Program Name : **Civil Engineering Program Group**

Program Code : **CE/CR/CS**

Semester : **Fourth**

Course Title : **Railway and Bridge Engineering**

Course Code : **22403**

1. RATIONALE

Railway and Bridge Engineering is an important aspect in Civil Engineering; as the progress and integration of any country can be well judged by good network of railways and bridges. This course is expected to develop the competency to execute the construction and maintain the permanent way i.e. railways, associated bridges and tunnels. Bridge plays a vital role in better connectivity for our country during perennial seasons. Bridge engineering involves components of construction and maintenance of different types of bridges across the country. The tunnel engineering work is also quite crucial as it shortens the distances of travel. The civil engineering diploma holders (also called technologists) have to do the related construction and maintenance activities effectively, as safety is also the prime objective.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Execute the construction and maintenance of railways,, bridges and tunnels**

3. COURSE OUTCOMES (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

a. Identify the components of railway tracks.
b. Maintain the railway tracks.
c. Diagnose the condition of bridges.
d. Maintain different types of railway bridges and their components.
e. Maintain different types of tunnels.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	-	-	4	3	70	28	30*	00	100	40	--	--	--	--	--	--

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit,*
***ESE** - End Semester Examination; **PA** - Progressive Assessment*

5. COURSE MAP (with sample COs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

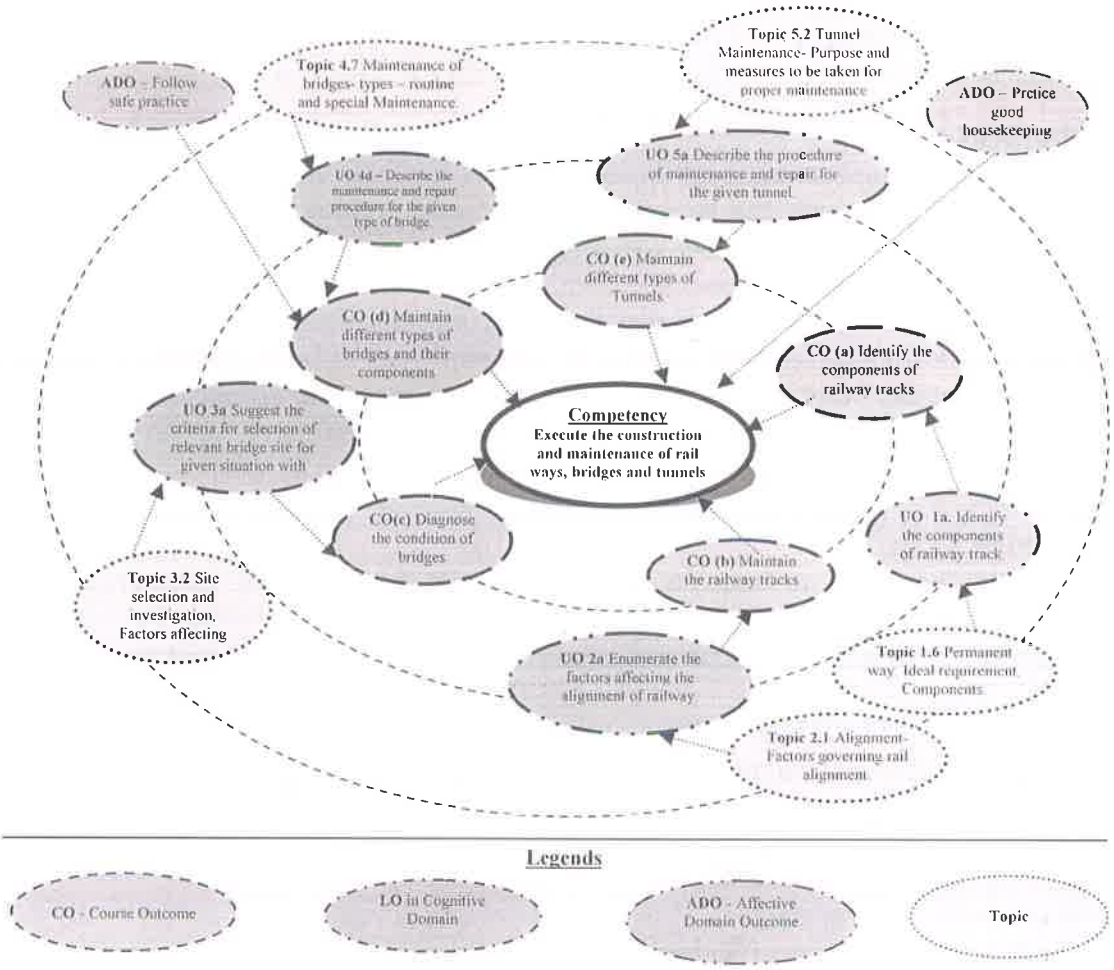

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

- Not applicable –

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

-Not applicable-

8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit—I Basics of Railway Engineering	1a. Describe with sketches the given components of railway track in the diagram. 1b. Suggest the remedy for	1.1 Role of transportation in the development of nation; Modes of transportation system – land way, waterway, airway. Merits and demerits of roadway and railway; Classification of Indian Railways, zones of Indian Railway

