Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NCED510	Railway Geotechnics	3	0	0	3

Course Objective

- The course aims to learn the geotechnical aspects of railway engineering for the design, construction and management of multi-layered railway track substructure.

Learning Outcomes

Upon successful completion of this course, the students should be able to understand:

- Students will be able to learn and demonstrate about the load environment, mechanics, design, construction, measurements and cost-effective management of a multi-layered railway track substructure. From the case studies, students shall also able to learn about the engineering behavior of track substructure, causes of track substructure instability and the cost-benefit trade- offs of potential remedial options.

Unit No.	Topics to be Covered	Contact Hours	Learning Outcome
1	**Track Structure and Loading:** Introduction to the railroad industry, Types of track structure, Component descriptions and functions, Track forces and Load transfer mechanism.	**3L**	Understand the different types of track structure and the load transfer mechanism.
2	**Ballast and Sub-ballast:** Factors governing ballast behaviour: Particle and aggregate characteristics, Effect of particle characteristics on behavior, Ballast degradation and particle breakage. Sub-ballast requirements: Stress reduction, Subgrade attrition prevention, Drainage and filtration, Recycle and reuse of solid waste materials (eg. mine overburden waste) as sub-ballast layer.	**7L**	Understand the behaviour of ballast and subballast layers under loading condition. Also understand the degradation and particle breakage characteristic under train loading.
3	**Subgrade:** Subgrade behavior: Subsurface investigation, Resilient modulus, Subgrade failure. Track bearing capacity: Meyerhof and Hanna Method, Slope stability method.	**6L**	Understand the subgrade failure mechanics and the track bearing capacity.
4	**Mechanics and Design:** Required ballast/Sub-ballast Depth: North America, British Railways, European Multi-layer Elastic methods etc. Design of Tracks: Threshold stress concept, Displacement based design, ORE method etc.	**7L**	Understand the design requirement of ballast and subballast layers and the different track design methods.
5	**Track Modelling:** Constitutive model for ballast: Plastic deformation models, Modelling of particle breakage. Computer models: ILLITRACK,	**6L**	Understand the constitutive model for ballast and different types

Unit No.	Topics to be Covered	Contact Hours	Learning Outcome
	GEOTRACK, KENTRACK, FEM and DEM modeling of track components, Modelling seepage from subgrade.		of track computer models.
6.	**Retrofitting in Tracks: Subgrade improvement alternatives:** Altering properties in Place, Reconstruction and replacement, Asphalt concrete application etc. Heavy axle and high-speed trains: Retrofitting techniques for improving the existing tracks, Railway bridges and tunnels. Geosynthetic application in tracks: Geotextiles/geogrid in the role of sub-ballast, Bituminous spray alternatives.	**6L**	Understand the subgrade improvement techniques, existing track improvement techniques for high-speed trains and geosynthetic application in tracks.
7	**Track Construction, Rehabilitation and Maintenance** **Track drainage:** Importance and drainage methods, Sub-ballast design and permeability. **Track maintenance:** Ballast fouling, Track settlement, Track geometry, Mechanics base maintenance model, Cost analysis.	**4L**	Understand the importance of track drainage methods and the track maintenance.
8	**Case Studies:** Recent developments and case studies in the field of track geotechnology.	**3L**	Exposure for recent developments in track geotechnology.
Total Contact hours		**42L**	

Text Books:

1. Selig, E.T. and Waters, J.M. (1994). Track Geotechnology and Substructure Management,1st Edition, ICE Publishing, UK.

References Books:

1. Indraratna, B., Salim,W. and Rujikiatkamjorn, C. (2018). Advanced Rail Geotechnology- Ballasted Track, 1st Edition, CRC Press.
2. Li, D, Hyslip, J and Sussmann, T. (2015). Railway Geotechnics, CRC Press