-requisites | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes | • CO1: Develop optimization models for any engineering system.<br>• CO2: Solve optimization problems.<br>• CO3: To learn about modern optimization methods |
| Topics Covered | **Introduction:** Model, Steps in modeling: Formulation, Deduction, Interpretation, Ten Principles of Modeling, Design Process, Differences Between Engineering Analysis and Design, Comparison Between Conventional Design and Optimal Design. **(4)**<br>**Introduction to optimization model formulation in engineering design:** Objective & Constraint function, Development of objective & constraint functions, Example formulations, Classification of optimization models**. (4)**<br>**Solution Techniques:** Linear programming: Linear Programming Problem, Graphical Solution, Linear Programming in Standard Form, Handling Inequality Constraints, Handling Variables Unrestricted in Sign, Basic Definitions in LP, Canonical reduction, Principles of the Simplex Method, Simplex Method in TABLEAU Form, Computational Problems, Big M Simplex Method, Two-Phase Simplex Method. Revised Simplex Method, Integer Programming, Fixed Charge Problem Formulation. **(8)**<br>**Nonlinear programming – 1:** Single variable unconstrained minimization, Basic Definitions, Optimality Criteria, Introduction to line search techniques**. (4)**<br>**Nonlinear programming – 2:** Multivariable unconstrained optimization, Optimality Criteria, Introduction to various Algorithms for Minimization. **(4)**<br>**Nonlinear programming – 3:** Multivariable constrained optimization, Equality Type Constraints, Lagrange Multiplier, Inequality type Constraints, Optimality Criteria Transformation Methods, Penalty Function Algorithm, Introduction to Linearization Methods, Introduction to Reduced Gradient Method, Introduction quadratic programming, Introduction to projected augmented Lagrangian Method. **(10)**<br>**Introduction to Advanced topics:** Dynamic & Geometric programming, Chance constrained & Multiple objective optimization, Soft computing techniques - Genetic Algorithm, Simulated Annealing Technique, Fuzzy logic, Artificial Neural Networks. **(8)** |
| Text Books, and/or reference material | ***Text Books:***<br>1. Engineering Hydrology by R. S. Varshney, Nem Chand & Bros. Roorkee (U.P.) 1986.<br>2. Operations Research – Principles and Practice by A. Ravindran, D. J. Philips and J. J. Solberg, 2nd Edition, John Weley & Sons, New York, 1987.<br>3. Engineering Optimization – Theory and Practice by S. S. Rao, 3rd Edition, New Age Int. (P) Ltd. Publishers, New Delhi, 2001.<br>***Reference Books:***<br>4. Nonlinear Programming – Theory and Algorithms by M. S. Bazaraa & C. M. Shetty, John Wiley & Sons, New York, 1990.<br>5. Introduction to Optimum Design by J. S. Arora, McGraw Hill Int. Editions, McGraw Hill Book Co. Singapore, 1989. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | - | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| CO3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO742** | **Theory of Elasticity and Plasticity** | **PEL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisites: | Course Assessment methods |
|---|---|
| Engineering and Solid Mechanics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes | • CO1: To develop basic understanding of the behaviour of materials.<br>• CO2: To define the stress and strain behaviour of structural elements.<br>• CO3: To apply theory of elasticity in bending and torsion problems.<br>• CO4: To apply theory of plasticity in failures of different materials and structures. |
| Topics Covered | **Stress & Strain**: Stress equilibrium equations, rectangular, cylindrical and spherical co-ordinates, Generalized Hooke's Law, Stress and strain compatibility equations. Plane stress and plane strain problems, Airy's stress function, Principal Stresses and strains, stress & strain invariants, numerical problems. **(15)**<br>**Torsion**: Shafts of circular and non-circular prismatic sections, Saint Venant theory, warping function, stress function. **(7)**<br>**Theories of Failure**: Basic concepts and Yield Criteria, Different Theories of Failure, Yield Locus and Yield Surfaces. Equations of Plasticity. **(8)**<br>**Plasticity**: hydrostatic stresses, deviatoric stresses, invariants of deviatoric stresses, yield criteria, von Misses, Tresca yield criteria, theories of plastic flow, plane stress, plane strain problems in plasticity, thick cylinders, thick spheres. **(12)** |
| Text Books, and/or reference material | ***Text Books:***<br>1. Theory of Elasticity and Plasticity by S. Timoshenko, MC Graw Hill Book company.<br>2. Theory of Elasticity and Plasticity by Sadhu Singh, Khanna Publishers.<br>***Reference Books:***<br>3. Advanced Strength of materials by Papov, MC Graw Hill Book Company.<br>4. Plasticity for structural Engineers by W. F. Chen and D. J. Han, Springer-Verlag, New York. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | 1 | - |
| CO3 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 1 | - |
| CO4 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 2 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO840** | **Finite Element Analysis and Applications** | **PEL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Mechanics, Mathematics, Engineering problems in various fields | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Knowledge of importance of FEA over classical methods and use it for modelling and analysis of real life engineering systems.<br>• CO2: Learning to simulate physical systems related to various engineering fields through FE modelling & interpret analysis data for prediction of system response.<br>• CO3: Skill to use computational tools for solving engineering problems.<br>• CO4: Foundation for using advanced FEA software packages for modelling and analysis of problems related to relevant field of studies in both industry and research. |
| Topics Covered (Hrs) | **Introduction**: Recapitulation of Matrix Manipulation Techniques, Solution of Simultaneous Linear Equations, Inverse of Matrix, Eigen Values and Eigen Vectors, Computer Implementation. **(5)**<br>**Engineering Problems:** Different numerical methods, History of Finite Element Method (FEM), Steps in FEM, Areas of Application, Verification problems, implementation of Engineering Problems in FEA**. (10)**<br>**Spring Element:** General, Implementation in FEA, Applications, Problems. **(5)**<br>**Bar Elements**: Definition, Property Matrix using Direct and Energy Approach, Engineering Implementation in FEA, Problems and Validation. **(6)**<br>**Application of FEA:** General Conduction Problems, Mechanical systems, Electrical systems etc. Validation, convergence study and error analysis in solution of real life engineering problems. **(10)**<br>**Computer Programs**/ SOFTWARES in FEA. **(6)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Finite element analysis: theory and programming by C S Krishnamurthy (2001). Publisher: Tata McGraw Hill Education<br>2. Finite Element Analysis Theory and Application with ANSYS by Moaveni. Publisher: Pearson (2008)<br>3. Fundamentals of Finite Element Analysis by David V. Hutton. Publisher: Tata Mcgraw Hill Education Private Limited (2005)<br>***Reference Books:***<br>4. Finite Element Procedures by Klaus-Jurgen Bathe. Publisher: Prentice-Hall (2009) |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | - | 3 | - | 2 | - | - | - | - | - | - | - | - | 3 | - | - |
| CO3 | - | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 | - |
| CO4 | - | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | 3 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO841** | **Disaster Management and Mitigation** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| None | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs): | • CO1: Understanding Disaster<br>• CO2: Ability to manage disaster<br>• CO3: Use of Modern tools to manage disaster |
| Topics Covered (Hrs) | **Understanding Disasters:** Understanding the Concepts & definitions of Disaster, Hazard, Vulnerability, Risk, Capacity–Disaster, Development & management **(5)**<br>**Types, Trends, Causes, Consequences and Control of Disasters:** Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters **(10)**<br>**Disaster Management Cycle and Framework:** Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment **(10)**<br>**Disaster Management in India:** Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter Governmental Agencies **(5)**<br>**Applications of Science and Technology for Disaster Management:** Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System **(5)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Disaster Management by W. Nick. Carter, 1991: Asian Development Bank, Manila<br>2. Introduction to International Disaster Management by D. P. Coppola, 2007, Elsevier Science (B/H), London.<br>3. Manual on natural disaster management in India by M C Gupta, NIDM, New Delhi<br>***Reference Books:***<br>4. An overview on natural & man-made disasters and their reduction by R K Bhandani, CSIR, New Delhi<br>5. http://www.nidmindia.nic.in/ |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | - | - | - | - | 3 | - | 2 | - | - | - | - | - | - | - |
| CO2 | 1 | - | - | - | - | 3 | - | 2 | - | - | 3 | - | 1 | - | - |
| CO3 | 1 | - | - | - | 3 | - | - | - | - | - | - | - | 1 | 2 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO842** | **Experimental methods in Engineering** | **PEL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Basic Engineering, statistics & probability | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs): | • CO1: Development of skills for predicting engineering system behaviour<br>• CO2: Knowledge of basics of data analysis for further applications.<br>• CO3: Developing the requisite skill that helps in the advanced courses related to experimental study |
| Topics Covered (Hrs) | **Types of measurements and errors**: Internal & external estimates of errors, Relative frequency distribution, Histogram, True value, Precision of measurement, Best estimate of true value & precision, Methods of calculating best estimate of true value & standard deviation **(7)**<br>**Combination of measurements**: Accuracy of mean, Significant digits. Method of least squares & its application for calculation of best estimate of true value, curve fitting, **(8)**<br>**General linear regression**: Comparison & combination of measurements. Extensions of least square method. Theory of errors, Binomial & Gaussian distribution, Confidence limits, Significance test, principle of maximum likelihood & goodness of fit, Chi-square test. **(9)**<br>**Displacement measurement**: Dial Gauge, Microcator, Optical Method, Pneumatic Transducer, Strain Gauges, Variable Inductance & Capacitance Transducer, Piezo-Electric, Electro-Kinetic, Photo-Electric, Ionization, Vibrating Wire & Vacuum Tube Transducer.<br>**Force & Torque:** Elastic Type, Fluid Load Cell, Dynamometers.<br>**Temperature:** Bi-Materials, Pressure & Resistance Thermometers, Thermocouples & Pyrometers.<br>**Pressure:** McLeod Gauge, Pirani Gauge, Ionization Gauge, Manometers, Bourdon Tube, Resistance Gauges.<br>**Fluid Velocity:** Pitot tube & Hot Wire Anemometer, LDA. Flow Measurement in Confined Passages & Open Channels. Miscellaneous measurements **(10)**<br>**Dynamic Response** of a Measuring Instrument, Response to Transient & Periodic Signals, First & Second-order systems as well as their Dynamic Response Characteristics. (**8)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Instrumentation, Measurement and Analysis by B C Nakra and K K Chaudhary, Tata McGraw Hill, 1985.<br>2. Principles of Measurement, Precision, Error and Truth by N C Barford, Addison Wesley, 1967.<br>***Reference Books:***<br>3. Physical Measurement and Analysis by N N Cook and E Rabinowicz, Addison Wesley, 1963<br>4. Experimental Methods for Engineers by J P Holman and W J Gajda, McGraw Hill Co., 1978 |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | 2 | - | - | - | - | - | - | 2 | - | - | - | 1 | 2 | - |
| CO2 | 3 | - | 3 | - | - | - | - | - | 1 | 2 | - | 2 | 2 | 2 | - |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | 2 | 2 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO850** | **Watershed planning & Management** | **PEL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Fluid Mechanics, Irrigation & Water Resources Engineering, Economics and Computer Applications | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: A clear understanding of different aspects of watershed<br>• CO2: Development of capabilities for optimization techniques, linear and dynamic programming for watershed management<br>• CO3: Development of ability to formulate model for watershed planning with deterministic as well as stochastic inputs, |
