Program : **Diploma in Civil Engineering**	
Course Code : **6011B**	Course Title: **Building Maintenance and Services**
Semester : **6**	Credits: **4**
Course Category: **Program Elective**	
Periods per week: **4 (L:4, T:0, P:0)**	Periods per semester:**60**

Course Objectives:

- To impart the ability to identify and rectify various defects in buildings
- To impart the ability to identify defects and maintain various building services
- To enable students to understand the various methods and challenges in retrofitting

Course Prerequisites:

Topic	Course code	Course name	Semester
Building materials		Building construction and construction materials	3
Structural design		Design of RCC and steel structures.	5

Course Outcomes:

On completion of the course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive Level
CO1	Outline the factors affecting durability of buildings and role of maintenance	15	Understanding
CO2	Analyse the common defects in building components	16	Applying
CO3	Summarize the common defects in building services, its causes preventive and remedial measures	15	Understanding
CO4	Outline retrofitting, restoration and conservation of building and heritages	12	Understanding
	Series Test	2	

CO - PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2						
CO2	2	3					
CO3	2						
CO4	2						

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline:

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Outline the factors affecting durability of buildings and role of maintenance**		
M1.01	Explain the factors affecting durability of buildings	4	Remembering
M1.02	Explain the preventive and remedial measures to increase durability	4	Remembering
M1.03	Outline the role of maintenance in durability and serviceability of buildings	4	Understanding
M1.04	Compare different types of maintenance	3	Understanding

Contents:

Durability of civil engineering structures

Importance of durability - Factors affecting durability of buildings - life expectancy of different classes of buildings. Environmental factors that affect the durability of structures - Effect of natural agents (Air, sun, rain, frost and biological agents such as vegetation & insects) - Environmental pollution - Effect of pollution of air, water and soil - Location effect (Marine, Industrial area etc.) - Usage aspects (Structures subjected to dynamical loading & abrasive condition) - Preventive and remedial measures. Role of maintenance in durability and serviceability of buildings: - Necessity of maintenance - Economic aspects of maintenance. Different types of maintenance - Preventive maintenance - Remedial maintenance - Routine maintenance - Pre-monsoon maintenance - Special maintenance - Planning aspects of maintenance.

CO2	**Analyse the common defects in building components**		
M 2.01	Analyse different cracks in buildings	3	Applying
M 2.02	Analyse defects in foundation	3	Applying
M 2.03	Analyse defects in masonry	2	Applying
M 2.04	Analyse defects in concrete, plastering and flooring	3	Applying
M 2.05	Outline defects in doors and windows	2	Understanding
M2.06	Outline defects in painting	1	Understanding
M2.07	Outline defects due to fire	2	Understanding
	Series Test - I	1	

Contents:

Cracks in buildings

Defects in foundation, masonry, plastering, Painting, flooring, doors and windows, concrete (RCC and PCC) and wooden roof - Corrosion of reinforcement and steel structures - structural damage due to fire - Causes - Preventive and remedial measures Cracks in buildings - Causes - Preventive and remedial measures Defects in foundation - Causes - Preventive and remedial measures. Defects in masonry - Causes - Preventive and remedial measures Defects in wooden roof - Causes - Preventive and remedial measures Defects in concrete (RCC and PCC) - Causes - Preventive and remedial measures Corrosion of reinforcement and steel structures - Causes - Preventive measures. Defects in plastering - Causes - Preventive and remedial measures Defects in flooring - Causes - Preventive and remedial measures Defects in doors and windows - Causes - Preventive and remedial measures Defects in Painting - Causes - Preventive and remedial measures Defects due to fire - Causes - Preventive and remedial measures

CO3	**Summarize the common defects in building services, its causes preventive and remedial measures**		
M3.01	Outline defects in stair, causes, preventive and remedial measures.	3	Understanding
M3.02	Outline defects in water supply system , causes, preventive and remedial measures	3	Understanding
M3.03	Outline defects in sewage and sullage system , causes, preventive and remedial measures	3	Understanding
M3.04	Outline defects in drainage system, causes, preventive and remedial measures	3	Understanding
M3.05	Outline defects in electrical system, causes, preventive and remedial measures	3	Understanding

Contents:

Defects in building services

Stair case, water supply system, sewage and sullage system, in drainage system and electrical system - Causes - Preventive and remedial measures. Defects in Stair case - Causes - Preventive and remedial measures. Defects in water supply system - Causes - Preventive and remedial measures. Defects in sewage and sullage system - Causes - Preventive and remedial measures. Defects in drainage system - Causes - Preventive and remedial measures. Defects in electrical system - Causes - Preventive and remedial measures. Building Services. Introduction to other building services (Topics under this section needs only brief description to understand their basic functions and requirements. Explanations with sketches are sufficient) Lift - Location - RTT - Number of lifts - lift well and shaft - Machine room. Air conditioning system: Types of A/C - Capacity determination - Requirements for an A/C room. Electrical installations: Panel board & Buss bar, rising mains - distribution boards - MCB - ELCB - DP - TP and change over switch switches - Telephone and TV connectivity - Requirements of domestic gas pipeline.

CO4	**Outline retrofitting, restoration and conservation of building and heritages**		
M1.04	Outline the various methods of retrofitting	3	Understanding
M2.04	Outline the challenges in retrofitting	3	Understanding
M3.04	Outline the causes of deterioration of monuments and historical buildings and its preventive and restoration works	3	Understanding
M2.04	Outline conservation of world heritages	3	Understanding
	Series Test - II	1	

Contents:

Retrofitting and restoration of building

Need for retrofitting and restoration - Common retrofitting works carried out - Shoring and underpinning - Different methods of retrofitting and restoration - Challenges in retrofitting and restoration works. Deterioration of monumental and historical buildings - Common causes - Preventive measures - Restoration works - Conservation of world heritages.

Text / Reference:

T/R	**Book Title/Author**
T1	B.S Nayak, A book on Maintenance Engineering, Khanna Publisher.
T2	Shetty M.S, Concrete technology, S Chand
R1	P.K.Guha, Maintenance and repair of buildings, New Central Book Agency

R2	Jacob Feld, Construction failures , Wiley
R3	S. Champion, Failures and repair of concrete structures, John Wiley & Sons

Online Resources:

Sl.No	Website Link
1	https://www.nptel.ac.in