

**School of Engineering**

**Department of Civil Engineering**

**Course Structure and Syllabi**

**Academic Programmes**

**April, 2018**

**JECRC UNIVERSITY**

**Department of Civil Engineering**

**Minutes of the meeting of the Board of Studies**

1. Minutes of the meeting of board of studies held on 26thApril, 2018 at 11.00 A.M. in the conference hall of Engineering block JECRC University, Jaipur.
2. The following members attended the meeting.
3. Mr. Rakesh Kumar Verma (Chairperson)
4. Prof. (Dr.) Ram Rattan (Director, School of Engineering)
5. Mr. Anirudh Sharma (Member)
6. Mr. RamvilasMeena(Member)
7. Dr. Gunwant Sharma (Associate Professor, MNIT, Jaipur)
8. Dr. J.K. Jain(Associate Professor, MNIT, Jaipur)
9. Mr. Rakesh Kumar Verma, Head, Department of Civil Engineering, greeted all the members and briefly apprised about the working agenda of the meeting listed below:
10. Constitution of research and practice oriented syllabus.
11. To discuss logical sequencing of the syllabus.
12. Modification of syllabus.
13. Introduction of the new syllabus.
14. The complete curricula of B.Tech. were discussed and finalized considering all academic aspects and significant contents in continuity. A judicious combination of engineering practice and research inputs was aimed for practical development of upcoming engineers, sufficient theory and satisfactory practical were kept in mind.
15. M. Tech. (Structural Engineering) curricula were considered and finalized with respect to prevailing circumstances and technical and academic requirements. The research part was duly given weightage and adopted as such.
16. The syllabi are revised by the faculty members on the basis of suggestions given by alumni, industrial and subject experts.
17. The syllabi are highly focused on employability & skill development and all the courses adopted have full relevance.
18. B. Tech. & M. Tech program has Choice based credit system and elective course system respectively.
19. The detailed contents of the syllabi are enclosed as a part of these minutes.
20. The following emerged from the discussions and course structure of the B.Tech. (CE) as follows:-

a) For the batch inducted in 2018, some new subjects has been added as per requirement of industry requirements.

b) For the batch inducted in 2018, the syllabus mentioned above will be adopted from 3rdsemester.

c) New added subjects are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **S.No.**  | **Subject Name** | **Credit** | **Semester** |
| 1. | Advanced Engineering Mathematics | 4 | 3rd |
| 2. | Building Materials | 3 | 3rd |
| 3. | Concrete Technology | 4 | 3rd |
| 4. | Building Drawing Lab | 2 | 3rd |
| 5. | Numerical Methods, Optimization Techniques and Special Functions | 3 | 4th |
| 6. | Quantity Surveying and Valuation | 3 | 6th |
| 7. | Ground Improvement Techniques | 3 | 7th |

1. The following emerged from the discussions and course structure of the B.Tech (CE) has been revised as follows:-

For the batch Inducted in Third Semester in 2018, following changes made to rationalize the syllabus

1. Subject **Multivariate Analysis, Linear Algebraand Special Function(BAS003A)** with 3 credit is removed from 3rd semester.
2. Subject **Building Materials & Concrete Technology (BCI001B)** with 3 credit is removed from 3rd semester.
3. Subject **Engineering Materials (BES018A)** with 3 credit is removed from 3rd semester.
4. Subject **Professional Skills-III Communication Skills-III (BHS010A)** with 3 credit is removed from 3rd semester.
5. Subject **Professional Skills-III Aptitude-III (BHS003A)** with 4 credit is removed from 3rd semester.
6. Subject **Energy Studies (BMC009A)** with 3 credit is removed from 3rd semester.
7. Subject **Complex Analysis (BAS005A)** with 2 credit is removed from 4th semester.
8. Subject **Professional Skills-IV (BHS004A)** with 6 credit is removed from 4th semester.
9. Subject **Seminar (BCI017A)** with 1 credit is removed from 4th semester.
10. Subject **CAD Building Drawing Lab(BCI065A)** with 2 credit is shifted from 5th semester to 4th semester.
11. Subject **Design of Steel Structures (BCI011B)** with 4 credit is shifted from 4th semester to 5th semester.
12. Subject **Optimization and calculus of variations(BAS004A)** with 2 credit is removed from 5th semester.
13. Subject **Professional Skills-V (BHS005A)** with 6 credit is removed from 5th semester.
14. Subject **Seminar (BCI025A)** with 1 credit is removed from 5th semester.
15. Subject **Program Elective-I**with 3 credit is removed from 5th semester.
16. Subject **Open Elective**with 3 credit is removed from 5th semester.
17. Subject **Advanced Design of Steel Structures(BCI026B)** with 3 credit is shifted from 5th semester to 6th semester.
18. Subject **Environmental Engineering I (BCI030A)** with 3 credit is shifted from 6th semester to 5th semester.
19. Subject **STAAD Pro Lab (BCI031B)** with 2 credit is shifted from 7th semester to 5th semester.
20. Subject **Quantity Surveying and Valuation Lab (BCI033A)** with 3 credit is removed from 6th semester.
21. Subject **Professional Skills-VI (BHS006A)** with 6 credit is removed from 6th semester.
22. Subject **Seminar (BCI034A)** with 1 credit is removed from 6th semester.
23. Subject **Program Elective-II & III**with 3 credit is replaced by **Program Elective-I** in 6th semester.
24. Subject **Open Elective**with 3 credit is removed from 6th semester.
25. Subject **Basic Simulation Laboratory(BEE024A)** with 2 credit is shifted from 6th semester to 7th semester.
26. Subject **Environmental Engineering II (BCI041B)** with 3 credit is shifted from 7th semester to 6th semester.
27. Subject **Environmental Engineering Lab(BCI044B)** with 2 credit is shifted from 7th semester to 6th semester.
28. Subject **Probability and Statistics (BAS006A)** with 2 credit is removed from 7th semester.
29. Subject **Professional Skills-VII (BHS007A)** with 6 credit is removed from 7th semester.
30. Subject **Seminar (BCI045A)** with 1 credit is removed from 7th semester.
31. Subject **Program Elective-IV & V**with 3 credit is replaced by **Program Elective-II** in 7th semester.
32. The following emerged from the discussions and course structure of the B.Tech (CE) has been revised as follows:-

For the batch Inducted in Third Semester in 2018, following changes made to rationalize the syllabus & credits:-

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.No.**  | **Subject Name** | **Credit** | **Semester** | **Remarks** |
| 1. | Geotechnical Engineering I | 4 | 4th | Tutorial added |
| 2. | Engineering Surveying I | 4 | 4th | Tutorial added |
| 3. | Hydraulics & Hydraulic Machine | 4 | 4th | Tutorial added |
| 4. | Engineering Surveying Lab I | 2 | 4th | Contact Hours reduced |
| 5. | Geotechnical Engineering II | 4 | 5th | Tutorial added |
| 6. | Engineering Surveying II | 4 | 5th | Tutorial added |
| 7. | Engineering Surveying Lab II | 2 | 5th | Contact Hours reduced |
| 8. | Transportation Engineering I | 4 | 6th | Tutorial added |
| 9. | Advance Design of Steel Structures | 4 | 6th | Tutorial added |
| 10. | Construction Project Management | 4 |  7th | Tutorial added |
| 11. | Project Work | 6 | 7th | Contact Hours increased |





