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DESIGN OF RCC AND STEEL STRUCTURES **Course Code : 316308**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Sixth**
Course Title	**: DESIGN OF RCC AND STEEL STRUCTURES**
Course Code	**: 316308**

I. RATIONALE

Design of RCC & Steel Structure is an important course in civil engineering discipline having significant contribution in making the structure more durable and safe. However, Design of structural members with maximum efficiency & minimum cost is always a challenge to the Engineers. Therefore, Structural design analysis is required to ensure that the structure complies with the relevant design codes and safety requirements. It is also worthy to mention here that main purpose of structural steel design is to check the viability of steel for any kind of project. An in-depth analysis will enable the decision makers to take the appropriate decisions regarding the load and the wind speed that can be sustained by a structure and its overall capability in other environmental conditions. A civil engineer is expected to have the basic understanding of these design and analysis principles and methods to ensure the safety of structures. With this intention, this course is designed to develop basic competency among the diploma students.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified, Industry / Employer Expected Outcome through various teaching and learning experiences:
Design the given RCC/ steel structural component using the relevant method.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Explain the given criteria in relation to RCC and steel structures.
- CO2 - Design the reinforced concrete beams for given condition as per IS codes
- CO3 - Design the given type of slab for the given edge condition.
- CO4 - Design of axially loaded short columns and footings.
- CO5 - Design the connections for the given steel joints.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316308	DESIGN OF RCC AND STEEL STRUCTURES	DRS	DSC	4	2	4	2	12	6	4	30	70	100	40	25	10	25#	10	25	10	175

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Total IKS Hrs for Sem. : 1 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Select the material of required specification as laid in relevant IS for construction of RCC. TLO 1.2 Explain the given terms used in RCC design. TLO 1.3 Identify different types of loads, as per IS:875-1987. TLO 1.4 Identify the components of the given steel structure. TLO 1.5 Use the steel table to check the dimensions of identified sections.	**Unit - I Fundamentals of RCC and Steel Structures** 1.1 RCC; Definition, functions of reinforcement, materials required with their properties, use of IS:456-2000 1.2 Definition and types of limit states, partial safety factors for material strength, characteristic strength 1.3 Types of loads, use of IS:875-1987, characteristic load, design load 1.4 Steel structures: Steel as a structural material - Advantages, disadvantages. Functions and components of towers, roof trusses, water tanks, bridges, gantry and crane girders, columns, chimney, frames etc. 1.5 Types of sections used, Grades of steel and strength characteristics use of steel table IS 808-1989. (IKS*: Iron Beam used in the construction of Jagannath temple of Puri & Sun Temple of Konark in Orissa.)	Lecture Using Chalk-Board Video Demonstrations Presentations Hands-on Flipped Classroom

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Discuss the various code provisions for limit state of flexure. TLO 2.2 Draw the stress-strain diagram for singly reinforced sections TLO 2.3 Differentiate between under-reinforced, over-reinforced, and balanced sections in RCC design. TLO 2.4 Design of singly reinforced rectangular beam using limit state method TLO 2.5 Draw the stress-strain diagram for doubly reinforced sections. TLO 2.6 Calculate the shear reinforcement for the given structural section. TLO 2.7 Determine the development length in tension and compression as per IS code provision.	**Unit - II Analysis and Design of Beam** 2.1 Limit State of collapse (flexure) : assumptions, IS specifications regarding spacing, cover, minimum reinforcement, effective span in beams 2.2 Stress-strain diagram for singly reinforced section, design parameters and constants, ultimate moment of resistance 2.3 Under- reinforced, over-reinforced and balanced sections 2.4 Analysis and design of singly reinforced section,: determination of design constants, ultimate moment of resistance, ultimate load carrying capacity, design of rectangular sections. 2.5 Introduction of Doubly reinforced section, conditions for providing doubly reinforced beams. Stress-strain diagram for Doubly reinforced section (No Numerical will be asked on doubly reinforced section) 2.6 Shear: Meaning of shear in beams and slabs. IS code specifications. Various forms of shear reinforcement .Use of bent up bars. Zones of minimum shear reinforcement. Numerical problems on design of shear reinforcement in beam. 2.7 Bond: Meaning of bond as per IS code provisions. Meaning and calculation of development length in tension and compression.	Lecture Using Chalk-Board Video Demonstrations Presentations Demonstration Hands-on
3	TLO 3.1 Suggest the relevant type of slab for the given support condition. TLO 3.2 Check the serviceability of slabs for deflection criteria. TLO 3.3 Design one-way and cantilever slabs, including development length check. TLO 3.4 Design two-way slabs with four edges discontinuous, including torsion reinforcement at corners and deflection check as per IS 456:2000	**Unit - III Design of Slabs** 3.1 Slabs, support conditions, I.S. specifications regarding main steel, distribution steel, spacing and cover for reinforcement, effective span, minimum reinforcement 3.2 Limit state of serviceability of slabs for deflection criteria only 3.3 Design of one-way and cantilever slab including development length check only 3.4 Design of two-way slab with four edges discontinuous and provision of torsion reinforcement at corners (As per IS 456:2000, table no 26 case no 9 only). Check for deflection only.	Lecture Using Chalk-Board Video Demonstrations Presentations Demonstration Hands-on