| Topics Covered (Hrs) | **Introduction**: Concept, Definition & Scope, Indian & Global Perspective, Timeline in India, Problems & Prospects, Problems & Constraints **(4)**<br>**Land Capability & Planning**: Definition, Classification, Planning, Use, Restoration, Policy Analysis & Decision Support **(3)**<br>**Watershed Characteristics:** Physical & Geomorphologic Factors, Classification & Measurement, Physical, Geomorphologic & Quantitative Characteristics **(4)**<br>**Importance of Watershed Properties:** Watershed Management, Effect of Physical Properties, Effect of Geomorphologic Factors & Associated Processes **(4)**<br>**Hydrologic Data**: Definition, Scope, Hydro-meteorological & Physiographical Data **(3)**<br>**Delineation and Prioritization**: Concept of Topographic or Contour Map, Boundary Delineation, GIS for Delineation, Accuracy in Delineation, Concept of Priority, Factors, Basics & Methods, Purpose & Benefits **(4)**<br>**Water Yield Assessment & Measurement**: Concept of Water Yield & its assessment, benefits, Perspectives, Measurement, Modelling & Assessment **(3)**<br>**Hydrologic and Hydraulic Design**: Hydrologic design, recharge structures, Earthen Embankments & Diversion Structures, Hydrology & Hydrologic design **(5)**<br>**Soil Erosion and its Control Measures**: Types, Problem & Control **(4)**<br>**Sediment Yield Estimation**: Generation & Transport Mechanism, Types Methods Estimation & Modelling, Estimation of Different Load **(4)**<br>**Rainwater Conservation & Harvesting**: Need, Techniques, Design **(4)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Watershed management challenges: Introduction and overview by E. R. Sharma & C. A. Scott, (2005), Watershed Management Challenges: Improving<br>2. Land and Water Management Engineering by V. V. N. Murthy & M. K. Jha, (2011), Kalyani Publishers, Ludhiana, India.<br>3. Watershed Management- Guidelines for Indian Conditions by E. M. Tideman, (1999), Omega Scientific Publishers, New Delhi.<br>4. Integrated Watershed Management in Rainfed Agriculture by S. P. Wani, J. Rockström & K. L. Sahrawat, (2011). CRC Press.<br>***Reference Books:***<br>5. http://www.ussi.co.uk/Weirs_and_Flumes.html. Last seen: 29th September 2013 |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | - | - | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - | - |
| CO3 | - | - | 3 | - | - | - | - | 3 | 3 | 3 | 3 | 3 | - | 2 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEO851** | **Elementary Structural Design** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Engineering /Solid Mechanics | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Apply knowledge of solid mechanics for design solutions.<br>• CO2: Understand basic design philosophy applicable to steel structures.<br>• CO3: Formulate, analyze, and design basic components of Civil Engineering Steel structures. |
| Topics Covered (Hrs) | **Properties** of Reinforced Concrete and Structural Steel, Loads & load combinations, Design Philosophies-Working Stress Method, Limit State Method **(4)**<br>**Limit State Method (LSM) of design for RC Structures:** Limit State of Flexure: Stress-strain characteristics of concrete & reinforcing steel, Moment of Resistance for singly reinforced, doubly reinforced sections. Limit State of Shear, Bond & Anchorage, Development length, Design of Beams, slab, Short Columns under axial load, Design of isolated Footing. **(19)**<br>**Limit State Method (LSM) of design for Steel Structures**: Limit state of collapse & serviceability, partial safety factor for material and loading, Connections: truss joint connections, Design of Tension member, Compression member, Design for Beams, Gusseted Column base foundation **(19)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Reinforced Concrete Design by S. U Pillai and Devdas Menon, Tata McGraw-Hill.<br>2. IS 456: 2000, Indian Standard Plain and Reinforced Concrete – Code of Practice (4th Revision), BIS, New Delhi.<br>3. Design of steel Structures by N. Subrhamanium (Oxford publications)<br>4. IS 800-2007: General Construction in Steel-Code of Practice<br>5. IS 808-1989: Dim of Hot Rolled Steel beam, column, channel and angle sections<br>6. www.nptel.iitm.ac.in/courses/<br>***Reference Books:***<br>*7.* Reinforced Concrete Design by S.N. Sinha, Tata McGraw-Hill Publishing*:*<br>8. Limit State Design of Steel Structures by S.K. Duggal, McGraw Hill publications |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | 3 | 2 | 3 |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | 3 | 1 | 3 |
| CO3 | - | 2 | 3 | - | - | - | - | 2 | - | 2 | 2 | 2 | 3 | 3 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEO852 | Reliability Engineering | PEL | 3 | 0 | 0 | 3 | 3 |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Engineering Mathematics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Apply the concepts of probability and statistics in reliability analysis.<br>• CO2: Aanalyze data for finding failure probability.<br>• CO3: Apply Monte carlo simulation technique in reliability analysis to solve different engineering problems.<br>• CO4: Develop the concepts of statistical quality control and reliability tests. |
| Topics Covered (Hrs) | **Elements of probability and statistics**: Basictheory of probability, random variable, functions of random variables, multiple random variables, Joint PMF, PDF, CDF, Conditional probability, Probability distributions (discrete and continuous), basic statistics, covariance and correlation. (8)<br>**Failures of Engineering systems**: Data analysis, Hazard models. (4)<br>**Basic reliability analysis**: Introduction, Definition of reliability, Different classical reliability analysis methods: First Order Reliability Method, Second Order Reliability Method, Engineering applications. (10)<br>**Simulation Techniques**: Monte Carlo simulation technique, theory and applications. (4)<br>**Statistical Quality Control and Reliability Tests:** Statistical Quality Control, Statistical Reliability Tests, Accelerated Testing, Goodness of fit tests. (8)<br>**System reliability**: Modeling, parallel and series system, Reliability improvement and allocation. (6) |
| Text Books, and/or reference material(s) | **Text Book(s)**<br>1. Probability concepts in engineering and design by Ang and Tang, John Wiley.<br>2. Probability, reliability and statistical methods in engineering design by A. Halder and S. Mahadevan, John Wiley and Sons. New York.<br>3. Probability, random variables and stochastic processes by A. Papoulis, McGraw Hill New York.<br>***Reference Book(s):***<br>4. Practical Reliability Engineering by Patrick O'Connor, Andre Kleyner, John Wiley and Sons, New York. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | 1 | 2 | - | 3 | - | - | - | - | - | - | - | - | 3 | - | - |
| CO3 | - | - | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | - |
| CO4 | - | - | 2 | 1 | - | - | - | - | - | - | - | - | - | 1 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE610** | **Advanced Design of Concrete Structures** | **PCL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Design of Concrete Structures | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) | • CO1: Acquire knowledge of engineering design of different Member<br>• CO2: Ability to analyze the Utility Structures: Bunker, Silo, Water Tank, Shell etc<br>• CO3: Ability for understanding the need of future studies |
| Topics Covered (Hrs) | **Combined footing:** Types, design of rectangular slab, trapezoidal, strip and raft type **(6)**<br>**Portal and multi-storied building frame:** Design of continuous beam, earthquake resistance design & detailing, codal provisions **(6)**<br>**Bunkers & silo:** Analysis & Design bunker & silo **(6)**<br>**Shell and folded plate:** Design of shell and folded plate **(4)**<br>**Serviceability Limit State:** Deflection and cracking **(4)**<br>**Deep and curve Beam:** Design of deep & curve beam **(4)**<br>**Tension Members:** Design under axial, bending and combination of both **(4)**<br>**Flat Slab:** Design of flat slab and associated Column **(4)**<br>**Water Tanks:** Different types tank **(6)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Ad. R. C. C Design Vol-II, by S.S. Bhavikatti, New Age International (P) Limited, New Delhi<br>2. Ad. R. C. C Design, by N.K. Raju, CBS Publishers & Distributor, New Delhi<br>3. IS 456: 2000, Indian Standard Plain and Reinforced Concrete – Code of Practice (4th Revision), BIS, New Delhi.<br>4. IS 3370 (I, II, IV): 2009 & 1965, Concrete structures for storage of Liquids- Code of practice (1stRevision), BIS, New Delhi.<br>5. IS 1893 (I): 2016, Criteria for earthquake resistance design of Structures-General provisions and building (6th Revision), BIS, New Delhi.<br>6. IS 13920: 2016, Ductile design & detailing of R. C. structures subjected to seismic forces- code of practice (1st Revision), BIS, New Delhi<br>7. www.nptel.ac.in<br>***Reference Books:***<br>8. Reinforced Concrete, 6th Edition, by S.K. Mallick and A.P. Gupta, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, 1996.<br>9. Reinforced Concrete Design, 2nd Edition, by S. Unnikrishna Pillai and Devdas Menon, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003 |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 1 | 2 | 2 | 3 |
| CO2 | - | - | 3 | - | 2 | - | 1 | - | - | - | - | 1 | 2 | 2 | 3 |
| CO3 | - | - | - | - | - | - | - | - | - | - | - | 3 | 1 | 1 | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE611** | **Advanced Structural Analysis** | **PEL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Engineering & Solids Mechanics with Structural Analysis | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Develop basic understanding of the fundamental concepts and theorems of the advanced topics in analysis of structures.<br>• CO2: Model and analyze different structural systems by matrix method of analysis using element approach of force/ flexibility method.<br>• CO3: Model and analyze different structural systems by matrix method of analysis using element approach of displacement/ stiffness method.<br>• CO4: Understand the basic methodology adopted in developing computer programmes for structural analysis and thus, develop an overall understanding of the available structural analysis softwares.<br>• CO5: Ability to write the governing equations for stability & analysis of structures. |
| Topics Covered (Hrs) | **Recapitulation** of basic concepts of structural analysis, force & displacement methods, statical & kinematic indeterminacies of pure truss, pure frame & generalized structures**(2)**<br>**Stiffness / Displacement Method**: System approach of solution, global and local coordinate systems, element stiffness matrices for truss and frame elements, displacement and force transformation matrices, connectivity arrays, global stiffness matrix, global load vector, assembling of stiffness matrix and load vector, solution of stiffness equation, output of global displacements and local member end forces, introduction to warping torsion and shear deformation, three dimensional element stiffness matrix and transformation matrix, analysis of grids, different types of example problems. (10)<br>**Flexibility/ Force Method**: System approach of solution, global and local coordinate systems, element flexibility matrices for truss and frame elements, force transformation matrices, global flexibility matrix, global load vector, assembling of flexibility matrix, solution of flexibility equation, output of displacements and member end forces, different types of example problems. (8)<br>**Elastic Stability Analysis** of beam, column and frames. (10) |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Structural Analysis by L.S. Negi & R.S. Jangid, Tata McGraw-Hill Publishing Company Limited<br>2. Structural Analysis: A Unified Classical and Matrix Approach, Amin Ghali, Adam M. Neville by E & FN SPON 4th Ed.<br>3. Stability Analysis and Design of Structureby M. L. Gambhir, Springer 2004 edition<br>***Reference Books:***<br>4. Structural Analysis: A Matrix Approachby G.S. Pandit & S.P. Gupta, Tata McGraw-Hill Publishing Company Limited |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 1 | 1 | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | 3 | 3 | 3 | - | 1 | - | - | - | - | - | - | - | 2 | - | - |
| CO3 | 3 | 3 | 3 | 1 | 1 | - | - | - | - | - | - | 1 | 2 | - | - |
| CO4 | - | - | - | - | 2 | - | - | - | - | - | 1 | 2 | - | - | - |
| CO5 | 3 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | - | - | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE-612** | **Mechanics of Composite Structures** | **Program Elective (PEL)** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Knowledge of Solid Mechanics, Structural Analysis & Design | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Development of skills of finding out mechanical properties of composite materials as well as predicting structural behaviour of composites under different loads.<br>• CO2: Knowledge of basics of analysis and design of structural components, made of variety of composite materials.<br>• CO3: Knowledge of using numerical tools for modeling and analysis of simple structural components |