**SCHOOL OF ENGINEERING**

**SYLLABUS AND COURSE STRUCTURE**

**M. TECH (STRUCTURAL ENGINEERING)**

**ACADEMIC YEAR 2018-19**

**M. Tech. (Structural Engineering)**

**Code & Subject Scheme**

**Semester I**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Code** | **Subject** | **Contact Hours/week** | **Total Credits** |  |
| **L** | **T** | **P** |
| MCI024A | Structural Dynamics  | 4 | 0 | 0 | 4 | C |
| MCI025A | Concrete Technology and Special Concretes | 4 | 0 | 0 | 4 | C |
| MCI026A | Design of Plates and Shells | 4 | 0 | 0 | 4 | C |
| MCI027A | Bridge Engineering  | 4 | 0 | 0 | 4 | C |
| MCI028A | Structural Engineering Laboratory | 0 | 0 | 2 | 2 | C |
| MCI029A | Advanced Concrete Lab | 0 | 0 | 2 | 2 | C |
| MCI007A | Seminar  | 0 | 0 | 2 | 2 | C |
|  | **Total**  | **16** | **0** | **6** | **22** |  |
|  |  |  |  |  |  |  |

**Semester II**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Code** | **Subject** | **Contact Hours/week** | **Total Credits** |  |
| **L** | **T** | **P** |
| MES001A | Research Methodology | 3 | 0 | 0 | 3 | F |
| MCI030A | Advanced Design of Steel Structures | 4 | 0 | 0 | 4 | C |
| MCI031A | Prestressed Concrete Design | 4 | 0 | 0 | 4 | C |
| MCI032A | Theory of Elasticity and Plasticity | 4 | 0 | 0 | 4 | C |
| MCI033A | Design Lab (SAP 2000) | 0 | 0 | 2 | 2 | C |
| MCI034A | Finite element Lab (MATLAB) | 0 | 0 | 2 | 2 | C |
| MES002A | Advanced Excel Lab\*\* | 0 | 0 | 1 | 1 | F |
| MCI013A | Seminar  | 0 | 0 | 2 | 2 | C |
|  | **Total**  | **15** | **0** | **7** | **22** |  |

**\*\*** Quantitative Techniques & Computer Applications Lab on ERP

**Semester III**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Code** | **Subject** | **Contact Hours/week** | **Total Credits** |  |
| **L** | **T** | **P** |
| MCI035A | Plastic analysis and design | 4 | 0 | 0 | 4 | C |
| MCI036A | Neo Construction Materials | 4 | 0 | 0 | 4 | C |
|  | Elective-I | 4 | 0 | 0 | 4 | S |
|  | Elective-II | 4 | 0 | 0 | 4 | S |
| MCI016A | Dissertation Part – I | 0 | 0 | 12 | 12 | C |
|  | **Total**  | **16** | **0** | **12** | **28** |  |

|  |
| --- |
| **Elective Subjects (one from each group)** |
| **Elective I** | **Elective II** |
| MCI037A | Stability of structures | MCI039A | Repair and Rehabilitation of Structures |
| MCI038A | Earthquake Resistant design | MCI040A | Advanced Foundation Design |
| MCI022A | Soil structure interaction | MCI041A | Design of Tall Buildings |

**Semester IV**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Code** | **Subject** | **Contact Hours/week** | **Total Credits** |  |
| **L** | **T** | **P** |
| MCI023A | Dissertation Part – II | 0 | 0 | 28 | 28 | C |
|  | **Total** | **0** | **0** | **28** | **28** |  |

**Semester-I**

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI024A – Structural Dynamics** | **Credits: 4** |
| **4-0-0** |

 **Objective:**

* Learn how to model discrete single-degree and multiple-degree vibratory systems and calculate the free and forced response of these systems.
* Apply the methods learned to a realistic engineering vibration problem and write a report on the results.

**Unit1**

Dynamics of Structures: Objectives and importance. Types of dynamic loads, Dynamic degree of freedom, Mathematical modelling, Damping and stiffness, Torsional stiffness, Equivalent stiffness, Free and forced vibrations

**Unit 2**

Single Degree of Freedom (SDOF) Systems: Undamped free vibrations, formulation of differential equation of motion: Newton’s law of motion, D’Alembert’s principle and energy approach. Natural frequency. Vibration response.

**Unit 3**

Single Degree of Freedom (SDOF) Systems: damped free vibrations, critically damped, under damped & over damped systems, formulation of differential equation of motion: Natural frequency. Vibration response.

**Unit 4**

Forced vibration response of SDOF damped and undamped systems to harmonic loading, rotating and reciprocating unbalance, support motion and impulsive type forcing function. Vibration isolation and transmissibility. Seismic Instruments.

**Unit 5**

Forced vibration response of SDOF damped and undamped systems to harmonic loading, rotating and reciprocating unbalance, support motion and impulsive type forcing function. Vibration isolation and transmissibility. Seismic Instruments.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Understood various type degree of freedom systems in structures.

CO2: Understood orthogonal relationship of principle modes Rayleigh's principle and its

Application.

CO3: Gained knowledge about application of structural dynamics to civil engineering

Problems.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H | H |  | L | L |  |  | M |  | L | M | H | M |  |
| CO2 | H | H |  | L | L |  |  | M |  | L | M | H | M |  |
| CO3 | H | H | H | H | H |  |  | M |  | L | M | H | M |  |

H = Highly Related M = Medium L=Low

***Text Book:***

1. *“Dynamics of Structures: Applications to Earthquake Engineering” by A. K. Chopra*

***Reference Book:***

1. *“Dynamics of Structures” by R.W. Clough and J. Penzien*
2. *Fundamentals of Structural Dynamics, 2nd Edition, by* [*Roy R. Craig*](http://as.wiley.com/WileyCDA/Section/id-302477.html?query=Roy+R.+Craig)*,* [*Andrew J. Kurdila*](http://as.wiley.com/WileyCDA/Section/id-302477.html?query=Andrew+J.+Kurdila)

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI025A – Concrete Technology and Special Concretes** | **Credits: 4** |
| **4-0-0** |

**Objectives**

* To familiarize with the fundamentals of concrete
* To study the different concreting methods
* To understand the basic concepts of special concretes, types, properties and their applications
* To study the application of different concretes

**Unit 1**

Characteristics of concrete and mix design: Properties of fresh and hardened concrete - strength, elastic properties, creep and shrinkage – variability of concrete strength - quality control – Principles of concrete mix design, methods of concrete mix design - High Strength Concrete Mix Design - Super - Plasticizers - Principles involved in mix design of high performance concrete with fly ash or GGBS replacements.

**Unit 2**

Concreting methods: Process of manufacturing of concrete-methods of transportation-placing and curing - extreme weather concreting - special concreting methods – vacuum dewatering - under water technology-special form work-Ready mix Concrete.

**Unit 3**

Polymer and fibre concretes: Polymer concrete-Types, Properties and Applications - Blended cement concretes-Fibre-reinforced Concrete-Different types of metallic and non metallicfibres - Types, Properties and Applications, Slurry-infiltrated fibre reinforced concrete.

**Unit 4**

Ferrocement, low and high density concretes: Ferrocement and its applications, Light Weight concrete -concrete - Roller compacted concrete - Types, Properties and Applications.

**Unit 5**

Other concretes: Bacterial concrete - Born again concrete (Recycled Aggregate concrete) Electric concrete (Smart concrete) description - applications. Performance concrete-Production and applications-Self compacting concrete - Reactive powder concrete - Description, Properties and Applications.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Ability to design concrete mix of different grade.

CO2: Knowledge about properties of concrete.

CO3: Knowledge about various NDT techniques.

