

# **CURRICULUM & SYLLABUS**



## **COURSEWORK**

**FOR**

**Doctor of Philosophy (Ph.D.)**

**IN**

**CIVIL ENGINEERING**

**FACULTY OF ENGINEERING AND TECHNOLOGY  
SRM UNIVERSITY DELHI-NCR, SONEPAT  
Plot No.39, Rajiv Gandhi Education City, P.S. Rai,  
Sonapat, Haryana-131029**

**SCHEME OF EXAMINATION FOR DOCTOR OF PHILOSOPHY DEGREE COURSE**

Subject Code	Subject Name	L	T	P	C	Exam Hrs.	Max. Marks	
							Int.	Ext.
RES701	Research Methodology	4	0	0	4	3	30	70
CPE-RPE101	Research and Publication Ethics	2	0	0	2	3	30	70
-	Elective - I	3	0	0	3	3	30	70
-	Elective - II	3	0	0	3	3	30	70
<b>Total Credit</b>						<b>12</b>		

# Research Methodology

**CODE: RES 701**

## **Unit 1: Introduction to Research**

Introduction, Philosophical Underpinnings, Meaning of Research, Objectives of Research, Motivations in Research, Types of Research, Research Approaches, Significance of Research, Scope of Research, Literature Review, Research Methods vs. Research Methodology, Research Process, Research and Scientific Methods, Criteria of Good Research, Research Questions, Research problem, Selecting the Problem, Necessity and Techniques of Research Problem, Qualitative & Quantitative Research, Research Proposal, Synopsis, Transdisciplinarity, Multidisciplinarity & Interdisciplinarity in Research.

## **Unit II: Data Collection & Sampling**

Collection of Primary Data/Sources, Secondary Data/Sources, Observation Method, Interview, Libraries, Archives & Repositories, Questionnaire, Schedules, Case Study and other Innovative Methods, Research Procedure. Sampling, Steps and Criteria for selecting a Sample procedure, Characteristics of Good Sampling, Types of Sample Design, Selecting Random Samples, Complex Random Sampling Design.

## **Unit III: Data Analysis & Interpretation**

Measures of Central Tendency, Dispersion, Correlation & Regression, Chi-Square Test: applications, Steps, Characteristics, Limitations, Analysis of Variance & Co-variance. Hypothesis: Meaning, Basic Concepts, Flow Diagram, Testing, of Means, Testing of Hypothesis testing of Correlation coefficients, Limitations of Tests of Hypothesis Theory & Empirical approaches, Ethnographic, Comparative and Interpretative Research.

## **Unit IV: Research Tools & Ethics in Research**

Computer Fundamentals, Basics, Data Representation, Word Processing Package, Creating & Editing a Word Document. Ethical issues related to Publishing & Plagiarism, LaTeX tool for Detection and Elimination of Plagiarism, Intellectual Property Rights, Copy Rights & Patent Laws.

## **Unit V: Research Report & Presentations**

Structure & Components of Research Report, Types of Report, Layout of Research Report, Mechanism of Writing a Research Report. Presentation: Tailoring the presentation to the target audience, Oral Presentation, Poster Presentation, Submission of Research Article, Thesis Writing, Visual & Delivery.

## **Reference**

1. Adam Pzeworsky and Frank Solomon. *On the Art of Writing Proposals*, rev. edn, New York, 1995.
2. Blaxter Loraine, Hughes Christina and Tight Malcolm. *How to Research*, Open University Press, 2006.
3. Gerard Guthrie. *Basic Research Methods*, Sage, London, 2010.
4. Kothari, C. R. *Research Methodology: Methods and Techniques*, New Age Publishers, Delhi, 2018.
5. Rand R. Wilcox, *Fundamentals of Modern Statistical Research*, Springer, New York, 2010.
6. Ross, Timothy J. *Fuzzy Logic with Engineering Applications*, 2<sup>nd</sup> Edn. Wiley Publications, 2005.

