NIRMA UNIVERSITY

Institute of Technology

School of Engineering

Master of Technology - Civil Engineering

(Computer Aided Structural Analysis and Design)

Semester- II

L	T	P	C
2	0	2	3

Course Code	6CL161
Course Name	Advanced Foundation Engineering

Course Outcomes:

At the end of the course, students will be able to –

1. examine soil properties through subsurface exploration
2. analyze and design shallow foundation and retaining structures
3. analyze and design deep foundation.

Syllabus — Teaching hours: 30

Unit-1: Soil Investigation — Hours: 03

Methods of subsurface exploration, Dynamic properties of soil, Investigation report.

Unit-2: Analysis and Design of Shallow Foundation — Hours: 11

Bearing capacity theories, Settlement analysis, Design of eccentrically loaded footing, Design of rafts and floating foundations, Machine foundation.

Unit-3: Retaining Structures — Hours: 04

Sheet piles: cantilever and anchor bulk head - free & fixed earth methods of analysis, Reinforced earth wall, Gabion wall.

Unit-4: Analysis and Design of Deep Foundation — Hours: 10

Pile foundation: vertical, lateral and uplift capacity, Pile groups: efficiency and settlement, Piled-raft foundation, Well foundation: Scour depth, Stability analysis.

Unit-5: Soil-Structure Interaction — Hours: 02

Evaluation of soil stiffness, Beams on elastic foundation.

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 05 Experiments to be incorporated.

Suggested Reading:

1. Bowles, J. *Analysis and Design of Foundation*, McGraw-Hill.
2. Saran, S. *Analysis and Design of Substructures*, Oxford and IBH Publishing.
3. Teng, W. C. *Foundation Design*, Prentice-Hall.
4. Tomlinson, M. *Foundation Design and Construction*, Prentice-Hall.
5. Das, B. M. *Principles of Foundation Engineering*, Cengage Learning.
6. Kurian, N. P. *Design of Foundation System*, Narosa Publishing House.
7. Codes: IS:6403, IS:2911.

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L	T	P	C
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Course Code	6CL162
Course Name	Structural Health Monitoring

Course Outcomes:

At the end of the course, students will be able to –

1. classify the distress in the structures
2. assess the health of structures using static and dynamic field methods
3. relate applications of smart materials in structural health monitoring.

Syllabus: Teaching Hours: 30

Unit-1: Structural Health Monitoring Hours: 05

Concepts, Various measures, Structural safety in alteration, Factors affecting health of structures, Causes of distress, Regular maintenance.

Unit-2: Structural Audit Hours: 05

Assessment of health of structure, collapse and investigation, Investigation management, Structural health monitoring procedures.

Unit-3: Static Field Testing Hours: 07

Types of static tests, Simulation and loading methods, Sensor systems and hardware requirements, Static response measurement.

Unit-4: Dynamic Field Testing Hours: 08

Types of dynamic field test, Stress history data, Dynamic response methods, Electro Mechanical Impedance (EMI) technique, Adaptations of EMI technique, Hardware for remote data acquisition systems, Remote structural health monitoring.

Unit-5: Application of Smart Materials Hours: 05

Introduction to smart materials and it's properties, Polyvinylidene Fluoride (PVDF) film, Piezoelectric materials and other smart materials, Smart structures and vibration control, Case studies.

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 05 Experiments/ Exercises to be incorporated.

Suggested Readings:

1. Balageas, D., Fritzen, C. P. & Güemes, A. *Structural Health Monitoring*, John Wiley & Sons.
2. Adams, D. E. *Health Monitoring of Structural Materials and Components Methods with Applications*, John Wiley & Sons.
3. Ou, J. P., Li, H. & Duan, Z. D. *Structural Health Monitoring and Intelligent Infrastructure*, *Vol. I & II*, Taylor & Francis.
4. Srinivasan, A. V. & McFarland, D. M. *Smart Structures - Analysis and Design,* Cambridge University Press.

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L	T	P	C
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Course Code	6CL163
Course Name	Structural Evaluation and Strengthening

Course Outcomes:

At the end of the course, students will be able to –

1. identify causes and mechanism of distress in structures
2. propose appropriate techniques for damage assessment of structures
3. apply suitable types of repair materials and techniques
4. design strategies for strengthening of structures.

Syllabus: Teaching Hours: 30

Unit-1: Structural Failures and Distress Hours: 05

Physical and chemical factors responsible for distress of concrete, Introduction to construction failure, Causes of failures, Accountability & liability, Prevention against failures, Investigation of failures, Case studies.

Unit-2: Damage Assessment of Structures Hours: 05

Overview of destructive and non-destructive testing, Non Destructive Testing (NDT) methods for evaluation of corrosion of emended steel, concrete quality and durability determination, concrete strength and integrity, performance of concrete structures, Correlation of properties obtained by NDT with basic structure of matter and other properties, Practical application and advances in NDT.