| Topics Covered (Hrs) | Introduction, Types of composite materials, Lamina and Laminate, Matrix and Fibre, Fibre-reinforced Composites, Comparison of strengths between bulk material and fibres. **(6)**<br>Co-ordinate systems, Effect of orientation of fibres on the strength and stiffness of Composites. **(6)**<br>Brief outline of manufacturing processes. **(4)**<br>Micromechanics and Macro mechanics, Constitutive relations, Stresses and Strains, Failure criteria of composites. **(8)**<br>Analysis of Composites: beams and plates **(12)**<br>Finite Element Method in analysis of Composite Structures **(6)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Mechanics of Composite Materials by Robert M. Jones, Taylor and Francis (2015)<br>2. Mechanics of Composite Structures by Autar K. Kaw, Taylor and Francis (2006)<br>***Reference Books:***<br>3. Mechanics of Composite Materials and Structures by Madhujit Mukhopadhyay, University Press (2004) |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | - | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - | 2 |
| CO3 | - | 2 | - | - | 3 | - | - | - | - | - | - | - | - | 3 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE-613** | **Material Technology** | **Program Elective (PEL)** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Engineering Mechanics and Mathematics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Development of skills for predicting structural behaviour of different materials under different loads<br>• CO2: Knowledge of basics of analysis and design of structural components, made of variety of materials<br>• CO3: Developing the requisite skill that helps in studying the advanced courses related to Structural Analysis, Design of Structures |
| Topics Covered (Hrs) | **Material and Material Defects**: Metallic materials, Polymeric Materials, Ceramics and Composites, elastic and plastic deformation, Mechanism of deformation and its significance in design and shaping **(8)**<br>**Failure mechanisms of Materials**: **Fracture:** Definition and types of facture, Brittle fracture: Critical stress and crack propagation velocity for brittle fracture. Ductile fracture: Notch effect on fracture. Fracture toughness. Ductility transition. Definition and signification. Conditions of ductility transition factors affecting it. **(6)**<br>**Fatigue Failure:** Definition of fatigue and significance of cyclic stress. Mechanism of fatigue and theories of fatigue failure, Fatigue testing. Test data presentation and statistical evolution. S-N Curve and its interpretation. Influence of important factors on fatigue. Notch effect, surface effect, Effect of pre-stressing, corrosion fatigue, Thermal fatigue. **(5)**<br>**Creep:** Definition and significance of creep. Effect of temperature and creep on mechanical behaviours of materials. Creep testing and data presentation. **(6)**<br>**Introduction to New Materials**: **Composites:** Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites and their applications. Nano Materials: Introduction, Concepts, synthesis of nano materials, examples, applications and nano-composites. Polymers: Basic concepts, Processing methods, advantages and disadvantages over metallic materials, examples and applications. **(10)**<br>**Strength Analysis of materials under different loading:** Stress, strain due to normal, shear, flexure, impact, torsion loads. Analysis by energy method. **(7)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. A Text Book of Strength of Materials by Ghosh & Datta, 2ed, New Age International Publication Pvt. Ltd, New Delhi<br>2. Engineering Materials Technology by W. Bolton, 3ed,Taylor & Francis Ltd<br>***Reference Books:***<br>3. Engineering Materials: An Introduction to Properties, Applications and Design by David R.H. Jones, Michael F. Ashby, 4ed, Elsevier (BH) |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | 3 | - | 1 |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | 3 | 1 | 1 |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | 3 | - | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE614** | **Applied Numerical Methods** | **PEL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Engineering Mathematics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Assess the error involved in a numerical method<br>• CO2: Solve problems in engineering and science with a required accuracy using appropriate numerical methods<br>• CO3: Write algorithm for the numerical methods for efficient coding of program<br>• CO4:Understand the mathematics concepts underlying the numerical methods |
| Topics Covered (Hrs) | **Fundamentals of numerical methods:** Need for Numerical methods in Civil Engineering, Sources of Errors, Absolute, Relative and Percentage, round off error, and stability of algorithms. **(04)**<br>**Linear system of algebraic equations:** Gauss elimination method, LU decomposition method; iterative methods, ill conditioned systems. Jacobi, Gauss Seidel method, Relaxation method. **(08)**<br>**Nonlinear equations:** Bisection method, Regula Falsi method, Newton Raphson method, Modified Newton-Raphson method, Higher order Newton's method Bairstow method, system of non-linear equations. **(8)**<br>**Interpolation and approximation**: Newton's, Lagrange and Hermite interpolating polynomials, cubic splines; least square and minimax approximations. (06)<br>**Numerical differentiation and integration:** Newton-Cotes and Gaussian type quadrature methods. **(06)**<br>**Ordinary differential equations:** Initial value problems: single step and multistep methods, stability and their convergence. Boundary value problems: functional approximation, finite difference method. **(08)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Numerical Methods for Scientists and Engineers by R. W. Hamming, Dover Publications; 2 edition<br>2. Numerical Methods: Problems and Solutions by Mahinder Kumar Jain (Author), S.R.K. Iyengar (Author), R. K. Jain, New age publishers<br>3. Numerical Methods for Engineers by Chapra, S. C., and Canale, R. P., McGraw Hill, Inc., 2007.<br>***Reference Books:***<br>4. Applied Numerical Methods for Engineers Using Matlab and C by Robert J. Schilling (Author), Sandra L. Harris, Nelson Engineering; Har/Cdr edition<br>5. Numerical Analysis for Scientists and Engineers: Theory and C Programs by Madhumangal Pal, Alpha Science Intl Ltd; 1 edition |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | 3 | - |
| CO2 | 3 | - | 3 | - | 3 | - | - | - | - | - | - | - | - | 3 | - |
| CO3 | 3 | - | 3 | - | 3 | - | - | - | - | 1 | - | - | - | 3 | - |
| CO4 | 2 | - | - | - | 3 | - | 1 | - | - | - | - | - | - | 3 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEE615 | Bridge Engineering | PCL | 3 | 0 | 0 | 3 | 3 |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Survey, Water Resource Engineering, analysis and design of structures | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) | • CO1: Acquire knowledge to select different type bridges by assessing their material, capacity, quality & suitability<br>• CO2: Ability to make a bridge plan and design following requisite criteria<br>• CO3: Supervise the construction procedure of different components of a bridge<br>• CO4: Assess the quality and roles of various components of bridge |
| Topics Covered (Hrs) | **Hydraulic design:** Survey, Catchment, Site selection, Hydraulic geometry, Linear waterways, Economic span, Afflux and Scour. **(4)**<br>**Loads on bridge:** Different types of load acting on bridge along with numerical **(6)**<br>**Slab and box culvert:** Analysis of deck slab - effective width & length method and numerical example with different type of live load. **(4)**<br>**R.C. beam-slab and steel composite bridges:** R.C. T-beam bridge and steel composite bridge design using Pigeaud's method and Courbon's method **(6)**<br>**Dynamic response of bridge deck:** General features, factor affecting vibration, practical approach for vibration analysis and numerical examples. **(2)**<br>**Prestressed concrete bridge:** General features, advantage of P.S.C. Bridge, design details of pre-tensioned and post–tensioned bridge and numerical (**6**)<br>**Bridge bearing:** Introduction, types of bearing, design principles of different bearing and numerical examples **(4)**<br>**Substructure:** Introduction, type of piers, forces acting on piers, stability analysis of abutment, types of wing wall and numerical examples of Pier and Abutment. **(4)**<br>**Bridge foundation:** General aspect, types of foundations, design aspect of pile and well foundations and numerical examples of pile and well foundations. **(4**) |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Bridge Engineering by S. Ponnuswamy, Tata McGraw-Hill Publishing Company Limited, New Delhi.<br>2. IRC: 6-2017 Standard Specifications and Code of Practice for Road Bridges<br>3. www.nptel.ac.in<br>***Reference Books:***<br>4. Design and construction of Highway Bridges by K. S. Rakshit, New Central Book Agency (P) Ltd |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | 2 | 3 | 3 |
| CO2 | - | 3 | 2 | - | 3 | - | 1 | - | - | - | - | - | 3 | 3 | 3 |
| CO3 | - | - | - | - | - | - | - | - | 3 | 2 | - | 1 | - | - | 1 |
| CO4 | - | - | - | - | - | - | - | - | - | - | - | 3 | 1 | - | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE620** | **Analysis and Design of Pavements** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Transportation Engineering | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO 1: Understanding of material characteristics for transfer of load<br>• CO 2: Understanding of mechanics of transfer of vehicular load to pavement<br>• CO 3: Development of ability to understand vehicle pavement interaction<br>• CO 4: Ability to determine stresses in different type of pavements<br>• CO 5: Development of expertise in design of pavement of different types of roads, highway, airport pavement |
| Topics Covered (Hrs) | **Characterization of Sub-Grade Soil and Mineral Aggregates:** Introduction, particle size analysis, gradation, moisture content, consistency, test, classification, composition, compaction, strength determination, strength properties of mineral aggregates **(8)**<br>**Bituminous Materials:** Introduction, desirable properties, tests, other binders, engineering properties and mix design **(8)**<br>**Design of Cement Concrete Mixes for Pavements:** Introduction, cement, properties, mineral aggregates, water, admixtures, properties of fresh concrete, test on hardened concrete, factors for durability, design of cement by BS (10262), IRC (44), Dry Lean Cement Concrete (MORTH 201), Mix Design for Rural Roads (IRC :SP:62) **(8)**<br>**Factors Affecting Pavement Design:** Types of pavements, factors affecting design of pavements **(4)**<br>**Analysis and Design of Flexible Pavements:** Stress analysis, design methods, benefits of M-E method, test roads **(4)**<br>**Structural Evaluation of Pavements:** Purpose, types, and methods of structural evaluation, structural evaluation by static loading, steady – state Vibratory Loading, impulse lading, Models of Falling Weight Deflectometer, FWD, back calculation of Layer Moduli from FWD Test data, uses of Back-calculated Pavement Layer Moduli, Structural Evaluation of Rigid Pavement using FWD.(**6)**<br>**Structural Evaluation of Unbound Granular and Sub-Grade Layers:** Using Dynamic Cone Penetrometer (DCP) – Development of DCP Test, The Dynamic Cone Penetrometer, material testing with DCP, determination of DCP index values, factors affecting DCP test results, correlation of DCP index values with other standard test values, application of DCP test data, limitation of DCP **(6)** |
| Text Books and/or reference material(s) | ***Text Books:***<br>1. Highway Engineering by R. Srinivas Kumar.<br>***Reference Books:***<br>2. Principles of Pavement Engineering by Nick Tom |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | - | - | - | - | - | - | - | 3 | - | - | 3 | - | - |
| CO2 | - | - | 3 | 4 | - | - | - | - | - | - | - | - | 2 | 1 | 1 |
| CO3 | - | - | - | - | 3 | - | - | - | 2 | - | - | - | 1 | 3 | 1 |
| CO4 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 |
| CO5 | - | - | - | - | - | - | - | 3 | - | - | 3 | 3 | 1 | 3 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE621** | **Finite Element Method** | **PEL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Solid Mechanics, Structural Engineering & Engg. Mathematics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Understanding the advantage of FEM over classical methods and use it for modelling and analysis of real life engineering structures.<br>• CO2: Skill to simulate simple engineering structures through FE modellling and interpret data from the FE analysis to ascertain their reliability and applicability in light of physical constraints of the system and common engineering sense.<br>• CO3: Ability to use computational tools for solving Civil Engineering problems.<br>• CO4: Skill of using advanced FEA software packages and development of FE codes for modelling, analysis and investigation of problems related to industry and research. |