CO4: Knowledge about durability of concrete.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H | H | H | H | H | L | H | M |  |  | H | H | H | H |
| CO2 | H | H | H | H | H | L | H | M |  | H | H | H | H |  |
| CO3 | H | H | M | M | H | L | H | M |  | H | H | H | H | M |
| CO4 | H | M | H | L | H | L | H | M |  | H | H | H | H |  |

H = Highly Related M = Medium L=Low

***Text Book:***

1. *Fintel, "Hand book of Concrete EnssiVannostrand", CBS Publishers &Distributors, 2004*

***Reference Book:***

1. *Metha P.K. and Monterio P.J.M. "Concrete-Structures", Properties andMaterials, 3rd Edition, McGraw Hill Professional, 2006.*
2. *M.S. Shetty, "Concrete Technology" S.Chand and Company Ltd, Delhi,2000.*
3. *Neville.A.M. "Properties of Concrete", Pitman Publishing Limited,London, 1990*

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI026A – Design of Plates and Shells** | **Credits: 4** |
| **4-0-0** |

**Objectives**

* Study the behaviour and design of shells, folded plates, space frames

**Unit 1**

Plate equation in cartesian and polar coordinates for isotropic plates - Analysis of rectangular and circular plates with different boundary conditions and loadings

**Unit 2**

Design and analysis of plates by various method, Orthotropic plates - Plates on elastic foundation.

**Unit 3**

Classification of shells - Membrane and bending theory for singly curved and doubly curved shells - Various approximations - Design of cylindrical shells, HP shells, conoids

**Unit 4**

Design and Analysis of folded plates by various approximate method

**Unit 5**

Design of diaphragms - Detailing of reinforcements for shells Framework for shells and folded plates.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Ability to know about Plate equation and behaviour of thin plates in Cartesian, polar and skew

coordinates.

CO2: Understand Isotropic and orthotropic plates, bending and twisting of plates; Numerical

solutions.

CO3: Ability to learn Shell behaviour, shell surfaces and characteristics, equilibrium equations in

curvilinear coordinates, force displacement relations.

CO4: Ability to understand Membrane analysis of shells of revolution and cylindrical shells under

different loads.

CO5:Able to design plate and shell structure for different kind of loading and different kind of

support condition.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H | H | M | H | M | M | L |  | M |  | L | H | L |  |
| CO2 | H | H | M | H | M | M | L |  | M |  | L | H | L |  |
| CO3 | H | H | L | H | H | M | L |  | M |  | L | H | L |  |
| CO4 | H | H | L | H | H | M | L |  | M |  | L | H | L |  |
| CO5 | H | H | L | H | H | M | L |  | M |  | L | H | L |  |

H = Highly Related M = Medium L=Low

***Text Book:***

1. *Billington.D.P, “Thin Shell Concrete Structures”, McGraw Hill Book Co.,New York, 1982.*

***Reference Book:***

*1. Santhakumar.A.R and Senthil.R, “Proceedings of International Conference onSpace Structures”, Anna University, Chennai, 1997.*

*2. Subramanian.N ,”Principles of Space Structures”, Wheeler Publishing Co.1999.*

*3. Ramasamy, G.S., “Design and Construction of Concrete Shells Roofs”, CBSPublishers, 1986.*

*4. ASCE Manual No.31, “Design of Cylindrical Shells”.*

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| --- | --- | --- |
| **L-T-P** | **MCI027A – Bridge Engineering** | **Credits: 4** |
| **4-0-0** |

**Objective:**

* To study the loads, forces on bridges and design of several types of bridges

**Unit 1**

Introduction - Classification and components of bridges, historical perspective, layout and planning, investigations for Bridges, choice of type of the bridges, conceptual bridge design, bridge aesthetics. Bridge appurtenances.

**Unit 2**

Loads on bridges - loading standards for highway and railway bridges (IRC, IRS) Analysis and design of RC and PSC bridge decks: slab culvert bridges, slab and beam bridges, load distribution in slabs and beams, bowstring girder bridges, behaviour of skew bridge decks.

**Unit 3**

Behaviour, analysis and design of RC and PSC box girder bridge decks. Behaviour, analysis and design of steel bridge decks: girder bridges, truss bridges, arch bridges, composite construction.

**Unit 4**

Design of bearings, substructure and foundations - piers and abutments of different types, shallow and deep foundations-design and constructional aspects.

**Unit 5**

Modern methods of construction of concrete, steel and composite bridges, their impact on analysis and design. Introduction to analysis and design of long span bridges: suspension.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Knowledge about the Types of Bridges, choice of bridge type.

CO2: Criteria for selection of bridge site, economic span, bridge loadings, slab bridges, effect of

skew.

CO3: Study about load distribution theories for multi beam bridges.

CO4: Design of R.C. T beam bridges, behaviour and structural action of box Girder Bridge.

CO5: Design of bridge bearings, inspection and maintenance procedures, rehabilitation of bridges.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | L | L | H | L |  |  | M | M |  |  |  |  | L |  |
| CO2 | L | H | H | L |  | H | M | M | H | M | H | L | L |  |
| CO3 | M | H | H | H | M | L | L |  |  | M | H | H | H |  |
| CO4 | H | H | H | H | M | M | L |  | M | H | H | H | H | M |
| CO5 | H | H | H | H | M | M | L |  | M | H | H | H | H | M |

H = Highly Related M = Medium L=Low

***Text Book:***

*1. Swami Saran, “Analysis and Design of Substructures”, Oxford & IBH Publishing Co., 1996.*

***Reference Book:***

*1. J.E. Long, “Bearings in Structural Engineering”, Newnes Butterworth & Co., 1974.*

*2. R.E. Rowe, “Concrete Bridge Design”, 1st Edition, Elsevier Science and Technology, 1962.*

*3. L.G. Hendry and A.W. Jaeger, “The Analysis of Grid Frameworks and Related Structures”, Chatto&Windus, 1958.*

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI028A – Structural Engineering Lab** | **Credits: 2** |
| **0-0-2** |

**List of Experiments:**

1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.

2. Testing of simply supported steel beam for strength and deflection behaviour.

3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.

4. Dynamic testing of cantilever steel beam

a. To determine the damping coefficients from free vibrations.

b. To evaluate the mode shapes.

5. Static cyclic testing of single bay two storied steel frames and evaluate

a. Drift of the frame.

b. Stiffness of the frame.

c. Energy dissipation capacity of the frame.

6. Determination of in-situ strength and quality of concrete using

i) Rebound hammer and

ii) Ultrasonic Pulse Velocity Tester

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Gain the knowledge on concept of NDT.

CO2: Analyze the deflection behaviour of different type of structures.

CO3: Analyze different characteristics of a structure for dynamic loadings.

CO4: Understand Dynamic testing of cantilever steel beam.

CO5: Understand Static cyclic testing of single bay two storey steel frames and evaluate

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H |  | H |  | H |  |  | M |  |  | H | H | H |  |
| CO2 | H |  | H |  | H |  |  | M | H |  | H | H | H |  |
| CO3 | H |  | H |  | H |  |  | M | H |  | H | H | H |  |
| CO4 | H |  | H |  | H |  |  | M |  |  | H | H | H |  |
| CO5 | H |  | H |  | H |  |  | M | H |  | H | H | H |  |

H = Highly Related M = Medium L=Low

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI029A – Advanced Concrete Lab** | **Credits: 2** |
| **0-0-2** |

**List of Experiments:**

1. Compressive strength of Cement

2. Mix Design of Concrete and Casting of Specimen.

3. Young’s Modulus of Concrete

4. Non destructive test on concrete.

5. Mix design of high strength concrete including casting and testing of specimens.

6. Mix design of fly ash concrete including casting and testing of specimens.

7. Determination of coefficient of permeability of concrete.

8. Determination of drying shrinkage of concrete.

9. Bending test on a RCC beam under.

a) Single point load

b) Three point load

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Gain the knowledge on concept of NDT.

CO2: Compare the strengths of concrete by different mix design methods.

