

# GUJARAT TECHNOLOGICAL UNIVERSITY

## BE (CIVIL & INFRASTRUCTURE ENGINEERING)

### RAILWAY AND BRIDGE ENGINEERING

**SUBJECT CODE:** 2154004

B.E. 5<sup>th</sup> Semester

**Type of course:** Core Subject in BE (Civil and Infrastructure Engineering)

**Prerequisite:** Elements of Civil Engineering

**Rationale:** Railway and Bridge Engineering is conceptual understanding of Railway infrastructure and bridge engineering. With the help of this knowledge students may be able:

1. To provide understanding of railway infrastructure and their components.
2. To identify the factors governing design of railway tracks and associated components.
3. To provide basic knowledge of components of bridges and feasibility studies for bridges.
4. To make student aware of IRC design parameters for bridges and Railway Bridge Code.
5. To provide concepts on structural health monitoring of existing bridges.

#### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
PA	ALA	ESE		OEP						
3	2	0	5	70	20	10	30	0	20	150

#### Contents:

Sr. No	Topics	Hrs.	% Weightage
1	<b>Indian Railway:</b> History, recent developments, gauges in Indian and other railways, gauge conversion issues. <b>Engineering Surveys for railway lines:</b> Alignment of railway lines, preliminary investigations for a new railway line, and types of surveys.	3	10
2	<b>Rail tracks and Components:</b> <b>Rails:</b> Functions, types of rails, standard rail sections, materials, properties, forces acting on track, resistance of traction, stress in rails, creep of rail, defects and failure of rails, rail flaw detection. <b>Sleeper:</b> Functions, requirements, materials used for sleepers, types of sleepers, density and spacing of sleepers <b>Ballast:</b> Function, types of ballast, aggregates used of track ballast, specifications of track ballast. <b>Fittings and fastening:</b> Function, requirement of track fittings, rail to rail fastening, fittings for sleepers, testing of fastening, rails joint and welding of rails.	8	20

	<b>Subgrade and formation:</b> Slopes of formation, execution of earthwork in embankments and cuttings, blanket and blanketing material, failure of railway embankment.		
3	<b>Geometric design of railway track:</b> Necessity for geometric design, details of geometric design of track, gradients, grade compensation on curves, Points and crossings, track junction and track layout. <b>Railway Stations and yards:</b> Purpose of a Railway Station, Selection of Site for a Railway Station, Facilities Required at Railway Stations, Requirements of a Passenger Station Yard, Classification of Railway Stations, Station Platforms, Types of Yards, Catch Sidings and Ship Sidings. <b>Signalling and Interlocking:</b> Objectives of Signalling, classification of signals, Signalling system, Interlocking.	11	20
4	<b>Introduction of Bridges:</b> Definition, components of a bridge, importance of bridge, classification of bridges based on structural behavior and materials, <b>Bridge components:</b> superstructure, bridge piers, abutments, wing walls, bridge foundations, bridge joints and bearings. <b>Engineering feasibility studies for bridges:</b> Need for investigations, selection of bridge site, preliminary data to be collected, design discharge and its determination, linear waterway, economical span, vertical clearance above HFL, afflux, scour depth, choice of bridge type.	6	16
5	<b>Standard Specifications:</b> Standard specifications for road bridges, types of loadings, code provisions on width of carriage way, clearances, loads considered etc. Standard specifications for railway bridges, Railway bridge code, Design aspects.	8	18
6	<b>Structural Health Monitoring of Bridges:</b> Introduction to health monitoring of bridges. Monitoring Techniques such as visual Inspection, NDT Test, Static load testing, Dynamic load testing etc. Repair and retrofitting measures.	6	16

**Suggested Specification table with Marks (Theory):**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	35	20	10	10	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above

**Course Learning Outcomes:**

1. Students will develop ability to understand railway infrastructure, components and planning.
2. Students will learn the design criteria of railway tracks and associated components
3. Students will be able to decide on guiding parameters of bridge planning and design

4. Students will be able to judge the health monitoring criteria of bridges.

**List of Tutorials:**

1. Investigation of preliminary surveys for railways
2. Geometric design of railway tracks
3. Determination of sleeper density
4. Field visit for understanding track components
5. Various Methods of Maintenance of railway tracks
6. Feasibility assessment of construction of bridge
7. Study of codal provisions of bridges
8. Repair and retrofitting of railway and bridge components
9. Case study of railway and bridges planning & construction

**Reference Books:**

1. S.C. Saxena and S. P. Arora, A Text Book of Railway Engineering, Dhanpat Rai & Sons, New Delhi
2. S.P. Bindra, Principles and Practice of Bridge Engineering, Dhanpat Rai & Sons, New Delhi
3. Chandra S. & Agrawal M M., “Railway Engineering.” Oxford University Press, New Delhi, 2007.
4. Victor D J., “Essentials of Bridge Engineering” Oxford and IBH Publishers, New Delhi, 2003.
5. Vazirani & Ratwani, “Design of Concrete Bridges, Khanna Publishers, New Delhi, 1986.
6. Ponnuswamy S., “Bridge Engineering” Tata McGraw Hill, New Delhi, 2003.
7. Raina V. K., “Field Manual for Highway and Bridge Engineers”, Shroff Publishers and Distributors Pvt. Ltd, 2009 (3rd Edition)
8. Raina V. K., “Concrete Bridge Practice: Construction, Maintenance and Rehabilitation”
9. Raina V. K., “Concrete Bridges: Inspection, Repair, Strengthening, Testing & Load Capacity Evaluation”
10. Helmut Wenzel, “Health Monitoring of Bridges” Wiley Publications,

**List of Open Source Software/learning website:**

[www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

**Active learning Assignments (AL) :** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The Power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.