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Explain the salient features of limit state of collapse in compression. TLO 4.2 Describe IS specifications for reinforcement in columns TLO 4.3 Perform load analysis for axially loaded columns in given situation. TLO 4.4 Design axially loaded short column of square and rectangular cross section. TLO 4.5 Suggest the relevant type of footing for the given situation TLO 4.6 Describe IS specifications for reinforcement in footings TLO 4.7 Design isolated square sloped footings with flexural design checks for given type of shear.	**Unit - IV Design of axially loaded short Columns and footing** 4.1 Limit state of collapse in compression, assumptions, effective length, slenderness ratio, short and long columns, and minimum eccentricity. 4.2 IS specifications for reinforcement in column 4.3 Load analysis for a column : load on an axially loaded column from beams at a different floor levels in a building 4.4 Design of axially loaded short column of square and rectangular section (IKS*:Construction of pillar in meenakshi amman temple and Sri Kalahasti Temple etc.) 4.5 Various RC footings : Isolated and Sloped footings, combined footings, piles 4.6 IS specifications for reinforcement in footing 4.7 Design of isolated square sloped footing: Flexural design with checks for bending moment, one-way shear, two-way shear and bond. (Problems on design of footing restricted to one check only in theory examination)	Lecture Using Chalk-Board Video Demonstrations Presentations Demonstration Hands-on
5	TLO 5.1 Discuss the various steel connection with their modes of failure. TLO 5.2 Describe IS specifications for bolt holes in bolted connections. TLO 5.3 Determine the strength of bolts in shear, and tension. TLO 5.4 Design the bolted joints for axially loaded condition TLO 5.5 Design welded connections for the given conditions. TLO 5.6 Design the fillet welded joints for the given situation TLO 5.7 Explain the significance of the terms tension and compression in steel members.	**Unit - V Design of Steel Structures Connections** 5.1 Steel Connection types, uses of bolts and joints: Black bolts and High strength bolts, modes of failure, 5.2 Specifications of bolt holes for bolted connections. 5.3 Strength of bolt in shear, tension, bearing and efficiency of joint. 5.4 Analysis and design of bolted joints for axially loaded plate, single and double angle members 5.5 Welded connections: Butt and Fillet welds, size of weld, throat thickness 5.6 Analysis and design of fillet welded joint for plate, single and double angle members subjected to axial load 5.7 Definition of Tension members and Compression members (No numerical will be asked in theory examination.)	Lecture Using Chalk-Board Video Demonstrations Presentations Demonstration Hands-on Flipped Classroom