CO3: Analyze different characteristics of a structure element for shrinkage and bending.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | L | M | L | H |  | M |  |  | L | M | H | L | L |  |
| CO2 | M | M | M | M |  | M |  |  | M | H | H | M | H |  |
| CO3 | H | M | M | H | H | L |  |  | M | H | H | H | H |  |

H = Highly Related M = Medium L=Low

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI007A – Seminar** | **Credits: 2** |
| **0-0-2** |

**Semester-II**

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MES001A – Research Methodology** | **Credits: 3** |
| **3-0-0** |

**Objectives:**

* To learn progress from the beginning stage to the end of a research project with the research methodology for each step.
* To learn the quantitative and qualitative methodologies.

**Unit 1**

Nature and Objectives of research; Methods of research: historical, descriptive and experimental. Study and formulation of research problem. Scope of research and formulation of hypotheses; Feasibility, preparation and presentation of research proposal.

**Unit 2**

Introduction to statistical analysis: Measures of central tendency and dispersion: mean, median, mode, range, mean deviation and standard deviation. Regression and correlation analysis.

**Unit 3**

Probability and probability distributions; Binomial, Poisson, Geometric, Negative binomial, Uniform, Exponential, Normal and Log-normal distribution. Basic ideas of testing of hypotheses; Tests of significance based on normal, t and Chi-square distributions.

**Unit 4**

Design of experiments: basic principles, study of completely randomized and randomized block designs. Analysis of variance technique.

**Unit 5**

Edition and tabulation of results, presentation of results using figures, tables and text, quoting of references and preparing bibliography. Use of common softwares like SPSS, Mini Tab and/or Mat Lab. For statistical analysis.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: At the end of the course students will be able to understand formulation of a research problem with a research design and data collection for the research.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H | H | H | L | M | L | L | L |  | H | L | M | M | M |

H = Highly Related M = Medium L=Low

***Text Books:***

1. *Borth, Wayne C, et.Al. - The Craft of Research: Chicago Guides to Writing Edition and Publishing.*

***Reference Books:***

1. *Meyer, P.L. - Introduction to Probability & Statistical, Applications, Oxford, IBH.*
2. *Hogg, R.V. & Craig, A.T., Introduction to Mathematical Statistics, MacMillan.*
3. *Goon, A.M., Gupta, M.K. &Dasgupta - Fundamentals of Statistics, Vol.I: World Press.*
4. *Gupta, S.C. & Kapoor, V.K. - Fundamentals of Mathematical Statistics, Sultan Chand & Sons.*
5. *Johnson, R.A. - Probability and Statistics, PHI, New Delhi.*

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI030A – Advanced Design of Steel Structures** | **Credits: 4** |
| **4-0-0** |

**Objective:**

* Perform Limit state design of trusses and frames.
* Perform Minimum weight design of steel structures.

**Unit 1**

Limit States Load and Resistance Factor Design methods. Behaviour and design of members under tension, compression, bending, and combined forces (shear bending, axial force bending).

**Unit 2**

Fasteners: Methods of installation and behaviour of rivets, bolts and welds. Screws and rivets in cold formed steel construction Connections, Types of fasteners, Behaviour of local elements, Analysis, Design and Detailing of Connections. Design for Earthquake Forces.

**Unit 3**

Cold formed Steel Sections - Types of cross sections - Local buckling and post buckling - Design of compression and Tension members - Beams - Deflection of beams - Combined stresses and connections.

**Unit 4**

Design for ductility, R factor, concentrically and eccentrically braced frames, non-buckling bracings.

**Unit 5**

Estimation of wind load - Design of industrial stacks - Self-supporting and guyed stacks lined and unlined – along wind and across wind vibration. Principles of analysis and design of Industrial buildings and bents - Gantry girders and crane

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Apply the design principles to elevated steel water tanks.

CO2: Identify the configuration of truss bridges and understand the design principles of truss

elements.

CO3: Develop the methodology of designing transmission line tower structures.

CO4: Understand the design concepts of self-supporting chimneys & foundations.

CO5: Develop confidence levels in understanding the plastic analysis, plastic mechanism and apply to

simple beams & frames.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H |  | M |  | H | L |  | M |  |  | H | H | H |  |
| CO2 | H |  | M |  | H | L |  | M | H |  | H | H | M |  |
| CO3 | H |  | M |  | H | L |  | M |  |  | H | H | H |  |
| CO4 | H |  | M |  | H | L |  | M |  |  | H | H | H |  |
| CO5 | H |  | M |  | H | L |  | M | H |  | H | H | L |  |

H =Highly Related M = Medium L=Low

***Text Book:***

1. *N. Subramanian: Design of steel structure.*

***Reference Book:***

1. *L.S. Beedle, “Plastic Design of Steel Frames”, John Wiley & Sons, 1958.*
2. *B.G. Neal, “Plastic Methods of Structural Analysis”, 3rd Edition, Chapman and Hall, 1977.*
3. R. Narayanan et al, “Teaching Resource for Structural steel design” Institute for Steel Development and Growth, 2003.
4. J.F. Baker, “Steel Skeleton”, University Press, 1953.
5. W.F. Chen, D.J. Han, “Plasticity for Structural Engineer”, J Ross Publishing, 2007.

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| --- | --- | --- |
| **L-T-P** | **MCI031A – Prestressed Concrete Design** | **Credits: 4** |
| **4-0-0** |

**Objective:**

* This subject is thought to give the concepts of pre stress
* To impart the knowledge about analysis and design of pre stressed concrete members.

**Unit 1**

Introduction to prestressed concrete: types of prestressing, systems and devices, materials, losses in prestress.

**Unit 2**

Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions in IS 1343. Statically determinate PSC beams: design for ultimate and serviceability limit states for flexure, and flexure combined with axial compression or tension.

**Unit 3**

Analysis and design for shear and torsion, code provisions. Transmission of prestress in pretensioned concepts, crack-width members. Anchorage zone stresses for posttensioned members.

**Unit 4**

Statically indeterminate structures Analysis and design continuous beams and frames, choice of cable profile, linear transformation and concordancy. Composite construction with precast PSC beams and cast insitu RC slab Analysis and design, creep and shrinkage effects. Partial prestressing principles, analysis and design calculations

**Unit 5:**

Analysis and design of prestressed concrete pipes, tanks and spatial structures slabs.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Understand the concepts of pre-stressing in concrete structures and identify the materials

for pre-stressing

CO2: Analyse a Pre-stressed Concrete section

CO3: Estimate losses of pre-stressing

CO4: Design pre-tensioned and post tensioned girders for flexure and shear

CO5: Design continuous pre-tensioned and post tensioned beams

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H | M |  | L | H | L |  | M | L |  | H | H | H | L |
| CO2 | H | H |  | L | H | L |  | M | L |  | H | H | H | L |
| CO3 | H | M |  | L | H | L |  | M | L |  | H | H | H | L |
| CO4 | H | H |  | L | H | L |  | M | L |  | H | H | H | L |
| CO5 | H | M |  | L | H | L |  | M | L |  | H | H | H | L |

H = Highly Related M = Medium L=Low

***Text Book:***

*1. Krishna Raju.N, (2004), Pre stressed Concrete, Third Edition, Tata McGraw Hill Co.*

***Reference Book:***

*1. Rajagopal.N, (2005), Prestressed Concrete, Second Edition, Narosa Publishing House.*

*2. Dayarathnam P, (2004), Prestressed Concrete Structures, S.Chand Publishers.*

*3. Sinha.N.C and Roy.S.K, (2000), Fundamentals of Pre-stressed Concrete, S.Chand& Company limited.*

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI032A – Theory of Elasticity and Plasticity** | **Credits: 4** |
| **4-0-0** |

**Objective:**

* This subject is taught to impart knowledge on theory of elasticity and plasticity

**Unit 1**

Introduction: Elasticity - notation for forces and stresses - components of stresses - components of strain - Hooks law. Plane stress and plane strain analysis - plane stress - plane strain – differential equations of equilibrium - boundary conditions - compatibility equations - stress function – boundary condition.

