



DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE (AUTONOMOUS)

(Approved by AICTE & Affiliated to Anna University, Chennai)
Re-Accredited by NAAC with 'A' Grade
Accredited by NBA for AERO, BME, CSE, ECE, EEE, IT & MECH.

PERAMBALUR-621212, TAMILNADU, INDIA.

Website: www.dsengg.ac.in



COURSE PLAN

Course Code/Name	U20CE851/ Repair and Rehabilitation of Structures			
Year/Section/Department	IV/-/Civil Engineering			
Credits Details	L:3	T:0	P:0	C:3
Total Contact Hours Required	45 Hours			

Syllabus:

UNIT I/ MAINTENANCE AND REPAIR STRATEGIES	No. of Periods:9
Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.	
UNIT II/ STRENGTH AND DURABILITY OF CONCRETE	No. of Periods:9
Quality assurance for concrete – Strength, Durability - Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion.	
UNIT III/ SPECIAL CONCRETES	No. of Periods:9
Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes.	
UNIT IV/ TECHNIQUES FOR REPAIR AND PROTECTION METHODS	No. of Periods:9
Non-destructive Testing Techniques, Load Test for Stability- Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, Cathodic protection.	

UNIT V/ REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES	No. of Periods:9
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Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – Transportation of Structures from one place to other-Structural Health Monitoring- Demolition Techniques - Engineered demolition methods - Case studies.

Objectives:

- To learn various distress and damages to concrete and masonry structures
- To understand the importance of maintenance of structures
- To study the various types and properties of repair materials
- To assess the damage to structures using various tests
- To learn the importance and methods of substrate preparation
- To learn various repair techniques of damaged structures, corroded structures
- To acquire the knowledge on Quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures and demolition procedures.

Text Books:

T1: Shetty.M.S. “ConcreteTechnology-Theory and Practice, S.Chand and Company, 2008.

T2: Varghese.P.C Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd 2014.

Reference Books:

R1: Dodge Woodson.R Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 2012.

R2: DovKominetzky.M.S.,-Design and Construction Failures, Galgotia, Publications Pvt.Ltd.,2001

R3: Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.

R4: Ravishankar.K. Krishnamoorthy.T.S, Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, Allied Publishers, 2004.

R5: Vidivelli.B Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.

R6. Dr.P.Oliver Jayaprakash,” Repair and Rehabilitation of Concrete Structures”, Magnus Publications.

R7. Gambhir.M.L., "Concrete Technology", McGraw Hill, 2008.

Websites:

W1. www.aquaguardinjection.com & <https://theconstructor.org>

Online Mode of Study (if Any):

- ❖ <http://nptel.ac.in/courses/114106037/11>
- ❖ <https://www.google.com/search design of column114106037>

Course Plan:

Topic No	Topic	Reference Detail	Page No	Mode of teaching	No of Periods Required	Cumulative Period
UNIT I - MAINTENANCE AND REPAIR STRATEGIES						
1	Maintenance, Repair and Rehabilitation	R6	1.1-1.2	BB	1	1
2	Facets of Maintenance	R6	1.2-1.5	BB	1	2
3	Importance of Maintenance	R6	1.6-1.8	BB	1	3
4	Importance of Maintenance	R6	1.6-1.8	BB	1	4
5	Various aspects of Inspection	R1	502-503	BB	1	5
6	Various aspects of Inspection	R1	502-503	BB	1	6
7	Assessment procedure for evaluating a damaged structure	R7	560-566	BB	1	7
8	Assessment procedure for evaluating a damaged structure	R7	560-566	BB	1	8
9	Causes of deterioration	R7	566-573	BB	1	9
Outcome of Unit I:						
<p>CO1: At the end of unit, Students shall able to understand the importance of maintenance and assessment method of distressed structures.</p>						
UNIT II - STRENGTH AND DURABILITY OF CONCRETE						
10	Quality assurance for concrete	R7	218-220	BB	1	10
11	Strength of concrete	R7	221-225	BB	1	11
12	Strength of concrete	R7	221-225	BB	1	12
13	Durability of concrete	R7	200-206	BB	1	13

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14	Durability of concrete	R7	200-206	BB	1	14
15	Cracks and its different types	R7	686-690	BB	1	15
16	Cracks and their causes	R7	686-690	BB	1	16
17	Effects due to climate, temperature	R7	691-709	BB	1	17
18	Effects due to Sustained elevated temperature and Corrosion.	R7	691-709	BB	1	18

Outcome of Unit II:

CO2: At the end of unit, students should be able to understand the strength and durability properties, their effects due to climate and temperature.

UNIT III- SPECIAL CONCRETES

19	Polymer concrete	R7	532-541	BB	1	19
20	Sulphur infiltrated concrete	T1	525-526	BB	1	20
21	Fibre reinforced concrete	R7	506-511	BB	1	21
22	High strength concrete	R7	544-547	BB	1	22
23	High performance concrete	R7	574-671	BB	1	23
24	Vacuum concrete & Self compacting concrete	R7	474-476	BB	1	24
25	Geopolymer concrete	T1	599-602	BB	1	25
26	Reactive powder concrete	T1	320-321	BB	1	26
27	Concrete made with industrial wastes	T1	506-513	BB	1	27

Outcome of Unit III:

CO3: At the end of unit, students should be able to know about the Recent development in concrete.