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify the relevant IS clauses related to partial safety factors from IS 456:2000.	1	Write IS clauses related to partial safety factors for loads and materials from IS 456:2000.	2	CO1
LLO 2.1 Identify the relevant IS clauses related to shear reinforcement in beams and slabs from IS 456:2000.	2	Write five IS clauses related to shear reinforcement in beams and slabs from IS 456:2000.	2	CO2
LLO 3.1 Identify the relevant IS clauses for slabs and columns from IS 456:2000.	3	Write five IS clauses related to each for slab and column from IS 456:2000.	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Write the stepwise procedure for design of Doubly reinforced beam section.	4	*Write the stepwise procedure for design of Doubly reinforced beam section.	2	CO2
LLO 5.1 Reading of working drawing of a structural element.	5	*Interpret the given working drawing and write reinforcement details along with sizes provided for minimum two structural members.	2	CO1 CO2 CO3 CO4
LLO 6.1 Use the given data to Design the given cantilever slab and draw reinforcement details.	6	*Design a cantilever slab for the given data and draw reinforcement details.	2	CO3
LLO 7.1 Use the given data to Design the given one way simply supported slab and draw reinforcement details.	7	*Design a one-way simply supported slab for the given data and draw reinforcement details.	2	CO3
LLO 8.1 Use the given data to Design the given two way simply supported slab and draw reinforcement details.	8	*Design a two-way simply supported slab for the given data and draw reinforcement details.	2	CO3
LLO 9.1 Use the given data to Design the beam and draw reinforcement details.	9	*Design the beam for the given data and draw reinforcement details.	2	CO2
LLO 10.1 Use the given data to Design one axially loaded Square column and draw reinforcement details.	10	*Design an axially loaded Square column for the given data and draw reinforcement details.	2	CO4
LLO 11.1 Use the given data to Design one axially loaded Rectangular column and draw reinforcement details.	11	*Design an axially loaded Rectangular column for the given data and draw reinforcement details.	2	CO4
LLO 12.1 Use the given data to Design footing for axially loaded Square column designed in Sr. no.10 and draw reinforcement details.	12	*Design the footing for the axially loaded Square column designed in Sr. no. 10 and draw reinforcement details.	2	CO4
LLO 13.1 Use the given data to Design footing for axially loaded rectangular column designed in Sr. no.11 and draw reinforcement details.	13	Design the footing for the axially loaded rectangular column designed in Sr. no. 11 and draw reinforcement details.	2	CO4
LLO 14.1 Draw the reinforcement details for the given type of slab under specific loading conditions.	14	*Draw the reinforcement details for cantilever slab, one way simply supported slab and two way simply supported slab designed in Sr. no. 06 to 08 using Auto-CAD software.(A2 Size Sheet)	4	CO3
LLO 15.1 Draw the reinforcement details for the given type of beam, column and footing under specific loading conditions.	15	*Draw the reinforcement details for the beam, column and footing designed in Sr. no. 09 to 13 using Auto-CAD software.(A2 Size Sheet)	4	CO2 CO4
LLO 16.1 Inspecting the reinforcement of RCC slab and beam to write a detailed report on it with neat sketches	16	*Prepare a report of site visit to a RCC work under construction for slab and beam reinforcement with neat sketches.	4	CO2 CO3
LLO 17.1 Inspecting the reinforcement of RCC column and footing to write a detailed report on it with neat sketches.	17	Prepare a report of site visit to a RCC work under construction for column and footing reinforcement with neat sketches.	4	CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 18.1 Identify the relevant IS clauses related to loads from IS 875:1987.	18	Write five IS clauses related to load from IS 875:1987.	2	CO1 CO2 CO3 CO4
LLO 19.1 Identify the relevant IS clauses related to joints in steel structures from IS 800:2007.	19	Write five IS clauses related to joints in steel structure from IS 800:2007.	2	CO5
LLO 20.1 Use the given data to Design a bolted connection.	20	*Design a bolted connection for the given data.	2	CO5
LLO 21.1 Use the given data to Design of a welded connection.	21	*Design a welded connection for the given data.	2	CO5
LLO 22.1 Identify the relevant IS clauses related to tension member and compression member steel structures from IS 800:2007.	22	Write three IS clauses related to tension member and compression member in steel structure from IS 800:2007.	2	CO5
LLO 23.1 Write the stepwise procedure for Design of tension member.	23	*Write the stepwise procedure for Design of tension member.	2	CO5
LLO 24.1 Write the stepwise procedure for Design of compression member.	24	*Write the stepwise procedure for Design of compression member.	2	CO5
LLO 25.1 Inspecting the joints in Steel structures and write a detailed report on it.	25	*Prepare a report on a site visit for joints in steel structures.	4	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Student should maintain a separate A3 size Sketch book to solve the assignment given by course teacher. Course teacher can assign following type of assignments to students. Assignments should be solved by individual students compulsorily and corrective actions should be given by course teacher.

1. Draw five standard rolled steel sections showing all details.
2. Draw five commonly used built up sections showing all details.
3. Draw cross section, strain –stress diagram for singly reinforced section.
4. Draw stress block diagram for Under- reinforced, over-reinforced and balanced sections showing all details.
5. Draw cross section, strain diagram and stress diagram for doubly reinforced section.
6. Draw diagrams showing transfer of loads from one way simply supported slab and two way simply supported slab to the supporting beam as per I. S. 456:2000.
7. Draw reinforcement detailing of dog legged stair.
8. Draw the table showing details of deflected shape along with effective length of column as per IS 456:2000.
9. Draw modes of failure for bolted connections.
10. Draw types of welds and types of welded joints.

Micro project

- Student should prepare 08-10 pages microproject on any topic in a group of 4 students only. Course teacher can allot following topics to microproject group. Microproject report should be prepared with new information other than

classroom teaching. The necessary guidance for the microproject work should be provided by course teacher.
1. Enlist various software used for the design of RCC structures and give details of any one software.
2. Enlist various software used for the design of steel structures and give details of any one software.
3. Collect the details of various types of the formwork used for RCC structures at site.
4. Collect the details of safety norms followed during RCC construction at site and write a report.
5. Collect the details of safety norms followed during Steel construction at site and write a report.
6. Collect the information of various types of connections used in actual practice.
7. Visit the site and study the labor management for any one activity related to RCC component and write a report.
8. Visit the site and study the material management for any one activity related to RCC component and write a report.
9. Visit the site and check the level for slab, plumb of column and depth of column as per blue print and write detailed procedure of any one.
10. Identify the various human errors occurred while placing reinforcement and suggest remedial measures.
11. Enlist all the instruments used on site along with photograph and parallel terminology used by local mason/labour/worker.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer system with Internet Connection	14,15
2	Auto-CAD Software	14,15