**Unit 2**

Two dimensional problems in rectangular coordinates - solution by polynomials - Saint- Venant’s principle - determination of displacements - bending of simple beams. Two dimensional problems in polar coordinates – strain components in polar coordinates - displacements for symmetrical stress distributions - simple symmetric and asymmetric problems - general solution of two- dimensional problem in polar coordinates - application of general solution in polar coordinates.

**Unit 3**

Analysis of stress and strain in three dimensions - principal stresses - stress ellipsoid - director surface - determination of principal stresses - max shear stresses – homogeneous deformation - principal axes of strain rotation. General Theorems: Differential equations of equilibrium – conditions of compatibility - determination of displacement - equations of equilibrium in terms of displacements - principle of super position - uniqueness of solution - the reciprocal theorem.

**Unit 4**

Torsion method - use of soap films in solving torsion problems - hydro dynamical analogies - torsion of shafts, tubes, bars etc. Bending of Prismatic Bars: Stress function - bending of cantilever – circular cross section - elliptical cross section - rectangular cross section - bending problems by soap film method – displacements of Prismatic Bars - torsion of prismatic bars - bars with elliptical cross sections – other elementary solution - membrane analogy - torsion of rectangular bars - solution of torsion problems by energy

.

**Unit 5**

Theory of Plasticity: Introduction - concepts and assumptions - yield criterions.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: To be able to execute the stress state and stresses analysis Topic of Work: The stresses

 State analysis

CO2: To be able to solve a problem of strain analysis Topic of Work: The strain state analysis

CO3: To be able to use the numerical methods for the problem of the theory of elasticity in

 Practice

CO4: To be able to use theory for solution of practice problem of stress and strain analysis

 Final examination

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H |  | M |  | H | L |  | M |  |  | H | H | H |  |
| CO2 | H |  | M |  | H | L |  | M | H |  | H | H | M |  |
| CO3 | H |  | M |  | H | L |  | M |  |  | H | H | H |  |
| CO4 | H |  | M |  | H | L |  | M |  |  | H | H | H |  |

H = Highly Related M = Medium L=Low

***Text Book:***

1. *Theory of Elasticity by Timeshanko, McGrawhill Publications.*

***Reference Book:***

1. *Theory of Plasticity by J.Chakarbarthy, McGrawhill Publications.*
2. *Theory of Elasticity by Y.C.Fung.*
3. *Theory of Elasticity by Gurucharan Singh.*

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| **L-T-P** | **MCI033A –Design Lab (SAP 2000)** | **Credits: 2** |
| **0-0-2** |

**Experiment**

Linear and non linear Analysis of structures

1. 2D/3D Analysis based on state-of-the-art Matrix method to handle extremely large job.
2. Beam, Truss, Tapered Beam, Shell/Plate Bending/Plane Stress. Full/Partial Moment Releases.
3. Design of Concrete Beam/Column/Slab/Footing as per all major international codes
4. Numerical and Graphical Design Outputs with complete reinforcement details. IS 456-2000 for RCC design implemented.
5. RC detailer as per IS 456-2000 has been implemented which has given a new dimension

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: analysis of structure

CO2: understand and design of the beam, truss.

CO3: Study about load distribution theories for multi beam bridges.

CO4: Numerical and graphical design of reinforcement.

CO5: Understand 2D/3D Analysis based on state-of-the-art Matrix method to handle extremely

large job.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H |  | H |  | H |  |  | M |  |  | H | H | H |  |
| CO2 | H |  | H |  | H |  |  | M | H |  | H | H | H |  |
| CO3 | H |  | H |  | H |  |  | M | H |  | H | H | H |  |
| CO4 | H |  | H |  | H |  |  | M |  |  | H | H | H |  |
| CO5 | H |  | H |  | H |  |  | M |  |  | H | H | H |  |

H = Highly Related M = Medium L=Low

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| **L-T-P** | **MCI034A – Finite Element Lab** | **Credits: 2** |
| **0-0-2** |

**List of Experiments:**

1. Computer programming for analysis of continuous beam

2. Computer programming for analysis of Plane trusses

3. Computer programming for analysis of Plane frame

4. Computer programming for analysis of Grid

5. Computer Programming for analysis of space truss

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: To obtain an understanding of the fundamental theory of the FEA method;

CO2: To develop the ability to generate the governing FE equations for systems governed by partial

differential equations;

CO3: To understand the use of the basic finite elements for structural applications using truss, beam,

frame, and plane elements; and

CO4: To understand the application and use of the FE method for heat transfer problems.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | L |  |  |  | H |  |  | M | H |  | H | L | L |  |
| CO2 | H |  | M |  | H | L |  | M |  |  | H | H | M |  |
| CO3 | H |  | M |  | H | L |  | M |  |  | M | H | H |  |
| CO4 | H |  | M |  | H | L |  | M |  |  | H | H | H |  |

H = Highly Related M = Medium L=Low

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| **L-T-P** | **MES002A – Advanced Excel Lab** | **Credits: 1** |
| **0-0-1** |

**Various Methods and Uses of Advance Excel Formulas:** Vlookup, Hlookup, Sumif, Sumifs, Sumproduct, Dsum, Countif, Countifs, If, Iferror, Iserror, Isna, Isnumber, Isnontext, Isblank, Istext, Getpivotdata, Dcount, Dcounta, Or, And, Search, Index, Match Etc

**Various Methods and Uses of IF Conditions:** When should use the "IF" Conditions?, Creation of Multiple IF Conditions in One Cell,Use the IF Conditions with the Other Advance Functions, How to use nested IF statements in Excel with AND, OR Functions

**ADVANCED EXCEL OPTIONS :**Various Methods of Filter and Advance Filter options, Creating and Updating Subtotals, Various Methods of Text to Column options, Uses of Data Grouping and Consolidation options, Uses of Goal Seek and Scenarios Manager, Various Method of Sorting Data, Creating, Formatting and Modifying Chart, Data Validation, Creating drop down lists using different data sources, Linking Workbooks and Uses of Edit Link options, Excel Options, Customizing the Quick Access Tool Bar, Formula Auditing features and Trace formula error

**Pivot Tables & Charts :**Various Methods and Options of Pivot Table, Using the Pivot Table Wizard, Changing the Pivot Table Layout, Subtotal and Grand total Options, Formatting, Grouping Items, Inserting Calculated Fields, Pivot Table Options, Calculation in Pivot Table, Display and Hide Data in Field, Select, Move & Clear Pivot Data, Creating and Modifying Pivot Chart

**Advance Use of Function:** Mixing Function to get Various MIS Outputs, Creating Data Table, Advance Data Validation, Using conditional formatting with Formulas and Function, Using Name Manager, Array Formulas

**Importing Data from External Sources: Macros,** What is a Macro?, Creating Excel Macro, Running Macros and Editing, Automating Tasks with Macro

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Understand the advance excel formulas and functions

CO2: Understand the filter option in excel and data validation

CO3: Learn the draw the table, graph and charts

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H |  | H |  | H |  |  | M |  |  | H | H | H |  |
| CO2 | H |  | H |  | H |  |  | M | H |  | H | H | H |  |
| CO3 | H |  | H |  | H |  |  | M | H |  | H | H | H |  |

H = Highly Related M = Medium L=Low

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| **L-T-P** | **MCI013A - Seminar** | **Credits: 2** |
| **0-0-2** |

**Semester III**

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| **L-T-P** | **MCI035A – Plastic Analysis and Design** | **Credits: 4** |
| **4-0-0** |

**Objectives:**

* To study the plastic methods which are used extremely by engineers for the design of steel structure, including simple beams, continuous beam, simple portal frames.
* To analysis based on either virtual work formulation or sophisticated plastic theory contained in specialist computer packages.

