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RAILWAY, BRIDGE AND TUNNEL ENGINEERING **Course Code : 314312**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Fourth**
Course Title	**: RAILWAY, BRIDGE AND TUNNEL ENGINEERING**
Course Code	**: 314312**

I. RATIONALE

Railway, Bridge and Tunnel Engineering is an important aspect of Civil Engineering as they are very crucial in shortening the distance of travel. Efficient and Effective network of different modes of transportation plays an important role in the Nation's economic progress and its integration. The basic requirements of efficient transportation are speed, safety and comfort. This course is intended to develop the basic skills related to investigation, surveys, alignment, construction and maintenance of Railway, Bridge, and Tunnels.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Execute the construction and maintenance of railways, bridges and tunnels.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify the relevant components of Railway Tracks.
- CO2 - Maintain the given Railway Track.
- CO3 - Maintain the given type of bridge through due inspection.
- CO4 - Suggest the relevant method of constructing a tunnel in the given strata.
- CO5 - Supervise the construction of tunnels including maintenance activities.

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	
314312	RAILWAY, BRIDGE AND TUNNEL ENGINEERING	RBT	DSC	4	-	-	2	6	3	3	30	70	100	40	-	-	-	-	25	10	125

Total IKS Hrs for Sem. : 3 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 Describe the development of Indian railways till date. TLO 1.2 Show the components of railway track in the given cross section of track. TLO 1.3 Suggest the types of sleepers provided for the specified railway track with justification. TLO 1.4 Propose the relevant type of ballast to be provided in specified railway track with justification. TLO 1.5 Identify the fixtures with fastening provided in the given rail section.	**Unit - I Introduction to Railway Engineering** 1.1 History of development of railways in India (IKS) ,Railway: Zones of Indian railways, Merits and demerits of roadway and railway, Introduction to Metro and Mono rail, Bullet Train. 1.2 Components of railway track: Rails , ideal requirements of railway track , types of Rails ,Rail Gauge- types, factors affecting selection of a gauge. tilting of rails and coning of wheels. Rail Joints : Necessity, types, requirements of welded joints. Creep of rail: Definition, causes and prevention of creep. 1.3 Sleepers : Requirement, functions and types, sleeper density 1.4 Ballast : requirement, function, types, suitability. 1.5 Rail fixtures and fastenings: fish plate, spikes, bolts, keys, bearing plates, chairs , types of anchors and anti-creepers.	Model Demonstration Video Demonstrations Lecture Using Chalk-Board Site/Industry Visit Case Study

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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 Fix the alignment of given railway track laid on typical terrain. TLO 2.2 Draw the cross section of the track showing its geometric elements with neat labels. TLO 2.3 Explain the track geometric components with its importance in its design. TLO 2.4 Explain with sketches the concept of turn outs, points, and crossings w.r.t railway track. TLO 2.5 Propose the relevant type of station with its salient parameters considered in its site selection. TLO 2.6 Justify the necessity of station yard in railway engineering. TLO 2.7 Maintain the track in the capacity of the permanent way inspector.	**Unit - II Track Geometrics** 2.1 Alignment: Factors governing rail alignment. 2.2 Cross sections of Track : Important technical terms- permanent land width/right of way, formation width, side slopes, side drains. Standard cross section of single and double line in cutting and in embankment. 2.3 Railway Track Geometrics: types and factors affecting Gradient , curves , grade compensation , super elevation- limits of Super elevation on curves , cant deficiency (No numerical in question-paper). 2.4 Branching of Tracks: Points and crossings: Turn out- left and right-hand turnout, components, and their functions ,important technical terms ,track junctions- crossovers, scissor cross over, diamond crossing, track triangle. 2.5 Railway Station : Purpose , requirement of railway station , factors affecting site selection for railway station, important technical terms , types of railway station. 2.6 Station yard: Function , Classification- Passenger, goods, locomotive and marshalling yards, drawbacks of marshalling yards. 2.7 Track Maintenance: Necessity , Classification , Tools required for track maintenance with their function , Organization of track maintenance , Duties of permanent way inspector, gang mate and key man.	Model Demonstration Video Demonstrations Case Study Presentations Lecture Using Chalk-Board Site/Industry Visit