| Topics Covered (Hrs) | **Introduction**: Engineering Problems, Different numerical methods, History of Finite Element Method (FEM), Steps in FEM, Areas of Application, Verification problems, implementation of Engineering Problems in FEM**. (10)**<br>**Solution of Engineering Problems using Matrix operation**: Importance, Matrix Manipulation Techniques, Solution of Simultaneous Linear Equations, Inverse of Matrix, Computer Implementation. **(6)**<br>**Spring Element:** General, Implementation in FEM, Applications in civil engineering, Problems. **(6)**<br>**Bar Elements**: Definition, Stiffness Matrix, Load vector and displacement vector, Implementation in FEM, Problems and Validation. **(6)**<br>**FE Modelling of Engineering Problems:** Trusses, beams, Frames etc. **(14)**<br>**Computer Programs**/ SOFTWARES based on FEM: Use in solution of Engineering Problems. **(3)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Finite element analysis: theory and programming by C S Krishnamurthy (2001): Tata McGraw Hill Education<br>2. An Introduction to the Finite Element Method by Reddy, J. N., 2005.<br>3. Fundamentals of Finite Element Analysis by David V. Hutton Publisher: Tata Mcgraw Hill Education Private Limited (2005)<br>***Reference Books:***<br>4. Finite Element Procedures by Klaus-Jurgen Bathe Publisher: Prentice-Hall (2009) |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | - | 3 | - | 2 | - | - | - | - | - | - | - | - | 3 | - | - |
| CO3 | - | - | - | - | 3 | - | - | - | - | - | - | - | - | 3 | - |
| CO4 | - | 2 | - | 3 | - | - | - | - | - | - | - | - | 2 | 3 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC622** | **Ground Improvement** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Soil Mechanics & Foundation Engineering | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: understand how to improve the geotechnical properties of soft soil by different techniques.<br>• CO2: identify ground conditions and suggest method of improvement<br>• CO3: understand the principles of soil reinforcement and confinement in engineering constructions. |
| Topics Covered (Hrs) | **Introduction:** Formation of soil, major soil type, collapsible soil, expansive soil, ground improvements; objective, potential. **(8)**<br>**Ground Improvement in Granular Soil**: In place densification by (i) Vibrofloatation (ii) Compaction pile (iii) Vibro Compaction Piles (iv) Dynamic Compaction. **(12)**<br>**Ground Improvement in Cohesive Soil**: Preloading with and without vertical drains, Compressibility, vertical and radial consolidation, preloading methods. Types of Drains, Design of vertical Drains, construction techniques. Stone Column: Function Design principles, load carrying capacity, construction techniques, settlement of stone column foundation. **(22)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Ground Improvement by M.P. Moseley and K. Krisch, (2006)–II edition, Taylor and Francis<br>2. Designing with Geosynthetics by Koerner, R. M (1994), Prentice Hall, New Jersey<br>3. Engineering Principles of Ground Modifications by Hausmann, M. R. (1990), McGraw Hill publications<br>***Reference Books:***<br>4. Earth Reinforcement and soil structures by Jones C. J. F. P. (1985), Butterworths, London.<br>5. Ground Control and Improvement by Xianthakos, Abreimson and Bruce<br>6. Ground Control and Improvement by K. Krisch & F.Krisch (2010), John Wiley & Sons, 1994.<br>7. Foundation Design principles and Practices by Donald P Coduto, 2nd edition, Pearson, Indian edition, 2012 |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | 3 | - | 2 | - | - | - | - | - | - | - | - | 3 | | 1 |
| CO2 | - | 2 | 3 | 2 | - | - | 1 | - | - | - | - | - | | 3 | 1 |
| CO3 | - | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEC623 | Remote Sensing & GIS | PEL | 3 | 0 | 0 | 3 | 3 |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| None | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | CO1: Learn about basic items, parameters & concepts related with remote sensing.<br>CO2: Apply techniques of visual image interpretation and digital image processing.<br>CO3: Use GIS and its components for basic applications in civil engineering. |
| Topics Covered (Hrs) | **Remote Sensing**: History, Physical basis, Electromagnetic spectrum, Spectral reflectance curves, Spectral signatures, Resolutions, Passive & active remote sensing, Remote sensing platforms. **(12)**<br>**Sensors**: Different types, Satellite band designations & principal applications, FCC, Aerial photography & its interpretation. **(9)**<br>**Digital image processing**: Pixels & DN values, Digital image formats, Image processing functions – Image enhancement, Image transformation, Image classification & analysis. **(10)**<br>**Geographic Information System:** Introduction, GIS components – hardware, software & infrastructure, GIS data types, Data input & processing, DEM generation, Preparation of thematic map from RS data. **(6)**<br>**Integration of RS & GIS techniques** and its applications in the field of Civil Engineering. (5) |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Remote Sensing & GIS (2nd Ed.) by B. Bhatta (Oxford University Press, New Delhi)<br>2. Textbook of Remote Sensing & Geographical Information Systems (3rd Ed.) by M. Anji Reddy (BS Publications, Hyderabad)<br>***Reference Books:***<br>3. Remote sensing & Image Interpretation (6th Ed.) by T.M. Lillesand, R.W. Kiefer & J.W. Chipman (Wiley India (P) Ltd., New Delhi)<br>4. Geographical Information Systems (2nd Ed.) by P.A. Longley, M.F. Goodchild, D.J. Maguire & D.W. Rhind (John Wiley & Sons, Inc.) |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | - | - | - | - | - | - | 1 | - | - | - | - | - | - |
| CO2 | 3 | 2 | - | 2 | 2 | - | 1 | - | 1 | 1 | - | 3 | - | - | - |
| CO3 | 3 | 2 | 3 | - | 2 | - | 1 | - | 1 | 1 | - | 3 | - | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE-624** | **Traffic Engineering and Management** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Transportation Engineering | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |
| Course Outcomes (COs): | • CO1: Apply knowledge of traffic study & analysis for design solutions.<br>• CO2: Understand basic design philosophy applicable to traffic flow & highway intersections.<br>• CO3: Formulate, analyze, and design basic components of highway intersections. | | | | | | |
| Topics Covered (Hrs) | **Traffic characteristics**, Traffic engineering studies and analysis: Volume, speed, delay, origin and destination. (18)<br>**Highway intersections**, Traffic flow theory, Traffic capacity, Traffic operations and control, Signal systems, Parking and terminal facilities, Traffic safety. (20)<br>**Impact of highway traffic** on environment. (4) | | | | | | |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Traffic Engineering by R. P. Roess, W.R. McShane and E.S. Prassas, Prentice Hall.<br>***Reference Books:***<br>2. Transportation Engineering and Planning, C. S. Papacostas, and P. D. Prevedouros, Prentice Hall India<br>3. Principles of Transportation Engineering, P. Chakroborty and A. Das, Prentice Hall India. | | | | | | |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | 3 | 3 | 1 |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | 3 | 2 | 1 |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | 1 | 2 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE625** | **Systems approach to Civil Engineering design** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisites: | | Course Assessment methods | | | | | |
| No pre-requisites | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |
| Course Outcomes | • CO1: Develop system approach based models of Civil Engineering systems.<br>• CO2: Solve optimization problems.<br>• CO3: Learn decision theory and its application to CE problems | | | | | | |
| Topics Covered | **Introduction:** System concept for engineering design, System classification, system modeling, Methodology of system design. **(4)**<br>**Optimization Techniques:** Linear Programming- Simplex Method Duality Theory, Dual Simplex, Sensitivity analysus, Integer programming **(8)**<br>**Network analysis:** Transportation problems, Assignment problems, Maximal flow, Project management **(8)**<br>**Non-Linear programming:** Basic concept, Introduction to Lagrange multipliers, Kuhn-Tucker conditions **(4)**<br>**Common Probabilistic models (8)**<br>**Decision theory:** Decision problems, Decision criteria, Maximax, Equally likely, Minimax, Maximum likelihood, Bays' decision rule, Application to civil engineering systems design. **(10)** | | | | | | |
| Text Books, and/or reference material | ***Text Books:***<br>1. Engineering Hydrology by R. S. Varshney, Nem Chand & Bros. Roorkee (U.P.) 1986.<br>2. Operations Research by A. Ravindran, D. J. Philips, and J. J. Solberg, Principles and Practice 2nd Edition, John Weley & Sons, New York, 1987.<br>3. Engineering Optimization – Theory and Practice by S. S. Rao, 3rd Edition, New Age Int. (P) Ltd. Publishers, New Delhi, 2001.<br>4. Introduction to Operations Research – A computer oriented Algorithmic Approach by B. E. Gillett, TMH Edition, New Delhi 1985.<br>***Reference Books:***<br>5. Nonlinear Programming – Theory and Algorithms by M. S. Bazaraa, & C. M. Shetty, John Wiley & Sons, New York, 1990.<br>6. Introduction to Optimum Design by J. S. Arora, McGraw Hill Int. Editions, McGraw Hill Book Co. Singapore, 1989.<br>7. Engineering Optimization – methods and Applications by G. V. Reklaitis, A. Ravindran, and K. M. Ragsdell, John Wiley & Sons, New York, 1983. | | | | | | |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | 3 | 3 | - | - | - | - | 2 | 2 | - | - | - | 3 | - | - |
| CO2 | - | 3 | 3 | - | - | - | 1 | - | - | 3 | - | 2 | 3 | - | - |
| CO3 | - | 3 | 3 | - | - | - | - | - | - | - | - | - | 3 | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE710** | **Structural Dynamics** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Solid Mechanics | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Develop & analyze damped & un-damped SDOF systems for free & forced vibration.<br>• CO2: Develop and analyze the MDOF systems for free & forced vibration.<br>• CO3: Model civil engineering structures & derive the dynamic properties of structures<br>• CO4: Calculate natural frequencies, mode shapes & structural responses numerically<br>• CO5: Apply the concepts & principles of structural dynamics for earthquake analysis of civil engineering structures & evaluate their seismic performance |
| Topics Covered (Hrs) | **Introduction:** D'Alembert's principle, dynamic loads, definition of degrees of freedom **(1)**<br>**SDOF system:** Equations of motion, undamped and damped SDOF systems, viscous damping, critically damped, over-damped and under-damped system, damping coefficient determination, dynamic magnification factor and transmissibility. **(7)**<br>**Forced vibration of SDOF systems:** Vibration under sinusoidal loads, response to general dynamic loading - Duhamel's integral: impulse, rectangular, triangular loading problems. **(5)**<br>**Fourier analysis and response in the frequency domain** theory, problems **(2)**<br>**MDOF system:** Development and solution of equations of motion, problems **(2)**<br>**Free vibration of MDOF systems:** Eigen values and vectors, natural frequencies and modes, orthogonality of modes, normalization of modes, modal expansion, concept of normal/generalized coordinates, problems **(5)**<br>**Free vibration response**: Free vibration of un-damped systems, modal analysis. **(3)**<br>**Forced vibration of MDOF systems:** Modal expansion of excitation vector, modal analysis, modal contribution factors. **(3)**<br>**Forced vibration response:** Modal analysis, forced vibration for un-damped systems subjected to sinusoidal loading and arbitrary loading**. (5)**<br>**Damping in structures:** Classical, non-classical damping, mass proportional, stiffness proportional, Rayleigh, Caughey damping, Modal analysis for classically damped free and forced vibration systems **(4)**<br>**Earthquake analysis of structures:** Equations of motion for un-damped and classically damped systems single and multiple degree of freedom systems, modal participation factors, modal analysis, response spectrum analysis, modal combination rules **(4)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Dynamics of Structures by Anil K. Chopra, PHI<br>2. Earthquake Resistant Design of structure by Pankaj Agarwal and Manish Shrikhande.<br>3. Structural Dynamics: Theory and Computation by Mario Paz, Kluwer Academic Publishers<br>***Reference Books:***<br>4. Elements of Earthquake Engineering, Jai Krishna, A.R. Chandrasekaran, B. Chandra. South Asian Publishers.<br>5. Theory of Vibration with Applications, W.T. Thomson, PHI |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | 3 | 3 | - | - | - | - | - | - | - | - | - | 2 | - | |
| CO2 | 2 | 3 | 3 | - | - | - | - | - | - | - | - | - | 2 | - | |
