

B.Tech. III Semester – VI

Subject Name : Maintenance & Repair of Structures

Subject Code : BTCL14608

Type of course : PEC-III

Prerequisite : Concrete & Construction Technology (BTCL13302)

Rationale : Majority of the existing buildings constructed in India are now becoming old as they have reached the age beyond 30 years and needs attention. Thus there is a great demand and employment potential in this area. This course is therefore introduced in the curriculum so that students can also develop competence in this area. The course deals with the maintenance of buildings, concrete repair chemicals, special materials used for repair and repair of various parts of a building, strengthening of reinforced concrete members by shoring, plate bonding, RC jacketing, control on termites and fungus in buildings, etc.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15	-	-	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	Introduction: Need of structural condition assessment, Structural Health: Factors affecting Health of Structures, Regular Maintenance, Facets of Maintenance, importance of Maintenance ,structural condition assessment, Repair Strategies: Construction and design failures, Assessment procedure for Inspection and evaluating a damaged structure, selection of repairing and rehabilitation methods,	11	25 %
2.	Structural Condition Assessment Assessment procedure for Inspection and evaluating a damaged structure Causes of Distress, Destructive testing and non-destructive testing, their applicability.	10	20 %

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3.	Repairing Materials: Strength and Durability Of Concrete- Quality assurance for concrete, Strength, Durability and Thermal properties of concrete Cracks, different types, causes, Effects due to climate, temperature, Sustained elevated temperature, Corrosion Effects of cover thickness; Special Concretes- 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	12	25 %
4.	Repair Techniques: Epoxy injection, Shoring, Underpinning, Corrosion protection techniques, Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection; Repair, Rehabilitation and Retrofitting of Structures- Evaluation of root causes; Underpinning & shoring; some simple systems of rehabilitation of structures; Guniting, shotcreting; Non-Destructive testing systems; Use of external plates, carbon fibre wrapping and carbon composites in repairs. Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake, Demolition Techniques, Engineered demolition methods, safety measures to be followed during demolition, care to be taken in dismantling of buildings so that maximum resale value material is generated. Case studies.	12	30 %

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	30	20	15	05

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels (**Revised Bloom's Taxonomy**)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of Publication	Publication Edition
1	Learning from failures Deficiencies in design, Construction and Service,	Raikar R. R & D centre (SDCPL)	Raikar Bhavan, Bombay	-	-
2	Concrete Technology by	A.R. Santakumar,	Oxford University press ISBN-13: 978-0-19-945852-3	2018	2 nd

3	Testing of Concrete in Structures	J.H. Bungey S.G. Millard M.G. Grantham	Taylor & Francis ISBN10: 0-415-26301-8 ISBN13: 978-0-415-26301-6	2004	4 th
4	Maintenance and Repair of Civil Structures	B.L. Gupta and Amit Gupta	Standard Publications. ISBN-10 : 8180141020 ISBN-13 : 978-8180141027	2009	1 st
5	Handbook on Repair and Rehabilitation of RCC Buildings	-	Central Public Works Department, Government of India	2001	1 st

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Review the structural condition assessment of building. (<i>R, U Cognitive Level</i>)	20
CO-2	Select the appropriate repairing materials. (<i>U, A Cognitive Level</i>)	25
CO-3	Select the suitable and feasible retrofitting procedure for damaged structure. (<i>A,N,C Cognitive Level</i>)	30
CO-4	Recommend the appropriate methods for demolition of distressed structures. (<i>N, E Cognitive Level</i>)	25

Mapping with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	1	2	2	2	1	1	2	3	2	1	2	2	2
CO-2	2	2	1	2	2	1	1	-	1	2	2	1	2	2	2
CO-3	2	2	1	3	3	1	-	-	2	2	2	1	2	2	2
CO-4	2	1	2	1	1	3	2	2	2	2	2	1	2	1	1
Rationale*	9	7	5	8	8	7	4	3	7	9	8	4	8	7	7

Rationale*: The content of subject is inclined to evaluate the maintenance and repair of the existing concrete structure.

List of Open learning website:

- <https://research.csiro.au/data61/structural-health-monitoring>
- <https://beanair.com/conditioning-monitoring-system.html>
- <https://www.ndt.net/events/NDTCanada2014/app/content/Slides/>
- https://cpwd.gov.in/Units/FinalDraftHandbook_Apr2007.pdf

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