**Unit 1**

Analysis of Structures for Ultimate Load: Fundamental Principles – statical method of Analysis Mechanism method of analysis – Method of analysis, Moment check – Carry over factor –Moment Balancing Method.

**Unit 2**

Design of Continuous Beams: Continuous Beams of uniform section throughout – Continuous Beams with different cross-sections.

**Unit 3**

Secondary Design Problems: Introduction – Influence of Axial force on the plastic moment – influence of shear force – local buckling of flanges and webs – lateral buckling – column stability.

**Unit 4**

Design of Connections: Introduction – requirement for connections – straight corner connections–Haunched connection – Interior Beam-Column connections.

**Unit 5**

Design of Steel Frames: Introduction – Sinole span frames – simplified procedures for Sinole span frames – Design of Gable frames with Haunched Connection. Ultimate Deflections: Introduction –Deflection at ultimate load – Deflection at working load – Deflections of Beams and Sinole span frames.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Knowledge of structural analysis using various analysis methods based on ultimate load.

CO2: Knowledge of design and analysis of continuous beams.

CO3: Knowledge based on design of various problems related to axial force, plastic moment, shear

force etc.

CO4: Design of various connections for beams and columns and knowledge of their requirements.

CO5: Analysis and design of steel frames using various theories and estimation of ultimate deflection

based on different forces.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H | H | M | M | H | L | H | M |  | L | H | H | H | M |
| CO2 | H | H | M | M | H | L | H | M |  | M | H | H | H |  |
| CO3 | H | H | M |  | H | L | H | M |  |  | H | H | H | H |
| CO4 | H | H | M | M | H | L | H | M |  | L | H | H | H | M |
| CO5 | H | H | M | M | H | L | H | M |  | L | H | H | H | M |

H = Highly Related M = Medium L=Low

***Text Book:***

*1. Plastic Design of Steel Frames, L.S.Beedle.*

***Reference Book:***

*1. Design of steel structure, S. Subramanyam.*

*2. Plastic Analysis, B.G.Neal.*

*3. Plastic Analysis, Horve.*

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| --- | --- | --- |
| **L-T-P** | **MCI036A - Neo Construction Materials** | **Credits: 4** |
| **4-0-0** |

**Objectives:**

* To study the new construction materials, its properties, behaviours.
* To study the materials and its uses in construction.

**Unit 1**

Introduction, Historical back ground of Light weight aggregate concrete - Artificial aggregates, Physical properties of aggregates, Light weight aggregate concrete - Applications of light weight aggregate concrete.

**Unit 2**

Properties of green light weight aggregate concrete - Effect of size aggregate on the strength Recycled aggregate -High performance concrete –applications - Pre placed aggregate concrete - Fiber reinforced concrete.

**Unit 3**

Behaviour of steel fibers in concrete - Glass fiber reinforced concrete - Natural fiber reinforced concrete - High strength concrete - Self-Compacting Concrete, Concrete made with waste rubber.

**Unit 4**

Changes in concrete with respect to time - Corrosion in concrete and its protection, Corrosion of rebars in concrete - Influence of fly ash on the corrosion steel bar in concrete, Industrial waste materials in concrete.

**Unit 5**

Special Concretes, Sulfur Concrete, Ferro cement, Geo synthetics - Adhesives in construction industry, Acrylics - Bridge bearings - Rapid wall panels - Nano Concrete - Moisture Barriers.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Knowledge about the aggregates in context of their type, properties, and applications.

CO2: Knowledge of green light weight aggregate, HPA, their applications etc.

CO3: Knowledge of behaviour of steel fibres, glass fibres, natural fibres, in different types of concrete

as HSC, SCC etc.

CO4: Knowledge of concrete properties depending upon time, corrosion effects, effect of fly ash etc

and their influences to concrete properties.

CO5: Knowledge different types of concrete based on their properties and applications.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H | H | M | M | H | L | H | M |  | L | H | H | H | M |
| CO2 | H | H | M | M | H | L | H | M |  | M | H | H | H |  |
| CO3 | H | H | M | M | H | L | H | M |  |  | H | H | H | H |
| CO4 | H | H | M | M | H | L | H | M |  | L | H | H | H | M |
| CO5 | M | M | M | M | H | L | H | M |  | L | H | H | H | M |

H = Highly Related M = Medium L=Low

***Text Book:***

*1. Kumar Mehta. P and Paulo J M Monteiro, “Concrete Microstructure, Properties and Materials”, McGraw Hill, 2006.*

***Reference Book:***

*1. A.M. Neville, “Properties of Concrete”, 5th Edition, PHI, 2012.*

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| --- | --- | --- |
| **L-T-P** | **MCI016A – Dissertation Part - I** | **Credits: 12** |
| **0-0-12** |

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| **Elective Subjects (one from each group)** |
| **Elective I** | **Elective II** |
| MCI037A | Stability of Structures | MCI019A | Repair and Rehabilitation of Structures |
| MCI038A | Earthquake Resistant design | MCI020A | Advanced Foundation Design |
| MCI022A | Soil Structure Interaction | MCI021A | Design of Tall Buildings |

**Elective I**

|  |  |  |
| --- | --- | --- |
| **L-T-P** | **MCI037A – Stability of Structures** | **Credits: 4** |
| **4-0-0** |

**Objective:**

* To study the stability of structure for different kind of loading
* To study for the different kind of buckling of structural element

**Unit 1**

Beam Columns: Differential equations for beam columns- beam columns with concentrated loads –continuous lateral loads-couples- beam columns with built in ends – continuous beams with axial load –application of trigonometrically series – Effects of initial curvature on deflections – Determination of allowable stresses.

**Unit 2**

Elastic Buckling of bars and frames: Elastic Buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns- Buckling of frames-large deflections of buckled bars-Energy methods- Buckling of bars on elastic foundations- Buckle line of bar with intermediate compressive forces - Buckling of bars with change in cross-section – Effect of shear force on critical load- built up columns.

**Unit 3**

In Elastic Buckling: Buckle line of straight bar- Double modulus theory – Tangent modulus theory, Inelastic lateral Buckling. Experiments and design formulae: Experiments on columns – Critical stress diagram – Empirical formulae for design – various end conditions

**Unit 4**

Torsion Buckling: Pure torsion of thin walled bars of open cross section – Non-uniform torsion of thin walled bars of open cross section- Torsional buckling – Buckling by torsion and flexure.

**Unit 5**

Lateral buckling of simply supported Beams: Beams of Rectangular cross-section subjected to pure bending. Buckling of simply supported Rectangular plates: Derivation of equation of plate subjected to constant compression in one and two directions.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Analyze structures with linear and nonlinear behaviour.

CO2: Gain the knowledge on Stability of Continuous systems.

CO3: Distinguish elastic buckling and in elastic buckling.

CO4: Analyse the critical state(s) of a structural system, use such information to enhance the design

analysis process

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H |  | M |  | H | L |  | M |  |  | H | H | H |  |
| CO2 | H |  | M |  | H | L |  | M |  |  | H | H | H |  |
| CO3 | H |  | M |  | H | L |  | M |  |  | H | H | H |  |
| CO4 | H |  | M |  | H | L |  | M |  |  | H | H | H |  |

H = Highly Related M = Medium L=Low

***Text Book:***

1. *Theory of elastic Stability by Timshenko& Gere-McGraw Hill*

***Reference Book:***

*2. Stability of metallic structures by Blunch- McGraw Hill*

*3. Theory of Beam- Columns Vol I by Chem. &Atste Mc. Graw Hill*

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| **L-T-P** | **MCI038A – Earthquake Resistant Design** | **Credits: 4** |
| **4-0-0** |

**Objective:**

* To deal with different aspect of earthquake forces
* Design of different type of member of building to resist the earthquake

**Unit 1**

Engineering Seismology: Earthquake phenomenon cause of earthquakes-Faults- Plate tectonics Seismic waves- Terms associated with earthquakes-Magnitude/Intensity of an earthquake-scales Energy released-Earthquake measuring instruments-Seismoscope, Seismograph, accelerograph-Characteristics of strong ground motions- Seismic zones of India.