| CO3 | 3 | 2 | 2 | - | 1 | - | - | - | - | - | - | 2 | - | 1 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 1 | 2 | - | 1 | 1 |
| CO5 | 3 | 2 | - | 2 | 1 | 1 | - | 1 | - | - | 1 | 2 | - | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEE711 | Advanced Design of Steel Structures | PEL | 3 | 0 | 0 | 3 | 3 |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Design of Steel Structures | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Understand the design aspects, principles of few steel structures as a whole.<br>• CO2: Apply basic knowledge of steel design of components for design solutions of whole structure.<br>• CO3: Formulate, analyze, and design of various Civil Engineering Steel structures. |
| Topics Covered (Hrs) | **Design of Industrial Shed**: Description of Different components, Loads Calculation, Analysis and Design of Truss members, Purlin, Top Chord and Bottom Chord Diagonals, Shoe Plate and Bolts design, Columns Design, Base Plate and Anchor Bolts Design. **(10)**<br>**Design of water tank**:Staging, Columns braced type staging. **(10)**<br>**Design of Castellated beams** and open web structures**. (4)**<br>**Bridges:** Design loads for highway / railway bridges, Design of truss bridges for highway and railway**. (10)**<br>**Introduction to Plastic Design**: Plastic hinge, Plastic-Collapse method, Plastic Analysis of Frames **(8)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Design of steel Structures by N. Subrhamanium (Oxford publications)<br>2. IS 800-2007: General Construction in Steel-Code of Practice<br>3. IS 808-1989: Dimensions of Hot Rolled Steel beam, column, channel and angle sections<br>4. SP 6(1)-1964: Handbook for Structural Engineers.<br>5. IS 3370-1965 code for concrete structures for he storage of liquids<br>6. IS 805: 1968 Code of Practice for Use of Steel in Gravity Water Tanks<br>7. IRC:6-2017 Standard Specifications and Code of Practice for Road Bridges<br>8. www.nptel.iitm.ac.in/courses/<br>***Reference Books:***<br>9. Limit State Design of Steel Structures by S.K. Duggal (McGraw Hill publications)<br>10. Design of steel Structures by S. S. Bhavikatti (IK Intl Publishing House, N Delhi) |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | - | 3 | - | - | - | - | 2 | 2 | - | - | - | 3 | - | 2 |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 3 | - | 2 | - | 2 | - |
| CO3 | - | 3 | 3 | - | 1 | - | - | 2 | - | 2 | 1 | 3 | 2 | 1 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE712** | **Theory of Plates and Shells** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Solid Mechanics, Structural Analysis | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |
| Course Outcomes (COs): | • CO1: Derive the expressions of the curvature and displacement relationships of plates subjected to bending moments, twisting moments and shear force.<br>• CO2: Analyse the simply supported plates and solve them by using Navier's and Levy's Methods.<br>• CO3: Analyse the thin shell structures using membrane theory.<br>• CO4: Design the cylinder shell and review the IS codal provisions of it. | | | | | | |
| Topics Covered (Hrs) | **Basic curvature and displacement relationships**. Expressions for bending, moment, twisting moments, shear forces. **(4)**<br>**Plate equation**, Edge conditions. Solution of simply supported plates by Navier's and Levy's methods. Introduction to anisotropic plates. **(10)**<br>**Plate subjected to in plane forces**, Buckling of plates. Numerical analysis of plates. Design of plates. **(6)**<br>**Shell structures** Classification, Differential geometry, Curvature, Strain, Displacement relations. **(4)**<br>**Membrane theory of thin shells** and design of cylindrical shells of double curvature (Synclastic and anticlastic), Shells of revolution, North light shell. **(10)**<br>**Design of shell** and review of IS code provisions, Introduction to bending theories: Application to cylindrical shells and design. **(6)** | | | | | | |
| Text Books, and/or reference material(s) | ***Text Book (s):***<br>1. Theory of Plates and Shells by Timoshenko and Krieger, McGraw Hill<br>2. Theory and Analysis of Plates by Classic and Numerical Methods, Rudolph Szilard, Prentice Hall Inc. New Jersey<br>***Reference Book:***<br>3. Design and Construction of Concrete Shell Roofs by G.S. Ramaswamy, CBS Publisher & Distributors (2005) | | | | | | |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | 3 | 1 | - |
| CO2 | 2 | 3 | - | - | - | - | - | - | - | - | - | - | 3 | 1 | - |
| CO3 | - | 3 | - | - | - | - | - | - | - | - | - | - | 3 | 1 | - |
| CO4 | - | 1 | 3 | - | - | | | | | | | | 3 | 2 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE713** | **Theory of Elasticity and Plasticity** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Engineering & Solid Mechanics | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes | • CO1: To develop basic understanding of the behaviour of materials.<br>• CO2: To define the stress and strain behaviour of structural elements.<br>• CO3: To apply theory of elasticity in bending and torsion problems.<br>• CO4: To apply theory of plasticity in failures of different materials and structures. |
| Topics Covered | **Stress & Strain**: Stress equilibrium equations, rectangular, cylindrical and spherical co-ordinates, Generalized Hooke's Law, Stress and strain compatibility equations. Plane stress and plane strain problems, Airy's stress function, Principal Stresses and strains, stress & strain invariants, numerical problems. **(15)**<br>**Torsion**: Shafts of circular and non-circular prismatic sections, Saint Venant theory, warping function, stress function. **(7)**<br>**Theories of Failure**: Basic concepts and Yield Criteria, Different Theories of Failure, Yield Locus and Yield Surfaces. Equations of Plasticity. **(8)**<br>**Plasticity**: hydrostatic stresses, deviatoric stresses, invariants of deviatoric stresses, yield criteria, von Misses, Tresca yield criteria, theories of plastic flow, plane stress, plane strain problems in plasticity, thick cylinders, thick spheres. **(12)** |
| Text Books, and/or reference material | ***Text Books:***<br>1. Theory of Elasticity and Plasticity by S. Timoshenko, MC Graw Hill Book company.<br>2. Theory of Elasticity and Plasticity by Sadhu Singh, Khanna Publishers.<br>***Reference Books:***<br>3. Advanced Strength of materials by Papov, MC Graw Hill Book Company.<br>4. Plasticity for structural Engineers by Chen, W.F. and Han, D.J, Springer-Verlag, New York. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | 1 | - |
| CO3 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 1 | - |
| CO4 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | 2 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEE-714 | Structural Health Monitoring | PEL | 3 | 0 | 0 | 3 | 3 |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Knowledge of Solid Mechanics and Structural Design | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Knowledge of assessment and monitoring of existing structures as well as for newly constructed structures.<br>• CO2: Exposure and skill to use relevant NDT equipment for research and industrial applications.<br>• CO3: Knowledge on instrumentations in structures, their use and interpret the collected data from instrumentations.<br>• CO4: Based on the above, the students are expected to suggest remedial measures for distressed structures. |
| Topics Covered (Hrs) | **Preamble:** Definition of structure, different types of structures, behaviour of structures under variety of loading conditions, deterioration and failure of structures, structural materials. **(4)**<br>**Introduction:** What is structural health and SHM, importance, application and present scenario of SHM in India and abroad, parameter related to structural health. **(4)**<br>**Types of SHM:** Periodic and continuous, methods for implementation of each. **(6)**<br>**Measurement techniques**: Destructive and non-destructive **(6)**<br>**Equipment:** For non-destructive testing, working principles of this equipment and use **(8)**<br>**Health monitoring in dynamic condition:** Basics of structural dynamics, sensing technologies, data collection and analysis, basic concept of signal processing, identification of structural health using modal parameters. **(14)**<br>**Field visit:** Visit to the site(s) of old structure(s) for assessing their existing condition for SHM purpose. **(3)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Structural Health Monitoring by Victor Giurgiutiu<br>2. New trends in Structural Health Monitoring by Ostachowich, Witslaw, Guemes, Alfredo.<br>3. Dynamics of structures by A K Chopra, Pearson/Prentice Hall.<br>***Reference Books:***<br>4. Non-destructive Testing of Materials and structures by Buyukozturk and Tasdemir: Springer |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | - | - | - | - | - | - | - | - | - | - | 3 | 2 | - |
| CO2 | - | - | - | 3 | 2 | - | - | - | - | - | - | - | - | 2 | 3 |
| CO3 | - | - | - | 2 | 3 | - | - | - | - | - | - | - | - | 3 | 1 |
| CO4 | - | 3 | - | - | - | - | - | - | - | - | - | - | 3 | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEE720 | Soil Dynamics | PEL | 3 | 0 | 0 | 3 | 3 |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Soil Mechanics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes | • CO1: develop a mechanism to design the foundations for resisting vibrations and achieve static equilibrium conditions of structures.<br>• CO2: understand the classical geotechnical failures due to liquefaction and mitigate the same.<br>• CO3: design of foundations in large structures like power plants, other industrial buildings etc., for analysing the vibrating waves which can be isolated and measures for achieving safety of the adjacent foundations. |
| Topics Covered (Hrs) | Vibration of elementary system, Single degree and two-degree freedom systems, Wave propagation in an elastic, homogeneous, isotropic medium. **(10)**<br>Propagation of waves in saturated media, Behaviour of dynamically loaded soils, Evaluation of dynamic properties of soil. **(10)**<br>Theories for vibration of foundations in elastic media, Design procedures for dynamically loaded foundations for vertical and rocking vibrations. **(14)**<br>Foundations under reciprocating engines, Foundations for forge hammers, motor generators, turbo-generators and crushers. **(10)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Soil Dynamics and Machine Foundation by Swami Saran, Galgotia Publicaions<br>2. Vibrations Vibration Analysis and Foundation Dynamics by NSV Kameswara Rao, Wheeler Publishing, New Delhi.<br>3. Fundamentals of Soil Dynamics by B M Das<br>***Reference Books:***<br>4. Vibrations of Soils and Foundations by Richart Hall and Woods<br>5. Foundations of Machines-Analysis and Design by Prakash and Puri.<br>6. Analysis and design of Foundations for Vibrations by P J Moore<br>7. Dynamics of bases and Foundations by D D Barkar |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modem tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | 3 | 2 | - | - | - | - | - | 1 | - | - | 2 | - | 3 |
| CO2 | - | 3 | - | - | - | - | 1 | - | - | - | - | - | 3 | - | 1 |
| CO3 | - | - | 3 | - | - | - | 2 | - | - | - | 1 | - | 3 | - | 2 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC721** | **Environmental Pollution & Control** | **PEL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| None | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Apply knowledge of different types of environmental affecting the community life pollutants (air, solid wastes and noise) for design solutions.<br>• CO2: Understand basic design philosophies applicable to control and safe disposal of different types of environmental pollutants.<br>• CO3: Formulate, analyze, and design basic control and disposal systems of different types of environmental pollutants. |
| Topics Covered (Hrs) | **Natural & man made sources of pollution**, types of pollutants. **(2)**<br>**Air pollution**: Its effects, measurement, methods of control, air pollution control equipment. **(16)**<br>**Community Solid wastes** – quantity & characteristics, methods of collection, disposal & reuse. **(16)**<br>**Noise pollution** - Its effects, noise measurement, methods of control of environmental noise. **(6)**<br>**Legal aspects** of environmental pollution & control. **(2)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Introduction to Environmental Engineering by M.L. Davis & D.A. Cornwell (Tata McGraw-Hill Education Private Limited, New Delhi)<br>2. Environmental Engineering by H.S. Peavy, D. R. Rowe & G. Tchobanoglous [McGraw Hill Education (India) Private Limited, New Delhi]<br>***Reference Books:***<br>3. Environmental Engineering – A Design Approach by A. P. Sincero & G. A. Sincero (Prentice – Hall of India Private Limited, New Delhi) |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | 2 | - | - |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | 2 | - | - |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | 3 | - | 2 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE 722** | **Construction Planning and Management** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisites: | | Course Assessment methods | | | | | |