## Research and Publication Ethics

Code: CPE-RPE101

### OBJECTIVE:

This course has total 6 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h- index, Impact Factor, etc.) and plagiarism tools will be introduced in this course.

### COURSE CONTENTS:

1. **Pedagogy:** Classroom teaching, guest lectures, group discussions, and practical sessions.
2. **Evaluation:** Continuous assessment will be done through tutorials, assignments, quizzes, and group discussions. Weightage will be given for active participation. Final written examination will be conducted at the end of the course.
3. **Course structure:** The course comprises of six modules listed in table below. Each module has 4-5 units.

MODULES	UNIT TITLE	TEACHING HOURS
<b>Theory</b>		
RPE 01	Philosophy and Ethics	4
RPE 02	Scientific Conduct	4
RPE 03	Publication Ethics	7
<b>Practice</b>		
RPE 04	Open Access Publishing	4
RPE 05	Publication Misconduct	4
RPE 06	Databases and Research Metrics	7
	<b>Total</b>	<b>30</b>

### SYLLABUS IN DETAIL

#### THEORY

- RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)
  1. Introduction to philosophy: definition, nature and scope, concept, branches
  2. Ethics: definition, moral philosophy, nature of moral judgments and reactions
- RPE 02: SCIENTIFIC CONDUCT (5 hrs.)
  1. Ethics with respect to science and research
  2. Intellectual honesty and research integrity
  3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
  4. Redundant publications: duplicate and overlapping publications, salami slicing
  5. Selective reporting and misrepresentation of data
- RPE 03: PUBLICATION ETHICS (7 hrs.)
  1. Publication ethics: definition, introduction and importance
  2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
  3. Conflicts of interest
  4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
  5. Violation of publication ethics, authorship and contributorship
  6. Identification of publication misconduct, complaints and appeals
  7. Predatory publishers and journals

## **PRACTICE**

- RPE 04: OPEN ACCESS PUBLISHING (4 hrs.)
  1. Open access publications and initiatives
  2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
  3. Software tool to identify predatory publications developed by SPPU
  4. Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.
  
- RPE 05: PUBLICATION MISCONDUCT (4hrs.)
  - (A) Group Discussions (2 hrs.)
    1. Subject specific ethical issues, FFP, authorship
    2. Conflicts of interest
    3. Complaints and appeals: examples and fraud from India and abroad
  - (B) Software tools (2 hrs.): Use of plagiarism software like Turnitin, Urkund and other open source software tools
  
- RPE 06: DATABASES AND RESEARCH METRICS (7hrs.)
  - (A) Databases (4 hrs.)
    1. Indexing databases
    2. Citation databases: Web of Science, Scopus, etc.
  - (B) Research Metrics (3 hrs.)
    1. Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score
    2. Metrics: h-index, g index, i10 index, altmetrics

COURSE CODE	COURSE NAME	L	T	P	C
19CE6001	COMPOSITE MATERIALS	3	0	0	3
PREREQUISITE	NIL				

**Introduction:** Definition, Classification and characteristics of Composite materials, advantages and limitations, Current Status and Future Prospects;

**Basic Concepts and characteristics:** Homogeneity and Heterogeneity, Isotropy, Orthotropy and Anisotropy; Characteristics and configurations of lamina, laminate, micromechanics and macromechanics, Constituent materials and properties;

**Elastic behavior of unidirectional lamina:** Anisotropic, separately orthotropic and transversely isotropic materials, stress-strain relations for thin lamina, transformation of stress and strain, transformation of elastic parameters;

**Strength of unidirectional lamina:** Macro mechanical failure theories- Maximum stress theory, maximum strain theory, Deviatoric strain energy theory (Tsai-Hill), Interactive tensor polynomial theory (Tsai-Wu);

**Elastic Behavior of multidirectional laminates:** Basic assumptions, Stress-strain relations, load deformation relations, symmetric and balanced laminates, laminate engineering properties;