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of RCC and Steel Structures	CO1	6	4	4	0	8
2	II	Analysis and Design of Beam	CO2	18	4	8	10	22
3	III	Design of Slabs	CO3	12	2	0	12	14
4	IV	Design of axially loaded short Columns and footing	CO4	12	0	4	10	14
5	V	Design of Steel Structures Connections	CO5	12	4	4	4	12
Grand Total				**60**	**14**	**20**	**36**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term work (Lab Manual), Self-Learning (Assignment) Question and Answers in class room, quiz and group discussion. Note: Each practical will be assessed considering 60% weightage to process related and 40 % weightage to product related.

Summative Assessment (Assessment of Learning)

- Practical Examination, Oral Examination, Pen and Paper Test.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	2	1	1	-	2			
CO2	3	3	3	2	1	1	2			
CO3	3	3	3	2	1	1	2			
CO4	3	3	3	2	1	1	2			
CO5	3	3	3	2	1	1	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Dayarathnam, P.	Design of Steel Structures	S. Chand and Company, Delhi. ISBN-13: 978-8121923200
2	S K. Duggal	Design Of Steel Structures (Edition3)	McGraw Hill Education (India) Private Limited 978-93-5532-503-7
3	Shah,V. L. Karve, S. R.	Limit State Theory and Design of Reinforced Concrete Structures	Structures Publications, Pune. ISBN-13: 9788190371711
4	Sinha, N.C. Roy, S.K.	Fundamentals of Reinforced Concrete	S. Chand & Co., New Delhi. ISBN-13: 978-8121901277
5	Varghese, P. C.	Limit State Design of Reinforced Concrete	PHI Learning Private Limited, Delhi.ISBN-13: 978-8120320390
6	BIS New Delhi	IS:800-2007 Indian Standard code of practice for use of structural steel in general building construction	BIS New Delhi
7	BIS New Delhi	IS:875-1987 Part-1 to 5: Indian Standard Code for Loading Standards	BIS New Delhi
8	BIS New Delhi	IS hand book No. 1 Properties of structural steel rolled section.	BIS New Delhi
9	BIS New Delhi	IS 456:2000 - Plain and Reinforced concrete code of Practice	BIS New Delhi
10	BIS New Delhi	SP16- Design Aids for reinforced concrete to IS 456	BIS New Delhi
11	BIS New Delhi	SP 24 - Explanatory Handbook on IS 456	BIS New Delhi
12	BIS New Delhi	SP34: 1987 - Handbook on concrete reinforcement and Detailing	BIS New Delhi

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=0fTvE8aSsiE	Design of Doubly Reinforced Beam Flexure - I

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Sr.No	Link / Portal	Description
2	https://www.youtube.com/watch?v=DjT5G6Klf1M	Limit State of Collapse Flexure - II
3	https://www.youtube.com/watch?v=pIdaC_I6H_M	Introduction – I (RCC)
4	https://www.youtube.com/watch?v=zVKf6hZfrhA	Limit State of Collapse Flexure
5	https://www.youtube.com/watch?v=iT2pjfYbyZg	Limit State of Collapse Shear
6	https://www.youtube.com/watch?v=PDJPcQq3PZE	Design of Slabs Part - 1
7	https://www.youtube.com/watch?v=wJWt0dcgafs	Design of Columns Part - I
8	https://www.youtube.com/watch?v=8ATp13mOhvg	Design of Footings Part - I
9	https://youtu.be/ruuKvu5QtkI	Steel as a structural material
10	https://youtu.be/KwDrEN5EPeY	Introduction to Connections
11	https://youtu.be/u9j04q6h4ww	Introduction to Bolt Connections
12	https://youtu.be/U1fOSARv6u4	Weld connection
13	https://youtu.be/bIITXe3MJzs	Design of Fillet Welds
14	https://youtu.be/EX2d8dri9EE	Tension Members and Net Area
15	https://youtu.be/pb-OyON6j_0	Design Strength of Tension Member
16	https://youtu.be/-0MogwoWgf4	Strength Calculation of Tension Members
17	https://youtu.be/79xaH_uTeMo	Strength of Tension Members with Weld Connection
18	https://youtu.be/r5ocul8iEKk	Compression Members
19	https://youtu.be/em-_8Ga0mzw	Compressive Strength
20	https://youtu.be/L0KnOJr7BIU	Design of Compression Members

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 04/09/2025 **Semester - 6, K Scheme**