| CEC303 + CES544 | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

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|---|---|
| Course Outcomes (COs) | • CO1: Learn preliminaries of construction planning and management.<br>• CO2: Learn construction safety aspects.<br>• CO3: Learn contract management. Get exposed to tendering and contracting.<br>• CO4: Learn about the running & operation of government–run–engineering depart., elements of project financing, project selection & use of construction equipment. |
| Topics Covered | **Construction planning:** Introduction to planning, Stages of planning, Work breakdown structure, Scheduling, Preparation of schedules for job, materials, labour, equipment and finance, Network techniques in construction management. **(8)**<br>**Organizing construction:** Principles of organization, Types of organization, Site organisation, Temporary services, Job layout. **(6)**<br>**Safety in construction:** Importance of safety & its measures in construction activities.**(3)**<br>**Construction labour:** Welfare facilities, Labour laws. **(3)**<br>**Contract management:** Different types of contracts, Notice inviting tender, Contract documents, Condition of contract, Earnest money, Security money, Termination of contract, Arbitration, Specification – different types. **(8)**<br>**Public works accounts:** Muster roll, Measurement book, Cash book, Material-at-site account, Imprest, Temporary advance, Mode of payment, Bill, Voucher, Running account bill, Final bill, Advance payment to contractor, Secured advance, Stock, Tools and plants. **(7)**<br>**Construction practices:** Various construction equipment, Factors affecting selection of equipment, Output of various equipment, Time value of money, Investment and operating cost, Depreciation. **(7)** |
| Text Books, and/or reference material | ***Text Books:***<br>1. Estimating and costing in civil engineering by B. N. Dutta, theory and practice<br>2. Estimating, costing and specification in civil engineering by M. Chakraborty<br>3. Text book of estimating and costing (civil engineering) by G. S. Birdie, Dhanpat Rai & Sons<br>4. Civil engineering Contracts and Estimates by B. S. Patil, Orient Longman, New Delhi, 1981.<br>5. PERT & CPM principles and applications by L. S. Srinath, Affiliated East-West Press Pvt.<br>6. Construction Management and Accounts by V. N. Vazirani, and S. P. Chandola, Khanna Publishers, Delhi-6, 1978.<br>***Reference Books:***<br>7. Management in Construction Industry by P. P. Dharwadker, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi, 1992.<br>8. Building Construction by S. C. Rangawala, Charotar Book Stall, Anand, 1980.<br>9. Construction equipment and its planning & application by M. Verma, Metropolitan book co. (p) Ltd. New Delhi, 1979 |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |
| CO2 | - | - | - | - | - | 3 | - | - | - | - | - | - | 3 | - | - |
| CO3 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |
| CO4 | - | - | - | - | - | - | - | - | - | - | 3 | - | 3 | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEE723 | Open channel Hydraulics | PEL | 3 | 0 | 0 | 3 | 3 |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Fluid Mechanics | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

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|---|---|
| Course Outcomes (COs) : | • **CO1:** Understanding mechanics of flow, energy & momentum in an open channel<br>• **CO2:** Computation of different components of flow in an open stream.<br>• **CO3:** Capability for design of different type of open channel for operationalization of water-resources systems |
| Topics Covered (Hrs) | **Introduction:** Descriptions, types of flow, state of flow, regime of flow **(2)**<br>**Open-Channels and their properties:** Types, geometry, geometric elements of channel sections, velocity distribution, wide open channel, measurement of velocity, velocity-distribution coefficients and determination, pressure distribution in a channel section, effect of slope on pressure distribution. **(8)**<br>**Energy and Momentum Principles:** Energy, specific energy, criterion for a critical state of flow, interpretation of local phenomena, energy in non-prismatic channels, momentum in open-channel flow, specific force, momentum principle applied to non-prismatic channels. **(6)**<br>**Critical flow computations and Applications:** Critical flow, factors, flow computation, hydraulic exponent for flow computation, control & measurement **(6)**<br>**Uniform flow in open channels:** Qualifications, establishment, expressing the velocity of a uniform flow, hydraulic gradient, Equation for uniform flow, Chezy formula, Chezy's resistance, factor, Manning's formula, Mannining's roughness coefficient, factors, Mannining's roughness coefficient table. **(6)**<br>**Computations of Uniform Flow:** The conveyance of a channel section, the section factor for uniform-flow computation, the hydraulic exponent for uniform-flow computation, flow in a channel section with composite roughness. Determination of the Normal Depth and Velocity, determination of the Normal and Critical Slopes, problems of uniform flow computation, computation of flood discharge, uniform surface flow **(6)**<br>**Design of Channels for Uniform Flow: (6)**<br>**(a) Non-erodible channels:** Non-erodible channel, non-erodible material and lining, minimum permissible velocity, channel slopes, freeboard, best hydraulic section, determination of section dimensions<br>**(b) Erodible channels with scour not silt:** Method of approach, maximum permissible velocity, method of permissible velocity, tractive force, tractive-force ratio, permissible tractive force, method of tractive force, stable hydraulic section<br>**(c) Grassed channel:** Grassed channel, retardance coefficient, the permissible velocity, selection of grass, procedure of design. |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Open Channel Hydraulics by K. Subramanya, Fourth Edition, McGraw Hills Education (India) Private Limited, New Delhi.<br>***Reference Books:***<br>2. Open-Channel Hydraulics by V. T. Chow, McGraw-Hill Book Company, Inc., New York |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 1 |
| CO2 | - | 3 | - | - | - | - | - | - | 3 | - | - | - | 2 | 1 | 1 |
| CO3 | - | - | 3 | - | 3 | 3 | - | - | - | 3 | 3 | 3 | 1 | 1 | 2 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEE724 | Ground Water | PEL | 3 | 0 | 0 | 3 | 3 |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Fluid Mechanics and Water Resources Engineering | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Understanding of occurrence, distribution, storage and transmission of water below the ground level.<br>• CO2: Understanding of mechanics of flow of water under the ground<br>• CO3: Techniques for exploitation of ground water on sustainable basis.<br>• CO4: Ability to develop models for storage and transmission of ground water.<br>• CO5: Development of capabilities in recharging, management & conjunctive use of ground water |
| Topics Covered (Hrs) | **Fundamentals of ground water:** Introduction – Characteristic of Ground water – Distribution of water - ground water column –Permeability - Darcy's Law - Types of aquifers - Hydrogeological Cycle – water level fluctuations. **(6)**<br>**Hydraulics of flow:** Storage coefficient - Specific field - Heterogeneity and Anisotropy - Transmissivity– Governing equations of ground water flow - Steady state flow – Dupuit Forchheimer assumptions – Velocity potential - Flow nets **(6)**<br>**Estimation of parameters:** Transmissivity and Storativity – Pumping test - Unsteady state flow - Thiess method – Jacob method - Image well theory – Effect of partial penetrations of wells - Collectors wells. **(6)**<br>**Ground water development:** Infiltration gallery - Conjunctive use - Artificial recharge Rainwater harvesting - Safe yield –Yield test – Geophysical methods – Selection of pumps. **(6)**<br>**Water quality:** Ground water chemistry - Origin, movement and quality - Water quality standards – Saltwater intrusion –Environmental concern **(6)**<br>**Artificial recharge:** Artificial recharge of ground water; concept of artificial recharge – recharge methods, relative merits, Application of GIS and Remote Sensing in Artificial Recharge of Ground Water **(3)**<br>**Groundwater management:** Ground water basin management; concepts of conjunction use **(3)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Ground Water Hydrology by H. M. Raghunath, Wiley Eastern Ltd., 2000.<br>2. Ground Water Hydrology by D. K. Todd, John Wiley and Sons, 2000.<br>3. Ground Water by Bawvwr, John Wiley & Sons<br>4. Groundwater System Planning & Management by R. Willes & W.W.G. Yeh, Printice Hall.<br>5. Applied Hydrogeology by C.W. Fetta, CBS Publishers & Distributers.<br>***Reference Books:***<br>6. Principles of Pavement Engineering by Nick Tom |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO3 | - | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - |
| CO4 | - | - | - | - | 3 | - | - | - | - | - | - | - | - | - | - |
| CO5 | - | - | - | - | - | - | - | - | 3 | 3 | 3 | 3 | - | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| CEE725 | Hydrology and Irrigation Engineering | PEL | 3 | 0 | 0 | 3 | 3 |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Physics and Fluid Mechanics | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Understanding of occurrence, distribution, storage & transmission of water in different form in space, over & below surface of earth, data collection & processing<br>• CO2: Understanding flow generation, occurrence of flood, drought, environmental flow requirement.<br>• CO3: Realizing need for food sufficiency, crop water, irrigation requirement, method & design of infrastructures for irrigation requirement. |
| Topics Covered (Hrs) | **Introduction**: Brief introduction to Hydrology and Irrigation system **(7)**<br>**Diversion head-works**: Definition of weirs and barrages and their classification, Layout of typical diversion head-works and function of its components. **(3)**<br>**Concrete gravity dams:** Forces acting, Elementary profile, Design of gravity dams **(3)**<br>**Earthen dams:** Types, Causes of failure, Seepage control, Slope protection **(3)**<br>**Hydraulic power:** Thermal-water power, systems, arrangement, equipment, operation **(2)**<br>**River navigation:** Requirements of navigable waterways, Methods of achieving navigability, Open channel methods, Navigation dams, Navigation locks, Financing river navigation projects. **(4)**<br>**Ground water:** Occurrence, Well hydraulics, Regional aquifer hydraulics, Ground water quality. **(4)**<br>**Flood damage mitigation:** Design flood, Flood mitigation, Improvement, Evacuation and flood proofing, Land management and flood mitigation, Flood forecasting, Flood plain management, Economics of flood mitigation **(6)**<br>**Planning for water resources development:** Level, Phases, objectives, formulation, evaluation, Environmental issues, Systems analysis, multiply purpose projects. **(2)**<br>**Engineering economy in water resources planning:** Social importance, Annual cost comparisons, Interest and taxes, Frequency and economy, Economy studies for public works, Cost allocation. **(4)**<br>**Planning for water resources development:** Level of planning, Phases, Objectives, Data requirements, Project formulation and evaluation, Environmental considerations, Systems analysis, Multiple purpose projects. **(4)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Engineering Hydrology by K. Subramanya, Fourth Edition, McGraw Hills Education (India) Private Limited, New Delhi<br>2. Irrigation and Water Power Engineering by B. C. Punmia, B. B. Pande, A. K. Jain & A. Kumar, 16th Edition, Laxmi Publications (P) Limited, new Delhi.<br>***Reference Books:***<br>3. Hydrology by V. T. Chow, McGraw-Hill Book Company, Inc., New York |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| CO2 | - | 3 | 3 | 3 | - | - | - | - | - | - | - | - | 1 | - | 1 |
| CO3 | - | - | - | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | - | 2 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE730** | **Principles of Reliability** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | | Course Assessment methods | | | | |
| Engineering Mathematics and Design of Concrete Structures | | | Continuous (CT) and end assessment (EA). CT+EA | | | | |

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|---|---|
| Course Outcomes (COs) : | • CO1: Understand of reliability theory based on knowledge of fundamentals of probability and statistics.<br>• CO2: Apply Monte carlo simulation technique to solve different civil engineering problems.<br>• CO3: Understand the different reliability analysis methods.<br>• CO4: To design the elements of civil engineering structures by using reliability methods. |