UNIT IV- TECHNIQUES FOR REPAIR AND PROTECTION METHODS

28	Non-destructive Testing Techniques	T1	437-452	BB	1	28
29	Load Test for Stability	T1	454-480	BB	1	29
30	Epoxy injection	W1, T1	121	BB	1	30

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31	Shoring, Underpinning	W1	W1	BB	1	31
32	Corrosion protection techniques	T1	402-405	BB	1	32
33	Corrosion inhibitors	T1	406-408	BB	1	33
34	Corrosion resistant steels	T1	402-404	BB	1	34
35	Coatings to reinforcement	T1	408-409	BB	1	35
36	Cathodic protection	T1	408-409	BB	1	36

Outcome of Unit IV:

CO4: At the end of unit, students should be able to understand the techniques for repair and protection methods.

UNIT V- REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES

37	Strengthening of Structural elements	T1	298-306	BB	1	37
38	Strengthening of Structural elements	T1	298-306	BB	1	38
39	Repair of structures distressed due to corrosion, fire, Leakage, earthquake	T1	325-348	BB	1	39
40	Transportation of Structures from one place to other	T1	368-376	BB	1	40
41	Structural Health Monitoring	T1	325-348	BB	1	41
42	Demolition Techniques	R6	5.27-5.33	BB	1	42
43	Demolition Techniques	R6	5.27-5.33	BB	1	43
44	Engineered demolition methods- Case studies	R6	5.33-5.52	BB	1	44
45	Engineered demolition methods- Case studies	R6	5.33-5.52	BB	1	45

Outcome of Unit V:

CO5: At the end of unit, students should be able to know about the Repair, rehabilitation and retrofitting of structures and demolition methods.

CO6: At the end of unit, students should be able to learn about the Repair strategies of structural elements and Restoration of Heritage structures.

Course Outcome:

At the end of course:

Students should be able to do:

CO1: The importance of maintenance and assessment method of distressed structures.

CO2: The strength and durability properties, their effects due to climate and temperature.

CO3: Recent development in concrete

CO4: The techniques for repair and protection methods

CO5: Repair, rehabilitation and retrofitting of structures and demolition methods.

CO6: The Repair strategies of structural elements and Restoration of Heritage structures.

Course Outcome Vs Program Outcome Mapping:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	-	-	-	1	1	2	-	-	1	-	-
CO2	3	2	3	-	-	-	1	1	1	-	-	1	1	1
CO3	3	2	3	-	-	-	1	1	1	-	-	1	1	-
CO4	2	2	3	-	-	-	1	1	1	-	-	1	-	1
CO5	2	2	3	-	-	-	1	1	1	-	-	1	-	2
CO6	2	2	3	-	-	-	1	1	1	-	-	1	1	1
AVG	3	2	3	-	-	-	1	1	1	-	-	1	1	1

Content beyond Syllabus:

- ❖ Restoration of Heritage structures.
- ❖ Financing in repair and rehabilitation projects.

Internal Evaluation Components:

Webportal	Assignment	Components	Topic Number with Topic / Unit Details	Relevance to CO
Webportal 1	--	Assessment – I (60)	Unit I and II	CO 1 & CO2
	1	Assignment – Handwritten (20)	1. Assessment procedure for evaluating a damaged structure 2. Cracks, different types and its causes	CO1 CO2

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	2	Assignment – Poster Presentation / PPT (20)	<ol style="list-style-type: none"> 1. Various aspects of Inspection and maintenance. 2. Quality assurance for concrete while making and after hardening. 	CO1 CO2
	--	Assessment – II (60)	Unit III and IV	CO3 & CO4
Webportal 2	3	Seminar (20)	<ol style="list-style-type: none"> 1. Vacuum concrete, Self compacting concrete and Geopolymer concrete. 2. Epoxy injection, Shoring and Underpinning. 	CO3 CO4
	4	Case Study Report (20)	<ol style="list-style-type: none"> 1. Concrete made with industrial wastes. 2. Non-destructive Testing Techniques. 	CO3 CO4
	--	Model Exam (75)	Unit I to V	CO1 to CO6
Webportal 3	5	MCQ (15)	Unit I to V	CO1 to CO6
	-	Course Attendance (10)	--	--

Submission Details:

Phase 1(Before AT 1)		Phase 2 (Before AT 2)		Phase 3 (Model)
Assignment 1	Assignment 2	Assignment 3	Assignment 4	Assignment 5

Google Class Code Details: 2b2ftwo

Class Name: RRS IV Year CIVIL

PLAN OF ASSESSMENT TEST –DISTRIBUTION OF MARKS:

TEST	CO- MARK WISE DISTRIBUTION						BLOOM'S LEVEL MARK WISE DISTRIBUTION					
	CO1	CO2	CO3	CO4	CO5	CO6	BTL1	BTL2	BTL3	BTL4	BTL5	BTL6
AT-1												
AT-2												
MODEL												