	the specified fault railway track with justification. 1c. Suggest the type of rail track joint for the given situation with justification. 1d. Suggest the type of fixtures and fastening for the given rail section with justification.	1.2 Permanent way: Ideal requirement, Components; Rail Gauge, types, factors affecting selection of a gauge. 1.3 Rail material, Rail Joints - requirements, types. 1.4 Creep of rail: causes and prevention of creep. 1.5 Sleepers - functions and Requirement, types - concrete sleepers and their density 1.6 Ballast - function and types, suitability. 1.7 Rail fixtures and fastenings – fish plate, spikes, bolts, keys, bearing plates, chairs-types of anchors and anti creepers.
Unit—II Track geometrics, Construction and Maintenance	2a. Explain the factors affecting the alignment of railway for the given terrain. 2b. Explain with sketches the turn outs, points and crossings with for the given situation. 2c. Describe with sketches the track geometrics elements for the given terrain. 2d. Describe the process of rail track maintenance for the given season. 2e. Describe the functions of the given tools and equipment required for maintaining the track in the specified terrain.	2.1 Alignment- Factors governing rail alignment. 2.2 Track Cross sections – standard cross section of single and double line in cutting and embankment. Important terms-permanent land, formation width, side drains, 2.3 Railway Track Geometrics : Gradient, curves-types and factors affecting, grade compensation, super elevation, limits of Super elevation on curves, cant deficiency negative cant, grade compensation on curves, Coning of wheel, tilting of rail. 2.4 Branching of Tracks-Points and crossings-Turn out-left and right hand turnout, components and their functions, important technical terms, components, types and inspection, track junctions: crossovers, scissor cross over, diamond crossing, track triangle. 2.5 Station and Yards-Purpose, requirement of railway station, important technical terms, types of railway station, factors affecting site selection for railway station. 2.6 Station yard-Classification-Passenger, goods, locomotive and marshalling yards-function & drawbacks of marshalling yards. 2.7 Steps involved in construction of rail track 2.8 Track Maintenance- Necessity, Classification, Tools required for track maintenance with their function, Organisation of track maintenance, duties of permanent way inspector, gang mate and key man.
Unit—III Overview of Bridge Engineering	3a. Propose the relevant type of bridge for the given situation on the basis of relevant criteria with justification. 3b. Identify the components	3.1 Classification of bridges according to span, purpose, material, life, alignment, H.F.L., Loading, level of bridge floor. 3.2 Site selection and investigation, Factors affecting selection of site for bridge. Bridge alignment-Factors controlling.

	of a given type of bridge with their functions. 3c. Explain with sketches the bridge section for the given site conditions. 3d. Propose the relevant type of foundation for the given type of bridge for the given situation with justification.	3.3 Important technical terms- waterway, economic span, afflux, scouring, freeboard, cut water, ease water. 3.4 Component parts of bridge: pier, abutment, wing wall, foundation, bearing 3.5 Piers-function, requirements, types. 3.6 Abutment – function, types. 3.7 Wing walls – functions and types. 3.8 Foundation – function, types of bridge foundations 3.9 Bearing – functions, types of bearing
Unit—IV Construction and Maintenance of bridge	4a. Compare the structure of the permanent and temporary bridge with reference to the given criteria. 4b. Suggest the type of bridge for the given site condition with justification. 4c. Describe the construction procedure for given type of bridge. 4d. Describe the maintenance and repair procedure for the given type of bridge.	4.1 Temporary Bridge- Necessity, Causeway-Flush, low level and high level causeway 4.2 Permanent Bridges- Types of RCC Bridges-Slab, Girder, RCC girder, 4.3 Pre-stressed bridge-Advantage & dis-advantages 4.4 Culvert-Types-Arch, Open or slab, Pipe and box 4.5 Choice of type of bridge, Types of bridge foundations 4.6 Steps involved in bridges construction 4.7 Inspection of bridges-General points to be observed, Pre and post monsoon inspection 4.8 Maintenance of bridges- types – routine and special Maintenance.
Unit—V Construction and Maintenance of tunnels	5a. Describe the criteria for selection of the tunnel for given situation with justification. 5b. Choose the relevant method of constructing the tunnel in the given situation with justification. 5c. Explain the process of lining of the tunnel in the given situation justification. 5d. Describe the type of ventilation provided for the given type of tunnel. 5e. Describe the procedure of maintenance and repair for the given type of tunnel.	5.1 Tunnel - Classification of tunnels according to purpose, conveyance, material, position or alignment, shape and size of tunnels. 5.2 Tunnels: Cross sections for highways and railways, Tunnel investigations and surveying, Tunnel Shaft - its purpose and construction. 5.3 Methods of tunnelling in Soft rock-needle beam method, fore-poling method. Line plate method, shield method. 5.4 Methods of tunnelling in Hard rock-Full-face heading method, Heading and bench method, drift method. 5.5 Drilling equipment-drills and drills carrying equipments, Types of explosives used in tunnelling. 5.6 Tunnel lining –Purpose, factors affecting type of lining, and methods 5.7 Tunnel ventilation and drainage- Purpose and methods 5.8 Tunnel Maintenance- Purpose and measures to be taken for proper maintenance