**Bending and vibration of laminated plates:** Governing equations, Deflection of simply supported rectangular symmetric angle-ply, specially orthotropic, anti-symmetric cross-ply laminates;

**Recent advances:** Functionally graded materials, Smart materials

**Essential Reading:**

1. R.M. Jones, Mechanics of Composite materials, Taylor and Francis, 1999.
2. I. M. Daniel and O. Ishai, Engineering mechanics of Composite materials, Oxford university press, 1999

**Supplementary Reading:**

1. P.K. Mallick, Fiber-reinforced Composites, Marcel Dekker Inc, 1988.
2. D. Hull and T. W. Clyne, An introduction to composite materials, Cambridge university press, Second Edition, 1996.
3. J.N. Reddy, Mechanics of laminated composite plates and shells-Theory and Analysis, CRC Press, Boca Raton, Second Edition, 2003.

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>19CE6002</b>	<b>ADVANCED CONSTRUCTION MATERIALS</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PREREQUISITE</b>	<b>NIL</b>				

**OBJECTIVES:**

To study and understand the properties of advanced construction materials used in construction such as special concretes, metals, composites, water proofing compounds, non weathering materials, and smart materials.

**OUTCOME:**

On completion of this course the students will have the knowledge of modern construction materials to be used in the field.

**SPECIAL CONCRETES**

Concretes, Behaviour of concretes – Properties and Advantages of High Strength and High Performance Concrete – Properties and Applications of Fibre Reinforced Concrete, Self compacting concrete, Alternate Materials to concrete on high performance & high Strength concrete.

**METALS**

Types of Steels – Manufacturing process of steel – Advantages of new alloy steels – Properties and advantages of aluminium and its products – Types of Coatings & Coatings to reinforcement Applications of Coatings.

**COMPOSITES**

Types of Plastics – Properties & Manufacturing process – Advantages of Reinforced polymers –Types of FRP – FRP on different structural elements – Applications of FRP.

**OTHER MATERIALS**

Types and properties of Water Proofing Compounds – Types of Non-weathering Materials and its uses – Types of Flooring and Facade Materials and its application.

**SMART AND INTELLIGENT MATERIALS**

Types & Differences between Smart and Intelligent Materials – Special features – Case studies showing the applications of smart & Intelligent Materials.

**REFERENCES:**

1. ACI Report 440.2R-02, “Guide for the design and construction of externally bonded RP systems for strengthening concrete structures”, American Concrete Institute, 2002.
2. Aitkens , High Performance Concrete, McGraw Hill, 1999
3. Ashby, M.F. and Jones.D.R.H.H. “Engineering Materials 1: An introduction to Properties, applications and designs”, Elsevier Publications, 2005.
4. Deucher, K.N, Korfiatis, G.P and Ezeldin, A.S, Materials for civil and Highway Engineers, Prentice Hall Inc., 1998.
5. Mamlouk, M.S. and Zaniewski, J.P., Materials for Civil and Construction Engineers, Prentice Hall Inc., 1999.
6. Santhakumar.A.R., Concrete Technology, Oxford University press, New Delhi
7. Shan Somayaji, Civil Engineering Materials, Prentice Hall Inc., 2001
8. Shetty M.S, Concrete Technology: Theory and Practice, S.Chand & Company Ltd., 2005.

<b>COURSE CODE</b>	<b>COURSE NAME</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>19CE6003</b>	<b>SEISMIC DESIGN OF STRUCTURES</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PREREQUISITE</b>	NIL				

<b>PURPOSE</b>		
<b>INSTRUCTIONAL OBJECTIVES</b>		<b>STUDENT OUTCOMES</b>
At the end of the course, student will be able to:		
1	Understand about earthquake and its causes	To develop systematic knowledge of earthquake and its causes
2	Understand the behavior of structural elements under EQ	To understand the basic concepts related to structural design for earthquake loads
3	Carry out analysis and planning of structural members	To develop an idea about various structural systems adopted
4	Understand about ductile detailing of members as per BIS	To familiarize with design and detailing of various types of systems
5	Understand about retrofitting and rehabilitation of structures and various methods	To introduce fundamentals of repair and rehabilitation techniques