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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.
3	TLO 3.1 Elaborate the typical features of major important bridges in India. TLO 3.2 Suggest the relevant type of bridge based on available data. TLO 3.3 Explain Factors affecting Site selection of given type of bridge. TLO 3.4 Explain with sketch Important technical terms related to a bridge. TLO 3.5 Explain with neat sketches the given component of bridge. TLO 3.6 Suggest the relevant type of bridge to be used in the given situation. TLO 3.7 Undertake the inspection of bridge during Pre and post monsoon period. TLO 3.8 Maintain the given type of bridge.	**Unit - III Bridge Engineering** 3.1 History of development of bridges in India (IKS) 3.2 Classification of bridges: according to span, purpose, material, life, alignment, H.F.L, Loading, level of bridge floor. 3.3 Site selection and investigation Factors affecting and controlling: Site For Bridge, Bridge Alignment. 3.4 Important technical terms: Waterway, Economic Span , Afflux ,Scouring , Erosion, Freeboard , Cut Water ,Ease Water,Apron 3.5 Component parts of bridge: Function, requirement, and types- Pier , Abutment , Wing Wall , Foundation ,Bearing 3.6 Types of Bridges: Causeway: Flush, low level, and high-level causeway. RCC Bridges , Pre-stressed bridge: Advantage & dis-advantages, Culvert: Types- Arch, Open or slab, Pipe and box 3.7 Inspection of bridges: General points to be observed, Pre and post monsoon inspection. 3.8 Maintenance of bridges: types - routine and special Maintenance.	Model Demonstration Video Demonstrations Case Study Presentations Lecture Using Chalk-Board Site/Industry Visit
4	TLO 4.1 Summarize the typical features of major important tunnels in India. TLO 4.2 Identify the type of the tunnel from the given sketch. TLO 4.3 Explain the criteria for selection of the tunnel for given situation with justification. TLO 4.4 Describe the process of shifting the alignment inside the tunnel through shaft. TLO 4.5 Suggest the relevant method of constructing the tunnel in the given terrain.	**Unit - IV Tunnel Engineering** 4.1 History of development of tunnels in India (IKS). 4.2 Classification of tunnels: according to purpose, conveyance, strata through which tunnel passing, alignment, shape, and size of tunnels. 4.3 Tunnels: Tunnel investigations and surveying, Cross sections for highways and railways. 4.4 Tunnel Shaft : its purpose and construction. 4.5 Methods of tunnelling in soft rock: Needle Beam method, Fore-Poling method, Line Plate method, Shield method.	Model Demonstration Video Demonstrations Case Study Presentations Lecture Using Chalk-Board Site/Industry Visit

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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.
5	TLO 5.1 Suggest the relevant method of constructing the tunnel in the available ground strata. TLO 5.2 Select the relevant type of drilling machine for the given strata. TLO 5.3 Describe the process of lining in the given tunnel in the given situation with justification. TLO 5.4 Justify the need to provide the provision for ventilation and drainage in the tunnel. TLO 5.5 Describe the procedure of maintenance of the given tunnel.	**Unit - V Construction and Maintenance of Tunnels** 5.1 Methods of Tunnelling in Hard Rock: Full-face method, Heading and bench method, drift method, New Austrian Tunnelling Method (NATM). 5.2 Drilling Equipment: TBM Tunnel Boring Machine, drills and drills carrying equipment's, Types of explosives used in tunnelling. 5.3 Tunnel Lining: Purpose, factors affecting type of lining, and methods. 5.4 Tunnel Ventilation and Drainage: Purpose and methods. 5.5 Tunnel Maintenance: Purpose and Methods.	Model Demonstration Video Demonstrations Case Study Presentations Lecture Using Chalk-Board Site/Industry Visit

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

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

Micro project

- Prepare report on Railway Zones in India .
- Prepare model of a bridge/Tunnel to demonstrate the relevant concepts.
- Prepare models of different gauges used in railways.
- Collect the details of new technologies of tunnel excavation and prepare the report.
- Collect the information relevant to transportation engineering about ongoing and completed Railway/Bridge/Tunnel projects. (Minimum 3)
- Role of Indian Railway (IR), MSRDC, NHAI and IRC in development and construction of Railways, Tunnels and Bridges.
- Prepare a report on Bullet Train, Mono rail, Metro Rail project.
- Summarize the salient features of relevant IS codes used in this course in the form of a report.