| Topics Covered (Hrs) | **Basic statistics and probability:** Definition of probability, Axioms of probability, Conditional probability, Total probability theorem, Bayes' theorem, Basics of statistics, Definition of random variable, Different functions of random variable, Discrete and continuous random variables, Multiple random variables, probability distribution of random variables (Bernoulli and Binomial distribution, Poisson, geometric, hypergeometric, uniform, normal, lognormal, gamma). **(10)**<br>**Simulation technique:** Monte Carlo method, theory and applications. **(5)**<br>**Reliability analysis:** Definition of reliability, Limit state function, Reliability Index, Different classical reliability analysis methods, First order reliability method, Hasofer-Lind reliability method, Rackwitz-Fiessler reliability method, Introduction to second order reliability method. **(15)**<br>**Reliability-based design:** Load and resistance parameter model, reliability based code format, Calibration of partial safety factors for a level I code, Applications to solve design problems. **(10)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Structural Reliability Analysis and Design by Ranganathan, Jaico Publishing House<br>2. Probability, Reliability and Statistical Methods in Engineering Design by A. Halder and S. Mahadevan, John Wiley and Sons. New York.<br>***Reference Books:***<br>3. Probability Concepts in Engineering and Design by Ang and Tang, John Wiley.<br>4. Structural Reliability Analysis and Prediction by R. E. Melchers and A. T. Beck, John Wiley. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO2 | 1 | 1 | - | 3 | - | - | - | - | - | - | - | - | - | 3 | - |
| CO3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| CO4 | 1 | - | 3 | - | - | - | - | - | - | - | - | - | 3 | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE731** | **Offshore Structural Dynamics** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | | Course Assessment methods | | | | |
| Solid mechanics & Structural analysis | | | Continuous (CT) and end assessment (EA). CT+EA | | | | |

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|---|---|
| Course Outcomes (COs) : | • CO1: Identify the types of offshore structures, parameters governing solid-fluid interaction and environmental forces acting on offshore structures.<br>• CO2: Apply static methods of analysis for stresses in Offshore structures<br>• CO3: Solve for response analysis of offshore structures – single and multi-degree of freedom problems, frequency and time domain analyses.<br>• CO4: Evaluate responses under random wanes |
| Topics Covered (Hrs) | **Introduction:** Loads and structural terms of different types of offshore structures. **(2)**<br>**Fundamental of offshore structural analysis:** Stress and strain, bending of beams, Beams under torsion, Beam deflection, Buckling of beams, Bernoulli-Euler beam theory, Matrix analysis of plane, Space trusses, Plane space frames. **(8)**<br>**Environmental loadings:** Winds forces, Ocean surface waves, Wave loads on offshore structures, Buoyant forces, Current loadings, additional environmental loadings. **(6)**<br>**Static methods of analysis:** Frame analysis of steel offshore structures, bending stresses correction from axial loading, Pressure induced stresses in steel structures, Ring stiffeners, Analysis of joints. **(10)**<br>**Dynamics of offshore structures:** Modelling of offshore structures-.Single and multi-degree freedom systems- Dynamic amplification factor- Response of offshore structures- Coupled and uncoupled motions- Frequency domain analysis- Time domain analysis- New Mark-Beta method- Wilson θ method- Response analysis of fixed platforms- Response analysis of compliant platforms. Response in Random Waves **(16)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Offshore Structural Engineering by Thomas H Dawson, Prentice Hall, 1983<br>2. Dynamic Analysis and Design of Ocean Structures by Srinivasan Chandrasekaran, Springer, 2015.<br>3. Dynamics of Offshore Structures by Wilson, J. F., John Wiley, 2002.<br>***Reference Books:***<br>4. Offshore Mechanics by Madjid Karimirad, Constantine Michailides and Ali Nematbakhsh, Wiley, 1 edition<br>5. Offshore structures – Vol. 1 & 2 by Clauss, G, Lehmann, E & Ostergaard, C., Springer-Verlag, 1992. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | 1 | - | - | - | - | - | 2 | - | - |
| CO2 | 3 | - | 2 | - | 3 | - | - | - | - | - | - | - | 3 | - | - |
| CO3 | 3 | - | 2 | - | 3 | - | - | - | - | 1 | - | - | 3 | 2 | - |
| CO4 | 3 | - | 2 | - | 3 | - | - | - | - | 1 | - | - | 3 | 2 | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE732** | **Pre-stressed Concrete** | **PCL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Solid mechanics and Design of Concrete Structures | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) | • CO1: Apply knowledge of solid mechanics & concrete structures for design solutions.<br>• CO2: Understand basic design philosophies applicable to pre-stressed concrete structures.<br>• CO3: Formulate, analyse, and design basic components of Civil Engineering Pre-stressed Concrete structures. |
| Topics Covered (Hrs) | **Introduction:** Basic principles, advantage, Comparison with RC, Types of pre-stressing and Stress analysis **(4)**<br>**Materials:** Specifications and characteristics of concrete and high tensile steel **(2)**<br>**Loss of Prestressed**: Different type of loss with derivation and numerical problems **(4)**<br>**Flexural Analysis:** Derivation of moment of resistance, Pre-stressing force and eccentricity with numerical problems **(6)**<br>**Shear and torsion:** Design of beam for shear and torsion **(5)**<br>**Deflection and Cracking:** Cause and requirement along with numerical problems **(5)**<br>**Design of end blocks:** Transmission length, design of bearing plate and burst reinforcement **(4)**<br>**Member Design:** One way slab and beam design, two-way pre-stressing, Circular pre-stressing, Partial pre-stressing, Composite construction with pre-stressed concrete and reinforced concrete. **(10)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Prestressed Concrete, 5th Edition by N. Krishna Raju, Tata McGraw-Hill Publishing Company Limited, New Delhi.<br>2. Prestressed Concrete, 5th Edition, by S. Ramamrutham, Dhanpat Rai Publishing Co. Pvt. Ltd. New Delhi.<br>3. IS 1343: 2012, Prestressed Concrete – Code of Practice (2nd Revision), BIS, New Delhi.<br>4. www.nptel.ac.in<br>***Reference Books:***<br>5. Fundamentals of Prestressed Concrete by N. C. Sinha& S. K. Roy, S. Chand & Company Ltd, New Delhi |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | 2 | 2 | 2 |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | 3 | 3 | 3 |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | 3 | 3 | 3 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE733** | **Advanced Concrete Technology** | **PCL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Solid mechanics and Concrete Technology | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) | • CO1: Acquire knowledge of selection and application of concrete making materials<br>• CO2: Understand the properties of concrete at different stages<br>• CO3: Gain an integrative idea on different concretes |
| Topics Covered (Hrs) | **Introduction:** Brief discussion on concrete making materials, fresh and harden concrete and mix design **(10)**<br>**Elasticity, Creep & Shrinkage:** Definitions and meaning, factors affecting, measurement and types. **(6)**<br>**Durability of Concrete:** Volume change, Permeability, Mass concrete, Freezing & thawing, Sulphate & Acid attack, Alkali-Aggregate reactions, Crack, Cover to Reinforcement **(6)**<br>**Testing of Harden Concrete:** Compression, Flexural, Ring Tension, Core and non-destructive test **(6)**<br>**Special Concrete:** Mass, Light Weight, High Density, Fibre Reinforced, Cold Weather, Hot Weather, Prepacked, Vacuum, Shotcrete, Ferro cement, Self-Compacted, Reinforced, Pre-stressed & etc. Concrete **(14)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Engineering Materials by S. C. Rangwala, K. S. Rangwala and P. S. Rangwala, Charotar Publishing House, Anand<br>2. Concrete Technology by M. S. Shetty, S. Chand Publisher, New Delhi<br>3. IS 10262: 2009, Concrete Mix Proportioning-Guidelines (1st Revision), BIS, New Delhi.<br>4. IS 383: 1970, Specification for Coarse and Fine aggregates from natural sources for concrete (2nd Revision) BIS, New Delhi.<br>***Reference Books:***<br>5. Concrete Technology by M. L. Gambhir, Tata McGraw Hill and www.nptel.ac.in |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | 3 | - | - | - | - | - | - | - | - | 1 | 3 | 2 | 2 |
| CO2 | 2 | - | 3 | - | - | 1 | 1 | - | - | - | - | 1 | - | - | - |
| CO3 | 2 | - | 3 | - | 3 | 1 | 1 | 2 | - | - | - | 1 | 3 | 2 | 2 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE734** | **Advanced Structural Mechanics** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Solid Mechanics | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: To develop basic understanding of the fundamental concepts of the advanced topics.<br>• CO2: To define the stress and strain tensors for structural members and to write the stress-strain relationships.<br>• CO3: To evaluate the state of stress or state of strain with respect to the different theories of failure and compare.<br>• CO4: To apply the principles of structural mechanics to special structures. |
| Topics Covered (Hrs) | **Analysis of stress:** Definition of stresses; stress matrix; state of stress; Cauchy's stress relations; stress transformation, principal stresses; equations of equilibrium; different types of stresses; polar coordinates; three-dimensional Mohr's circle. **(7)**<br>**Analysis of strain:** Definition of strains; deformation vector; strain-displacement relations; strain matrix; principal strains; total distortion and rigid body rotation; strain compatibility conditions; volumetric strain; polar coordinates. **(6)**<br>**Stress-strain constitutive relations:** (4)<br>**Theories of failure:** (3)<br>**Analysis of non-prismatic member**s: General Euler-Bernoulli Law; linear Euler-Bernoulli equation; effect of bending of non-prismatic members. **(2)**<br>**Thin Walled Pressure Vessels**: Stresses, strains in cylindrical and spherical vessels; change in volume, strengthening of thin cylinders, solution of numerical problems to implement the above concepts. **(4)**<br>**Thick Walled Pressure Vessels:** Cylinders and Spheres: stresses; compatibility; Lame's equation; special case of solid shaft; thick spherical shells. **(4)**<br>**Curved Beams**: Introduction; stresses in curved beams; eccentricity; rings under loads; distribution of stresses and bending moments in rings. **(4)**<br>**Unsymmetrical Beam Bending**: Introduction; beams with doubly symmetric cross-sections; beams with arbitrary cross sections. **(4)**<br>**Introduction To Plates** (4) |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Solid Mechanics by S.M.A. Kazimi, Tata McGraw-Hill Publishing Company Limited<br>2. Advanced Mechanics of Solids by L.S. Srinath, Tata McGraw-Hill Publishing<br>***Reference Books:***<br>3. Mechanics of Solids by Abdul Mubeen |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modem tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | 3 | - | 3 | 2 | - | - | - | - | - | - | - | - | 2 | - | - |
| CO3 | 3 | - | 3 | 2 | 2 | - | - | - | - | - | - | - | 2 | - | - |
| CO4 | - | - | - | 2 | - | - | - | - | - | - | - | - | - | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE810** | **Sediment Transport** | **PEL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| CEC 302, CEC 601. | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs): | • CO1: Understanding of the origin and mechanism of sediment transport<br>• CO2: Development of capabilities to analyze sediment load.<br>• CO3: Ability to develop model to predict sediment load.<br>• CO4: Capability to design stable channel to carry the predicted sediment load |
| Topics Covered (Hrs) | **Introduction: (2)**<br>**Sediment properties:** particle size shape and density, fall velocity, viscosity, colloids and flocculation. Introduction **(4)**<br>**Threshold of particle motion**. **(4)**<br>**Sand transport by air:** Surface creep, effects of sand movement on wind, instability of a flat sand surface, ridges and dunes. **(4)**<br>**Sediment movement in water:** bed features and meanders, analytical models, stresses in flow of fluid-solid mixtures. **(4)**<br>**Channel roughness and resistance to flow. (2)**<br>**Sediment load:** Bed Load, Bed Forms; Effective bed roughness; Armouring, suspended sediment, diffusion approach, energy approach, statistical approach, suspended sediment load, total Load. **(8)**<br>**Stable Channel Design**: The empirical stable channel design - Tractive force method of stable channel design - Drag distribution and resistance to motion - Design values for boundary shear - The stable cross-section - Design by tractive force method **(8)**<br>**Cohesive sediments: (2)**<br>Erosion, deposition, scour, local scour at different structures. **(2)**<br>Dimensional Analysis and Similitude **(2)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Mechanics of Sediment Transportation and Alluvial Stream Problems by R. J. Garde, K. G. Ranga Raju, Revised Third Edition, New Age International Publishers, and New Delhi.<br>2. Loose boundary hydraulics by A. J. Raudkivi, 2nd edition Pergamon press<br>***Reference Books:***<br>3. Sediment Transport by V. T. Chow, McGraw-Hill Book Company, Inc., New York |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | 3 | - | - | - | 2 | - | - |