Session	Description of Topic	Contact Hours	C-D-I-O	IOs
<b>UNIT -1 (INTRODUCTION)</b>		<b>8</b>		
1	Introduction to engineering seismology, various theories, measurement scales	3	C	1
2	vibration measuring instruments, Past earthquakes in India and world	2	C,I	1
3	Response spectrum, significance, construction & use	3	C,I	1
<b>UNIT -2 (STRUCTURAL MATERIALS AND SYSTEMS)</b>		<b>8</b>		
4	Performance of structural materials under cyclic loads- masonry, steel, concrete, soil	2	C,I	2
5	Various structural systems in steel and concrete for horizontal load transfer	2	C,D,I	2
6	their behavior and limitations, braced frames	2	C,D,I	2
7	rigid frames, shear walls, wall-frame systems	2	C,D,I	2
<b>UNIT -3 (STRUCTURAL PLANNING AND ANALYSIS)</b>		<b>10</b>		
8	Seismic design philosophy, Design spectrum, ductility based analysis	2	C,D,I	3
9	capacity design concepts, pushover analysis concepts	2	D,I	3
10	energy based design Layout and planning of buildings in seismic zones	2	C,I	3

11	regular and irregular buildings, centre of rigidity and centre of mass, torsion	2	C, I	3
12	Computing storey shear, drift - using provisions of Bureau of Indian Standards (BIS) codes	2	C	3
<b>UNIT -4 (DESIGN AND DUCTILE DETAILING)</b>		<b>8</b>		
13	Load combinations, Ductility based design	2	C, D,I	4
14	Detailing for seismic performance	2	C, D,I	4
15	Provisions of IS: 13920 for RCC structural elements, frames, shear walls	2	C	4
16	Design of shear walls	2	D, I	4
<b>UNIT -5 (SEISMIC RETROFITTING AND ISOLATION)</b>		<b>8</b>		
17	Damage Assessment techniques - safety analysis and rating	2	C, I,O	5
18	Reliability assessment - Retrofitting techniques - materials	3	C, I,O	5
19	Base Isolation techniques - Active and passive control devices	3	C, I,O	5
<b>TOTAL CONTACT HOURS</b>		<b>42</b>		

<b>LEARNING RESOURCE</b>	
<b>S.No.</b>	<b>TEXT BOOKS</b>
1	Paulay, T. and Priestly, M.N.J., "Aseismic Design of Reinforced Concrete and Masonry Building", John Wiley and Sons, 1987
2	Agarwal, P., and Shrikhande, M., "Earthquake Resistant Design of Structures" Prentice Hall of India, New Delhi, 2007
3	Anil.K.Chopra, "Dynamics of Structures (Theory and Applications to Earthquake Engineering)", 3rd Edition, Prentice Hall of India Private Limited. New Delhi, 2009
4	Short course on Seismic Design of Reinforced Concrete Buildings, CEP, IIT, Kanpur, Dec.1995
<b>REFERENCE BOOKS AND OTHER MATERIALS</b>	
5	Course Notes, "Structural Design for Dynamic Loads", SRM Engineering College, 2002
6	Allen.R.T., and Edwards.S.C, "Repair of Concrete Structures", second edition Blackie Academic & Professional, an imprint of Chapman hall, U.K. 1993
7	Lecture Notes, "Health Monitoring of Structures - A Proactive Strategy", ISTE Sponsored course held at SRMEC, Jan 2003
8	Guidelines for - "Improving Earthquake Resistance of Housing", Building Materials and Technology Promotion Council, Ministry of Urban Development and Poverty Alleviation, Department of Urban Employment and Poverty Alleviation, Government of India, New Delhi, 1999 – 2000.