Unit-3: Material and Techniques for Repair & Rehabilitation of Structures Hours: 05

Overview of repair materials**,** Surface preparation, Grouting, Sprayed concrete, Steel jacketing, Fibre Reinforced Polymer (FRP) wrapping etc., Crack and patch repair using epoxy injection, polyurethane injection etc., Techniques for protection of concrete and steel structures.

Unit-4: Strengthening of Elements and Structures Hours: 15

Strategies, Philosophy and design of strengthening, Shear and flexural strengthening of beams, columns, slab etc. using techniques such as FRP wrapping, concrete jacketing, Use of different codal provisions such as ACI, ISIS etc., Introduction to performance based strengthening strategies, Case studies of buildings and heritage structures.

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 05 Experiments to be incorporated.

Suggested Readings:

1. Bungey, J. H., Millard, S. G. & Grantham, M. G. *Testing of Concrete in Structures*, Taylor & Francis.
2. Mehta, P. K. & Monterio, P. J. M. *Concrete: Microstructure, Properties and Materials*, McGraw Hill.
3. Emmons, P. & Sabnis, G. *Concrete: Repair and Maintenance Illustrated, Problem Analysis, Repair strategy and Techniques*, Galgotia Publications.
4. Feld, J. & Harper, K. *Construction Failure*, John Wiley & Sons.
5. Codes: ACI:364, ACI:201, ACI:224, ACI:440, IS:13311, ISIS.

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Course Code	6CL164
Course Name	Hydraulic Structures

Course Outcomes:

At the end of the course, students will be able to –

1. outline and model components of hydraulic structures for real-life practice
2. design dam components
3. design canal components.

Syllabus: Teaching hours: 30

Unit 1: Introduction **Hours: 03**

Classification and Components of Hydraulics structures

Unit 2: Design of Dam Components **Hours: 14**

Hydraulic and structural design of storage reservoirs, Structural design of spillways, dams, outlet works, etc.

Unit 3: Design of Canal Components **Hours: 13**

Hydraulic and structural design of transition structures: cross-drainage, canal siphons, aqueducts, etc.

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 05 Experiments/ Exercises to be incorporated.

Suggested Readings:

7. Novak P., Moffat A. I. B., Nalluri C. and Narayan R., *Hydraulic Structures*, Taylor & Francis.
8. Leliavsky S., *Design Text Books in Civil Engineering Vol. I to VI*, Oxford IBH.
9. *Manual on Barrages and Weirs on Permeable Foundation*, Publication 179, (Volumes I and II), Central Board of Irrigation and Power, New Delhi.
10. Khatsuria, R. M., *Hydraulics of Spillways and Energy Dissipators*, Marcel Dekker Publishing, New York.
11. Sharma, J.K. and Narain L. *Analysis and Design of Hydraulic Structures*, Krishna Prakashan Media (P) Ltd.

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Course Code	6CL165
Course Name	Design of Masonry Structures

Course Outcomes:

At the end of the course, students will be able to –

1. infer types of masonry elements and mechanical properties of masonry
2. design masonry and reinforced masonry structural elements
3. interpret codal provisions for seismic resistance and strengthening of masonry structures.

Syllabus: Teaching hours: 30

Unit-1: Fundamentals of Masonry Hours: 04

Materials for masonry, Masonry properties, Theory of masonry failure, Masonry in shear, flexure, and biaxial stress, General considerations.

Unit-2: Masonry Components Hours: 10

Structural and non-structural masonry, Lintels, Unreinforced structural masonry, Reinforced brick masonry, Reinforced hollow components.

Unit-3: Analysis and Design of Masonry Elements Hours: 08

Estimation of load and load combination, Analysis and design of masonry and reinforced masonry members.

Unit-4: Seismic Design of Masonry Structures Hours: 05

Structural systems with emphasis on lateral force analysis of masonry structures and their connections, Reinforced masonry, Codal provisions for seismic resistance, Seismic strengthening.

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Laboratory work will be based on above syllabus with minimum 05 Experiments/ Exercises to be incorporated.

Suggested Readings:

12. Jagadish, K.S. *Structural Masonry*, IK International.
13. Drysdale, R. G., Hamid, A. A. & Baker, L. R. *Masonry Structures-Behavior and Design*, Prentice Hall.
14. Hatzinikolas, M., Korany, Y. & Brzev, S. *Masonry Design: for Engineers and Architects*, Canadian Masonry Publications.
15. Schneider, R. & Dickey, W. L. *Reinforced Masonry Design*, Prentice Hall.
16. Hendry, A. W. *Structural Masonry*, Macmillan Education.
17. Codes: IS:1905, IS:4326, IS:1893, IS:13828, IS:13935.

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