**Unit 2**

Conceptual design: Introduction-Functional planning-Continuous load path-Overall form-simplicity and symmetry-elongated shapes-stiffness and strength-Horizontal and Vertical members-Twisting of buildings-Ductility-definition-ductility relationships-flexible buildings-framing systems-choice of construction materials-unconfined concrete-confined concrete-masonry-reinforcing steel. Introduction to earthquake resistant design: Seismic design requirements-regular and irregular configurations-basic assumptions-design earthquake loads-basic load combinations-permissible stresses-seismic methods of analysis-factors in seismic analysis-equivalent lateral force method-dynamic analysis-response spectrum method-Time history method.

**Unit 3**

Reinforced Concrete Buildings: Principles of earthquake resistant deign of RC members- Structural models for frame buildings- Seismic methods of analysis- Seismic deign methods- IS code based methods for seismic design- Seismic evaluation and retrofitting- Vertical irregularities- Plan configuration problems- Lateral load resisting systems- Determination of design lateral forces-Equivalent lateral force procedure- Lateral distribution of base shear. Masonry Buildings: Introduction-Elastic properties of masonry assemblage- Categories of masonry buildings- Behaviour of unreinforced and reinforced masonry walls- Behaviour of walls- Box action and bands- Behaviour of infill walls-Improving seismic behaviour of masonry buildings- Load combinations and permissible stresses-Seismic design requirements- Lateral load analysis of masonry buildings.

**Unit 4**

Structural Walls and Non-Structural Elements: Strategies in the location of structural walls- sectional shapes- variations in elevation- cantilever walls without openings – Failure mechanism of non structures-Effects of non-structural elements on structural system- Analysis of non-structural elements-Prevention of non-structural damage- Isolation of non-structures.

**Unit 5**

Ductility Considerations in Earthquake Resistant Design of RC Buildings: Introduction- Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile detailing considerations as per IS 13920. Behaviour of beams, columns and joints in RC buildings during earthquakes-Vulnerability of open ground storey and short columns during earthquakes. Capacity Based

Design: Introduction to Capacity Design, Capacity Design for Beams and Columns-Case studies.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Knowledge about earthquake hazards and related basic concepts.

CO2: Ability to understand the Seismic Vulnerability and its estimation.

CO3: Knowledge about methods of seismic retrofitting of buildings.

CO4: Ability to design different type of structural member to resist earthquake forces.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H | H | H | M | M |  |  | M | M | M | H | H | M | M |
| CO2 | H | H | H | M | M |  |  | M | M | M | H | H | M | M |
| CO3 | H | H | H | M | M |  |  | M | M | M | H | H | M | M |
| CO4 | H | H | H | M | M |  |  | M | M | M | H | H | M | M |

H = Highly Related M = Medium L=Low

***Text Book:***

*1. Earthquake Resistant Design of structures – S. K. Duggal, Oxford University Press*

***Reference Book and Codes:***

*1. Earthquake Resistant Design of structures – Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.*

*2. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and M.J.N. Priestly, John Wiley & Sons*

*3. Masory and Timber structures including earthquake Resistant Design –Anand S. Arya, Nemchand& Bros*

*4. IS: 1893 (Part-1) -2002. “Criteria for Earthquake Resistant – Design of structures.” B.I.S., New Delhi.*

*5. IS: 4326-1993, “Earthquake Resistant Design and Construction of Building”, Code of Practice B.I.S., New Delhi.*

*6 IS: 13920-1993, “Ductile detailing of concrete structures subjected to seismic force” – Guidelines, B.I.S., New Delhi.*

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| **L-T-P** | **MCI022A - Soil Structure Interaction** | **Credits: 4** |
| **4-0-0** |

**Objectives:**

* The ability to identify the situations where the topic is relevant
* Should be able to apply the effects of interaction between soil and foundation
* The ability to apply the concepts for solving multi task applications

**Unit 1**

Scope of soil-foundation interaction analysis, Critical study of conventional methods of foundation design.

**Unit 2**

Nature and complexities of soil-foundation interaction, Interface behaviour, soil response models, Winkler, Elastic continuum. Contact pressures and soil-structure interaction for shallow and deep foundations.

**Unit 3**

Concept of sub grade modulus, effects/parameters influencing sub-grade modulus, Analysis of foundations of finite rigidity, Beams on elastic foundation concept, Interaction problems based on the theory of sub-grade reaction.

**Unit 4**

Concept of analysis of piles and pile groups, axially, laterally loaded piles and pile group interaction analysis, Elastic continuum and elasto-plastic analysis of piles and pile groups.

**Unit 5**

Application of advanced techniques of analysis such as the finite element method, finite differences and interaction for the evaluation of soil-foundation interaction for different types of foundations under various conditions of loading and subsoil characteristics.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Designing structures under seismic conditions considering effect of SSI.

CO2: Understand capabilities of various models used to simulate the interaction

CO3: Ground response analysis for different soil conditions.

CO4: Exposure to various different codes of practices.

CO5: Finite element approach in solving in SSI problems.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

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| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H | M | H |  | H | L |  | M | L |  | H | H |  | M |
| CO2 | H | M | H |  | H | M |  | M | L |  | H | H |  | M |
| CO3 | H | M | H |  | H | H |  | M | L |  | H | H |  | M |
| CO4 | H | M | H |  | H | H |  | M | L |  | H | H |  | M |
| CO5 | H | M | H |  | H | M |  | M | L |  | H | H |  | M |

H = Highly Related M = Medium L=Low

***Text Book:***

*1. Bowels J.E. - Analytical and Computer Methods in Foundation, McGraw Hill.*

***Reference Book:***

*2. Selvadurai, A. P. S. - Elastic Analysis of Soil-Foundation Interaction, Elsevier.*

*3. Poulos H. G., & Davis E. H. - Pile Foundation Analysis and Design, John Wiley,*

*4. Bowles J.E. - Foundation analysis and design, McGraw Hill.*

**Elective II**

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| --- | --- | --- |
| **L-T-P** | **MCI039A – Repair and Rehabilitation of Structures** | **Credits: 4** |
| **4-0-0** |

**Objective:**

* The course seeks to recognize the mechanisms of degradation of concrete structures, provide the students with the knowledge of available techniques and their application for strengthening or upgrading existing structural systems.

**Unit 1**

Introduction: Deterioration of structures with aging, Need for rehabilitation, Effects due to climate, temperature, chemicals, wear and erosion , design and construction errors , corrosion mechanism , Effects of cover thickness and cracking, Method of corrosion production., corrosion inhibitors , corrosion resistant steels, coatings, cathodic production.

**Unit 2**

Structural Health Monitoring: An overview of Structural Health Monitoring, Structural Health Monitoring and Smart Materials, Health Monitoring versus Non Destructive Testing, A broad overview of smart materials, Overview of Application potential of SHM.

**Unit 3**

Maintenance and Repair Strategies: Definitions: Maintenance, Repair, Rehabilitation, Facets of maintenance, Importance of maintenance, preventive measures on various aspects, assessment procedure for evaluating damaged structure, causes of deterioration – Testing techniques.