Assignment

- Inspect nearby Railway Track /Bridge/Tunnel (any one) to enumerate the defects if any and prepare the report suggesting remedial measures for ensuring its stability.
- Draw the standard cross section of single line and double line railway on embankment and in cutting.
- List the advanced equipment's/machineries and materials required for preparation of subgrade of railway.
- Compile the relevant information on project Atal tunnel/Patalpani Rail tunnel with your own comments.
- Compile the relevant information on project Bandra Worli sea link bridge/Pamban Bridge with your own comments.
- Visit a nearby Bridge site/Tunnel and prepare a detailed photographic report.
- Compile the relevant information on project Mumbai to Ahmadabad Bullet Train with your own comments.

- Prepare a site visit report to the nearby railway station mentioning the details of the type of station, requirements fulfilling the station and any other important findings with required figures and facts.

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 with internet facility	All

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	Introduction to Railway Engineering	CO1	10	4	4	4	12
2	II	Track Geometrics	CO2	18	4	12	6	22
3	III	Bridge Engineering	CO3	14	2	6	6	14
4	IV	Tunnel Engineering	CO4	10	4	4	4	12
5	V	Construction and Maintenance of Tunnels	CO5	8	0	4	6	10
Grand Total				**60**	**14**	**30**	**26**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Under SLA : Assignment, Microproject (60% Weightage to process and 40% weightage to product), Question and Answer

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test)

XI. SUGGESTED COS - POS MATRIX FORM

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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	2	----	----	2	2	----	3			
CO2	3	1	1	2	2	1	3			
CO3	3	2	2	3	2	2	3			
CO4	3	3	3	2	3	2	3			
CO5	3	3	3	3	3	2	3			

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	S. C. Saxena , S. P. Arora	A Text Book of Railway Engineering	Dhanpat Rai Publications (p) Ltd.-New Delhi ISBN-13:978-8189928834
2	Bindra S. P.	Elements of Bridge ,Tunnel & Railway Engineering	Dhanpat Rai Publications (p) Ltd.-New Delhi ISBN: 9789383182220, 9383182229
3	Ahuja & Birdi	Roads, Railways, Bridges and Tunnels Engineering	Standard Book House ISBN: 978-81-89401-33-7
4	Raji A K, K K Babu	Transportation Engineering (Theory and Practice)	AICTE New Delhi ISBN 978-81-960576-1-9
5	N L Arora	Transportation Engineering	New India Publishing House, New Delhi
6	R. Srinivasan	Harbour, Dock and Tunnel Engineering	Charotar Publishing House Pvt. Ltd.ISBN-13 978-9385039195

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://indianrailways.gov.in/	Indian Railway Zones (IKS)
2	https://iricen.gov.in/iricen/BooksList.jsp	IRICEN Books on Railway and Bridge Engineering
3	https://nhsrcl.in/en/home	National High Speed Rail Corporation Limited (Bullet Train)
4	https://msrdc.in/Site/Common/ProjectListDetails.aspx?ID=56&MainId=18	Versova-Bandra Sea Link Project by MSRDC
5	https://marvels.bro.gov.in/AtalTunnel	Atal Tunnel, Rohtang
6	https://archive.nptel.ac.in/courses/105/105/105105216/	Bridge Engineering video lectures by NPTEL
7	https://nptel.ac.in/courses/105107123	Railway Engineering video lectures by NPTEL

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Sr.No	Link / Portal	Description
8	https://mmrda.maharashtra.gov.in/projects/transport/metro-line-1/overview	Mumbai Metropolitan Region Development Authority

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. 21/11/2024 **Semester - 4, K Scheme**