GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code: ME02000251

Course / Subject Name: Analysis and Design of Bridges

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	Analysis and Design of Bridges
Rationale:	Bridge is an important infrastructure facility required for the passage of railways, road ways, footpaths and even for carriage of fluids. Further, the constant increase in traffic loads associated with the economic growth in modern societies imparts large demands to build such structures. Therefore, the study of analysis and design of bridges is essential for the structural engineering students.

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes
01	Develop design basis report
02	Prepare General Arrangement Drawings for different span of bridges
03	Use of computational software for analysis & design of bridges and verify with manual calculations or excel spreadsheets.
04	Analyze and design minor and major bridges as per IRC specifications.
05	Have basic understanding of design of special bridges and recent practices in bridge design.

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Essentials of Bridge Engineering**	4	5
	Components of bridges and Classification of Bridges, Investigations and planning, Choice of type of bridges, Geometric Design Considerations, Hydrology and Hydraulic Design, General Design Requirement, Construction & Constructability Considerations.		
2.	**Loads, Load Combinations and Load Distribution**	7	15
	Loadings: IRC, IRS and other international specifications on live loads for road, rail bridges, Various forces acting on bridges.		
	Load Distribution Theories: Courbon's Method, Hendry Jaeger Method, Grillage analogy, Pigeaud's curves.		
3.	**Design of Bridge Superstructure**	14	35
	General design considerations, Analysis and design of reinforced concrete culverts, T or I girder, and solid slab bridges, Design of diaphragms or cross girders, crash barrier, etc. Design overview of prestressed concrete I beam bridges, Box girder bridges, Composite Bridges.		
4.	**Bridge Bearings, Substructure and Foundation Design**	14	35
	Substructure: General design considerations, Load calculations, Design of Piers and Abutments, Pier cap, pedestals and seismic arrestors. Capacity based design of bridge substructure as per IRC: SP: 114-2018.		
	Foundation: General design considerations, Load calculations, Design of Open Foundation, Pile Foundation, Well Foundation. Overview of		

	Strut-Tie Method for bridge components.		
	Bridge Bearings: Different types of bridge bearings and their functional requirements, Design of Elastomeric Bearings.		
4.	**Advance Topics in Bridge Engineering**	**06**	**10**
	New era methodology/technology for design and construction of bridges – Accelerated Bridge Construction. Overview of Seismic Analysis of Bridges using Response Spectrum and Time History Analysis, Seismic resistant design provisions. Overview of Integral Bridges, Segmental Bridges, Balanced Cantilever Bridges, Cable Supported Bridges, Arch Bridge and load test on bridges.		
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
05	**15**	**15**	**25**	**20**	**20**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Hendy C. R. and Smith D. A., "Designers' Guide to EN 1992-2 Eurocode 2: Design of concrete structures. Part 2: Concrete Bridges", Emerald Publishing Ltd
2. Prab Bhatt, "Prestressed Concrete Design to Eurocodes", Taylor & Francis Ltd.
3. Prab Bhatt, "Reinforced Concrete Design to Eurocodes: Design Theory and Examples", CRC Press.
4. Johnson Victor, "Essentials of Bridge Engineering", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 6th Ed. 2019.

5. Jagadeesh T. R. and Jayaram M. A., “Design of Bridge Structures”, PHI Learning, 3rd Ed.
6. Krishnaraju, N., "Design of Bridges" Oxford and IBH Publishing Co., Bombay, Calcutta, New Delhi, 1988
7. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 1989
8. Taylor, F.W., Thomson, S.E., and Smulski E., "Reinforced Concrete Bridges", John Wiley and Sons, New York
9. Raina V.K. "Concrete Bridge Practice”, Tata McGraw Hill Publishing Company, New Delhi, 1991.
10. M.J. Ryall, G.A.R Parke, J.E. Harding, "The Manual of Bridge Engineering", Thomas Telford Publishers.
11. R. Rajagopalan, "Bridge Superstructure", Tata McGraw- Hills Publishing Company Limited
12. Chen Wai-Fah, Duan Lian, Bridge Engineering Handbook - Fundamentals, CRC Press.
13. Chen Wai-Fah, Duan Lian, Bridge Engineering Handbook - Superstructure Design,CRC Press.
14. Chen Wai-Fah, Duan Lian, Bridge Engineering Handbook - Construction & Maintenance, CRC Press.
15. Chen Wai-Fah, Duan Lian, Bridge Engineering Handbook - Seismic Design, CRC Press.
16. Chung C. Fu, Wang Shuqing, Computational Analysis & Design of Bridge Structures, CRC Press.
17. IRC: 5, IRC: 6, IRC: 78, IRC: 83, IRC: 112, IRC SP: 105, IRC SP: 114

(b) Open source software and website:

https://ndl.iitkgp.ac.in/
https://nptel.ac.in/

Suggested Course Practical List:

Practical work shall consist of solution of at least five problems from each topic out of which at least half of problems shall be checked by use of professional / open-source software. A design project shall be given to bridge the theory and practice. The report shall consist of full analytical treatment, design procedure, references and all necessary drawings in the form of neat dimensioned sketches.

List of Laboratory/Learning Resources Required:

Professional Software: STAAD-Pro, Midas Civil, CSI Bridge, Sofistik.

Suggested Project List: --- Analysis and Design of a simply supported RCC / PSC bridge using available computer packages and verify with manual calculations.

Suggested Activities for Students: --- Detailing of bridge components using CAD tools.

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