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of Railway Engineering	12	04	04	04	12
II	Track geometrics, Construction and Maintenance	14	04	06	06	16
III	Overview of Bridge Engineering	14	04	08	04	16
IV	Construction and Maintenance of Bridge	10	02	04	04	10
V	Construction and Maintenance of Tunnels	14	04	06	06	16
Total		**64**	**18**	**28**	**24**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a. Collect the statistical data of Indian Railways and prepare chart showing the development of railways.
b. Prepare the scaled bridge model of any one type using ice-cream sticks.
c. Collect the details of new technologies of tunnel excavation and prepare the report.
d. Collect the data from YouTube/videos showing various concepts and technologies related to the subject under consideration.
e. Visit the railway station nearby to understand the cross-section of rail components, arrangement of station yard and layout of railway station and prepare the detailed report with site photographs.
f. Visit to any one type of bridge to summarize its components and its present condition and prepare the detailed report with site photographs.
g. Visit to roadway tunnel or railway tunnel to verify the structural components and ty lining work and prepare the detailed report with site photographs.
h. Library/ Internet survey of hydraulic structures.
i. Prepare power point presentation or animation for understanding different principles of the course under consideration.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. Teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects
f. Use Flash/Animations to explain various theorems, concepts and procedures related to the subjects under consideration.
g. Demonstrate various concepts of components of railway, bridge using corresponding models.
h. Encourage students to refer different websites to have deeper understanding of new concepts of railway, bridge and tunnel construction works.
i. Recommend the students to collect statistical and physiological data of present railway, bridge and tunnel conditions across the country.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a. Draw the cross-section of rail components and layout of a railway station and yard. Prepare the detailed report with site photographs.
b. Inspect the nearby railway track, bridge or tunnel **(any one)** to enumerate the defects (if any) and prepare the report suggesting the remedial measures for ensuring its stability.
c. Prepare a model of a bridge/tunnel to demonstrate the relevant associated concept.
d. Prepare a chart showing Classification of tunnels according to purpose, conveyance, material, position or alignment, shape and size of tunnels under different conditions
e. Collect photographs of different types of bridge and tunnels from actual site and compare their relevance at that particular site.
f. Prepare models of different gauges used in railways.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Road,Railways, Bridge and Tunnel Engg	Birdi, Ahuja	Standard Book House, New Delhi, March 2010, ISBN: 978-8189401337
2	Traffic Engineering and Transport Planning	Kadiyali, L.R.	Khanna Publishers, New Delhi, 2008, ISBN: 978-8174092205
3	Bridge Engineering	Ponnuswamy, S.	McGraw-Hill Education, New Delhi, 2008, ISBN: 9780-070656956
4	Railway Engineering	Chandra, Satish and Agarwal, M.M.	Oxford University Press, New Delhi, 2013, ISBN: 978-0198083535
5	Railway Engineering	Rangwala, S.C.	Charotar Publishing House , Anand 2002, ISBN: 978-9380358772
6	Highway, Railway, Airport and Harbour Engineering	Subramanian, K.P.	Scitech Publications, Hyderabad, 2016, ISBN: 978-8183712712

14. SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=w_4V8kwkdNU
b. http://www.nptel.ac.in/courses/105107123/14
c. http://nptel.ac.in/courses/105107123/9
d. https://www.youtube.com/watch?v=37WMS483T7Y
e. http://onlinepubs.trb.org/onlinepubs/millennium/00014.pdf
f. http://nptel.ac.in/courses/105103093/24
g. https://www.youtube.com/watch?v=qx_EjMlLgqY
h. http://nptel.ac.in/courses/105103093/23