**Unit 4**

Materials and Methods of Repair: Special concrete and mortar, Concrete chemicals, special elements for accelerator, strength gain, expansive cement , polymer concrete , sulphur infiltrated concrete , ferro-cement, fiber reinforced concrete. Shortcreting, Grouting, Epoxy-cement mortar injection, Crack ceiling

**Unit 5**

Seismic Retrofitting of reinforced concrete buildings: Introduction: Considerations in retrofitting of structures, Source of weakness in RC frame building – Structural damage due to the discontinuous load path, Structural damage due to lack of deformation, Quality of workmanship and materials, Classification of retrofitting techniques, Retrofitting strategies for RC buildings – Structural level (global) retrofits methods, Member level (local) retrofit methods; Comparative analysis of methods of retrofitting

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: various distress and damages to concrete and masonry structures

CO2: The importance of maintenance of structures, types and properties of repair materials etc.

CO3: Assessing damage to structures and various repair techniques

CO4: Strategies and techniques to upgrade the structure performance.

CO5: Ability to understand field monitoring and non-destructive evaluation of concrete structures.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H | M | H |  | H | L |  | M | L |  | H | H |  | M |
| CO2 | H | M | H |  | H | M |  | M | L |  | H | H |  | M |
| CO3 | H | M | H |  | H | H |  | M | L |  | H | H |  | M |
| CO4 | H | M | H |  | H | H |  | M | L |  | H | H |  | M |
| CO5 | H | M | H |  | H | M |  | M | L |  | H | H |  | M |

H = Highly Related M = Medium L=Low

***Text Book:***

*1. Diagnosis and treatment of structures in distress by R.N.Raikar, Published by R&D Centre of Structural Designers & Consultants Pvt.Ltd., Mumbai, 1994.*

*2. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande, Prentice-Hall of India, 2006.*

***Reference Book:***

*1. Shetty, M.S. (2005), Concrete Technology Theory and Practice, S.Chand and company, New Delhi.*

*2. Santha Kumar, A.R., (1996), Concrete chemical Theory and Applications, Indian society for construction engineering and technology, madras.*

*3. Garas, F.K,.Clarke, J.L, Armer, GST (1997), Structural assessment, Butterworths, UK.*

*4. R.T. Allen and S.C.Edwards, (1998), Repair of Concrete Structures, Blakie and Sons, UK.*

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| --- | --- | --- |
| **L-T-P** | **MCI040A – Advanced Foundation Design** | **Credits: 4** |
| **4-0-0** |

**Objectives:**

* This subject is taught to impart the knowledge in the area of analysis and design of foundations and earth retaining structures.

**Unit 1**

Shallow Foundation: Terzaghi's bearing capacity equation, General bearing capacity equation , Balla's& Meyerhof's theory, Effect of water table, special footing problems, I.S. Code, Footing pressure for settlement on sand, Soil pressure at a depth, Boussinesq's&westergaard methods, Computation of settlements (Immediate & Consolidation) Permissible settlements, Proportioning of footing, Inclined & Eccentric loads.

**Unit 2**

Pile Foundation:  Timber, concrete, Steel piles, estimating pile capacity by dynamic formula, By wave equation & By static methods, Point Bearing piles, Pile loads tests, Negative skin friction, Modulus of subgrade reaction for laterally loaded piles, Lateral resistance.

**Unit 3**

Single Pile v/s Pile  Groups, Pile group consideration, Efficiency, Stresses on underlying strata, Settlement of pile group, Pile caps, Batter piles, Approximate and exact analysis of pile  groups,  I.S code.

**Unit 4**

Well foundation: Types (open end & closed or box, pneumetic, drilled) shapes, Bearing capacity and settlements, Determination of grip length by dimensional analysis, Design of well foundation construction, Tilts & shifts.

**Unit 5**

Machine Foundations: Types, Analysis and design by Barkens methods, Determination of coeff. of uniform elastic compression, Pauw's analogy and design of a Block type M/C foundation, I.S.I method of design, Co- vibrating soil mass.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Design different foundation components.

CO2: Ability to understand various aspects of Design and Construction of foundation including

special foundations on difficult soils.

CO3: Knowledge to amylases shallow the deep foundation.

CO4: Ability to design pile foundation.

CO5: Ability to design well foundation

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H | L | M | L | H | M |  | H | H | M | M | H | L | H |
| CO2 | H | M | H | L | H | M |  | H | H | M | M | H | L | L |
| CO3 | H | H | H | L | H | M |  | H | H | L | H | H | L | M |
| CO4 | H | H | H | L | H | M |  | H | H | L | H | H | L | M |
| CO5 | H | H | H | L | H | H |  | H | H | M | H | H | M | H |

H = Highly Related M = Medium L=Low

***Text Book:***

*1. B. M Das, Principles of Foundation Engineering, Thomson Brooks/Cole*

*2. GopalRanjan and ASR Rao, (2002), Basic and applied Soil Mechanics, Wiley Eastern Ltd.*

***Reference Book:***

*3. N.P. Kurien, Design of Foundation Systems: Principles & Practices, Narosa, New Delhi 1992*

*4. H. F. Winterkorn and H Y Fang, Foundation Engineering Hand Book, GalgotiaBooksource*

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| **L-T-P** | **MCI041A – Design of Tall Buildings** | **Credits: 4** |
| **4-0-0** |

**Objectives:**

* This course is intended to teach the concept of tall structures.
* Various methods to analyze the tall structure will be explained in the classes.

**Unit 1**

Introduction - Classification of buildings according to NBC – Types of loads – wind load– Seismic load – Quasi static approach.

**Unit 2**

Plane Frame System - Calculation of wind load – Approximate method – Portal -Cantilever and factor methods – Kani’s method – Substitute frame method for dead load and live loads.

**Unit 3**

Shear Wall System - Rosman’s analysis – Design aspect – RC frame and shear wall interaction – Equivalent frame method.

**Unit 4**

In-filled Frame Systems - Importance – Methods of analysis – Equivalent truss and frame method – Force-displacement method – Effect of perforation in the in-filled frame.

**Unit 5**

Three Dimensional Analysis - Basic principles – Centre of rotation of a rigid floor – Force displacement method.

**Course Outcomes:**

***At the end of this course, students will be able to:***

CO1: Study of Structural systems and concepts. Frame, shear wall, Frame shear wall Interaction,

coupled shear walls, braced frames, TubularBuildings, Diagrids and Exoskeleton.

CO2: Understand Approximate and Matrix methods of Analysis, Foundation superstructure

interaction.

CO3: Analyze Wind Effects, Earthquake effects and design for ductility. Review of relevant Indian

standards.

CO4: Design the shear wall system and in filled frame systems.

CO5: Do the three dimensional analysis.

**MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

|  |  |  |
| --- | --- | --- |
| **Course Outcome** | **Program Outcome** | **Program Specific Outcome** |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PSO1 | PSO2 | PSO3 |
| CO1 | H |  | M |  | H | L | H | M |  |  | H | H | H |  |
| CO2 | H |  | M |  | H | L | H | M |  |  | H | H | H |  |
| CO3 | H |  | M |  | H | L | H | M |  |  | H | H | H | M |
| CO4 | H |  | M |  | H | L | H | M |  |  | H | H | H |  |
| CO5 | H |  | M |  | H | L | H | M |  |  | H | H | H |  |

H = Highly Related M = Medium L=Low

***Text Book:***

*1. Ramachandra (2005), Design of Steel Structures–Vol.II, Standard Book House, 1750-a,NaiSarak, Delhi-6.*

***Reference Book:***

*1 SarwarAlamRaz, (2001), Analytical methods in Structural Engineering, Wiley Eastern*

*Private Limited, New Delhi.*

*2. Ghali.A.,Neville.A.M and Brown.T.G, (2003), Structural Analysis – A unified classical and Matrix Approach (Fifth Edition), Span press.*

**Semester IV**

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| **L-T-P** | **MCI023A – Dissertation Part - II** | **Credits: 28** |
| **0-0-28** |