| CO2 | - | 3 | - | - | - | - | - | - | 3 | - | - | - | 2 | - | - |
| CO3 | - | - | - | - | 3 | - | - | 3 | - | - | - | - | 2 | - | - |
| CO4 | - | - | - | - | - | - | - | - | - | 3 | 3 | 3 | 2 | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE811** | **Slope Stability and Reinforced Earth** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Foundation Engineering | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: learn basic mechanism of reinforced earth.<br>• CO2: design wall with reinforced backfill<br>• CO3: analyze stability of reinforced slopes |
| Topics Covered (Hrs) | **Introduction,** Basic mechanism of reinforced earth, Practical application. **(6)**<br>**Basic components of reinforced soil**: Soil or fill matrix, Reinforcements, facing elements. **(6)**<br>**Strength characteristics of reinforced soil**: Basic concept, Sigma and Tau models, laboratory studies, sliding shear test, pull-out tests. **(8)**<br>**Wall with reinforced backfill**: Pressure intensity on the wall, Stability against sliding, overturning and bearing failure, Increase of earth pressure due to a line load on the backfill, design procedure. **(10)**<br>**Methods of Slope Stability**: Taylor Charts, Method of Slices, Effect of Tension Cracks, Vertical Cuts. Bishop's Analysis. Non-circular Failure Surfaces, Stabilization of slopes: Drainage measures, Soil reinforcement (geosynthetics/soil nailing etc). **(15)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Reinforced Earth & Geotextiles by Koerner<br>2. Reinforced Earth & Geotextiles by G. V. Rao<br>3. Earth and Earth-Rock Dams by Sherard, Woodward, Gizienski and Clevenger. John Wiley &. Sons. 1963<br>4. Earth and Rock Fill Dams by Bharat Singh and H. D. Sharma, 1999<br>***Reference Books:***<br>5. Slope Stability and Stabilisation methods by L. W. Abramson, T. S. Lee, and S. Sharma, John Wiley & sons. (2002)<br>6. The Stability of Slopes by E. N. Bromhead, (1992), Blackie academic and professional, London.<br>7. Earth & Rockfill Dams, Principles of Design and Construction by Christian, Kutzner Published Oxford and IBH.<br>8. Handbook of Slope Stabilization by J. A. R. Ortiago, and A. S. F. J. Sayao, 2004. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| CO2 | - | 2 | 3 | - | - | - | - | - | - | - | - | - | 2 | 1 | 1 |
| CO3 | - | 3 | - | 2 | - | - | - | - | - | - | - | - | 2 | 1 | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE812** | **Soil Structure Interaction** | **PEL** | **3** | **0** | **0** | **3** | **3** |

| Pre-requisite(s) | Course Assessment methods |
|---|---|
| Structural Analysis, Soil Mechanics and Foundation Engineering | Continuous (CT) and end assessment (EA). CT+EA |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Understand the basis of soil-structure interaction.<br>• CO2: Understand various soil interaction models like beams on elastic foundation (Winkler beam model), infinite beam, finite beam models.<br>• CO3: Apply soil-structure interaction models to different type of foundations like pile, sheet pile walls (cantilever and anchored sheet pile walls).<br>• CO4: Analyse the foundation of different civil structures with considering soil-structure interaction in static as well as dynamic conditions. |
| Topics Covered (Hrs) | **Introduction**, Superstructure-foundation interaction, Analytical formulations. **(4)**<br>**Interaction problems** of shallow foundation combined footing, Rigid method, and Flexible method. **(5)**<br>**Beams on elastic foundation**, Infinite beam, Finite beam, Modulus of subgrade reaction and effecting parameters. **(8)**<br>**Sheet pile wall**, Cantilever and anchored sheet pile wall, Fixed earth support, Free earth support. **(6)**<br>**Retaining walls**, Conduits, Load on different types of conduits, Design charts. **(5)**<br>**Braced excavation**, Pressure distribution in braced walls, Estimation of strut load etc., Stability of bottom of excavation. **(4)**<br>**Piles** under different loading conditions, Analysis under lateral load, Different approaches, Mechanism of failure, Ultimate load, Deflections, Elastic continuum approach, Analysis and design**. (8)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Geotechnical Engineering: Principal and Practices of Soil Mechanics and foundation Engineering by V N.S. Murthy,<br>2. Foundation analysis and Design by J. E. Bowles.<br>3. Basic and Applied Soil Mechanics by G. Ranjan and A. S. Rao<br>***Reference Books:***<br>4. Advanced Geotechnical Engineering soil-structure Interaction using Computer and Material Models by C. S. Desai, and M. Zaman<br>5. Advanced Soil Mechanics by B. M. Das, McGraw Hills Publishers |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| CO2 | 2 | 1 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO3 | 2 | - | 2 | - | - | - | - | - | - | - | - | - | 2 | 1 | 1 |
| CO4 | 1 | 2 | - | 1 | - | - | - | - | - | - | - | - | 2 | 1 | 1 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEC813** | **Industrial Wastes** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Environmental Engineering | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

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|---|---|
| Course Outcomes (COs) : | • CO1: Apply knowledge of different types of industrial pollutants (air, solid waste and wastewater) for design solutions.<br>• CO2: Understand basic design philosophies applicable for control and safe disposal of different types of industrial pollutants.<br>• CO3: Formulate, analyze, and design basic control and disposal systems of different types of industrial pollutants. |
| Topics Covered (Hrs) | **Industrial sources of pollution**, types of pollutants. **(5)**<br>**Air pollution** – Its effects, measurement, methods & equipment of control**. (15)**<br>**Solid wastes** – quantity & characteristics, methods of collection, disposal & reuse**. (12)**<br>**Wastewater** – characteristics, methods of collection, treatment & disposal. **(10)** |
| Text Books, and/or reference material (s) | ***Text Books:***<br>1. Environmental Engineering by H.S. Peavy, D. R. Rowe & G. Tchobanoglous, McGraw Hill Education (India) Private Limited, New Delhi<br>2. Introduction to Environmental Engineering by M.L. Davis & D.A. Cornwell, Tata McGraw-Hill Education Private Limited, New Delhi<br>***Reference Books:***<br>3. Environmental Engineering – A Design Approach by A.P. Sincero & G.A. Sincero, Prentice – Hall of India Private Limited, New Delhi<br>4. Industrial Water Pollution Control by W.W. Eckenfelder, Jr. (McGraw-Hill Higher Education) |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 2 | - | - | - | - | - | - | - | 2 | - | - | - | 1 | - | - |
| CO2 | 3 | - | 3 | - | - | - | 1 | - | - | 2 | - | 2 | 3 | 1 | 1 |
| CO3 | - | - | 3 | - | - | - | - | 2 | - | 2 | 1 | 3 | 3 | 2 | 2 |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE814** | **Water resource System Planning and Management** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Fluid Mechanics, Irrigation Engineering, Water Resources Engineering, Economics and Computer Applications | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Understanding of different aspects of systems of water resources<br>• CO2: Learning of optimization techniques, linear and dynamic Programming.<br>• CO3: Ability to formulate models of reservoir systems, size, operation and hydropower production |
| Topics Covered (Hrs) | **Introduction:** Overview and Role of engineers **(2)**<br>**Engineering economic analysis:** Principles of engineering economics, Mathematics of economic analysis, Price theory and resources allocation, Conditions of project optimality, Benefit-cost analysis, Discount rate. **(5)**<br>**Identification and evaluation of water management plans:** System concept, System design methodology, Optimal design, Introduction to classical optimisation techniques with simple numerical examples, Simulation analysis. **(5)**<br>**Planning for flood control:** Planning context, Developing the supply, Estimating the demand, Project feasibility. **(5)**<br>**Planning for drainage:** Planning context, Developing the supply, Estimating the demand, Project feasibility. **(5)**<br>**Planning for water supply:** Planning context, Developing the supply, Estimating irrigation demand, Estimating urban demand and Project feasibility. **(5)**<br>**Planning for hydroelectric power:** Planning context, Developing the supply, Estimating the demand, Project feasibility**. (5)**<br>**Planning for navigation:** Planning context, Developing the supply, Estimating the demand, Project feasibility**. (5)**<br>**Irrigation planning and operation:** Planning context, Developing the supply, Estimating the demand, Project feasibility**. (5)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Water Resources Systems – Modelling Techniques and Analysis by S. Vedula and P. P. Mujumdar, Tata McGraw-Hill Publishing Company Limited, New Delhi.<br>***Reference Books:***<br>2. Irrigation System Design – An Engineering Approach by H. Cuenca, Richard, Prentie Hall, Englewood Cliffs, New Jersey 07632<br>3. Water Demand Management by Butler, David and Memon, Fayyaz Ali, IWA Publishing, London |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | - | - | - | - | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | - | - | 3 | - | - | - | - | - | - | - | - | - | 3 | - | - |
| CO3 | - | - | 3 | - | - | - | - | - | - | - | - | - | 3 | - | - |

| Course Code | Title of the course | Program Core (PCR) / Electives (PEL) | Total Number of contact hours | | | | Credit |
|---|---|---|---|---|---|---|---|
| | | | Lecture (L) | Tutorial (T) | Practical (P) | Total Hours | |
| **CEE815** | **Machine Foundation** | **PEL** | **3** | **0** | **0** | **3** | **3** |
| Pre-requisite(s) | | Course Assessment methods | | | | | |
| Mechanics of structures | | Continuous (CT) and end assessment (EA). CT+EA | | | | | |

| | |
|---|---|
| Course Outcomes (COs) : | • CO1: Acquire knowledge of Machines and its Foundation: Types and Forces acting upon, dynamic analysis<br>• CO2: Ability to conduct Field-Experiment and Analyze the data with interpretation for determining dynamic properties of Soil<br>• CO3: Ability to Design Suitable Foundations based on Soil as a Spring, and as a Half-Space continuum<br>• CO4: Ability for understanding the need of future studies |
| Topics Covered (Hrs) | **Single Degree freedom system:** Free vibration of Single Degree freedom system, natural frequency and time period, damping, Amplitude, Forced vibration, dynamic magnification factor **(5)**<br>**Two Degree Freedom System:** Free and Forced Vibration of Two Degree Freedom System, Natural frequencies and their arrangement, Eigen value and Eigen vector, normal coordinates, Effect of damping, generalized mass and stiffness matrices. **(7)**<br>**Soil Stiffness and damping:** Experimental Procedure for finding out Soil Stiffness and damping. **(2)**<br>**Machine Vibration:** Type of Machines, permissible amplitude vs. time period, Soil modeling as linear un-damped springs. Soil as Half-Space, inclusion of damping, embedment effect. **(6)**<br>**Foundation design:** Foundation analysis and design as linear spring, vertical vibration, pure sliding and rocking vibration. **(6)**<br>**Couple vibration of sliding and rocking. (6)**<br>**Elastic half-space approach of analysis and design (8)** |
| Text Books, and/or reference material(s) | ***Text Books:***<br>1. Hand book of Machine Foundations by P. Srinivasulu and C.V. Vaidyanathan, Tata-Mc-Graw-Hill Publishing Company ltd.<br>***Reference Books:***<br>2. Design Aids in Soil Mechanics and Foundation Engineering by S.R. Kaniraj, Tata-Mc-Graw-Hill Publishing Company ltd. |

Mapping of Course Outcomes COs→POs→PSOs

| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment & sustainability | Ethics | Individual & team work | Communication | Project management & finance | Life-long learning | Plan, analyse, design and prepare | Computer aided skill and tools | codal provisions / guidelines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 1 | - | - | - | 3 | - | - | - | - | - | - | - | 1 | - | - |
| CO2 | - | 3 | - | - | 2 | - | - | - | - | - | - | - | 1 | 1 | 1 |
| CO3 | - | - | 3 | - | - | 2 | - | 1 | - | - | - | - | 2 | 1 | 1 |
| CO4 | - | - | - | - | - | 2 | - | 1 | - | - | - | 3 | 1 | 1 | 1 |