1	**Name of Course**	**Professional Diploma in Railway Track Technology**
2	**Max No.of Students**	30
3	**Duration**	1 Year
4	**Course Type**	Full Time
5	**No. of Days per week**	6 days
6	**No. of hours per day**	6 Hrs
7	**Space require**	66 m^2 classroom and 66 m^2 Laboratory
8	**Entry qualification**	Diploma Civil Engineering / FE- Civil Engineering,
9	**Objective of syllabus**	To provide civil engineers with practical skills in modern railway track design, construction, maintenance, and project planning for careers in railway, metro, and infrastructure projects.
10	**Employment opportunities**	Student will get jobs in Government as well as Private railway companies
11	**Teachers Qualification**	ME/ M.Tech/Ph.D

12 **Teaching Scheme :**

Sr. No	Subject	Subject Code	Theory (Hr)	Credit	Practical (Hr)	Credit	Total
1	Railway Track Engineering & Modern Permanent Way	RCEPCC-01	60	4	90	3	7
2	Railway Earthwork, Drainage & Structures	RCEPCC-02	45	3	90	3	6
3	Track Construction, Maintenance & Modern Machines with AI	RCEMDM-03	45	3	90	3	6
4	Track Surveying, Alignment & GIS Applications	RCEPP-04	45	3	90	3	6
5	Railway Project Planning, Contracts & Quality Management	RCESEC-05	45	3	90	3	6
6	Capstone Project (Industry Oriented)	RCECC-06	-	-	390	13	13
		Total	**240**	**16**	**840**	**28**	**44**

13	

Examination Scheme – Final Examination will be based on a syllabus of One year.

Sr. No	Subject	Subject Code	Theory				Practical			Total	
			Duration (Hr	Max	Min	Int	Duration (Hr.)	Max	Min	Min	Max
1	Railway Track Engineering & Modern Permanent Way	RCEPCC-01	4	80	32	20	-	-	-	40	100
2	Railway Earthwork, Drainage & Structures	RCEPCC-02	3	80	32	20	-	-	-	40	100
3	Track Construction, Maintenance & Modern Machines with AI	RCEMDM-03	3	80	32	20	-	-	-	40	100
4	Track Surveying, Alignment & GIS Applications	RCEPP-04	-	-	-		3	100	40	40	100
5	Railway Project Planning, Contracts & Quality Management	RCESEC-05	-	-	-		3	100	40	40	100
6	Capstone Project (Industry Oriented)	RCECC-06	-	-	-		-	100	40	40	100
Total											600

Note: For Paper I,II,III

Internal Examinations of Total Marks: 20

Pattern / Examination nature may be as follows (Any Two of Following): Written test/ Seminar/ PPT Presentation/ Open book examination / Field Work report / Project Report etc.

RCEPCC-01: Railway Track Engineering & Modern Permanent Way

Duration: 60 hrs Theory + 90 hrs Practical

Course Objectives

By the end of this course, students will be able to:

1. To introduce students to the evolution and development of railway track systems in India, including metro and high-speed rail.
2. To familiarize students with various track components, their specifications, and functional requirements.
3. To provide knowledge of modern track structures such as Long Welded Rails (LWR) and Continuous Welded Rails (CWR).
4. To impart understanding of ballast less track systems and their application in metro and high-speed rail projects.
5. To train students in modern track construction methods and mechanization for efficient track laying and renewal.

Course Outcomes

After completing this course, the learner will be able to:

CO01: Explain the evolution of track systems and their relevance in current Indian railway projects.

CO02: Identify & describe different track components and their functions in track performance.

CO03: Understand the design, laying, and maintenance aspects of LWR and CWR track structures.

CO04: Analyze the use of ballast less track systems (Rheda 2000, Pandrol, precast) in metro and high-speed rail projects.

CO05: Apply modern mechanized methods for track construction, renewal, and maintenance.

Module	Module Title & Topics	Hours
Module 1	**Evolution & Indian Railways** –BG (1676 mm, 96.6% network), MG (1000 mm), NG (762/610 mm) history; Uni-Gauge project since 1992 converted most to BG for interoperability. Metro growth includes Delhi (400+ km), Mumbai; RRTS corridors; Mumbai-Ahmedabad HSR (508 km, Japan-funded). Tracks classified as mainline (high-speed capable), freight (heavy load), metro (urban), high-speed (200+ km/h).	**7**
Module 2	**Components & Functions** – Rails: DH/BH (head-hardened), flat-footed, 52/60 kg sections (90 UTS steel). Sleepers: PSC (270 kg, P-clip for 60 kg rails), wooden/steel/CI; spacing 60 cm. Ballast cushions tracks, graded 20-65 mm; fastenings like Pandrol clips, fishplates. Formation/subgrade needs drainage, soil stabilization	**7**

Module 3	**LWR & CWR**- Welding eliminates joints; LWR breathing length ~70-80 m (52/60 kg rails), expansion gaps; CWR stress-free at td0°C, anti-buckling anchors. Alumino-thermic/flash-butt welding; grinding/monitoring essential.	**8**
Module 4	**Ballastless Tracks** – Reduces maintenance; Rheda 2000® (bi-block sleepers, slab) for MAHSR; Pandrol slab systems in metros. Vibration damping via elastics; precast for urban projects	**7**
Module 5	**Construction & Mechanization** – NTC machines lay panels; renewal via relaying trains, ballast cleaners (full/shoulder), tampers. Monitoring: track cars, OMS; IRS/RDSO specs, safety protocols.	**7**
Module 6	**Switches & Turnouts-** Tongue rails, crossings (1:8/12 angles), curved switches; turnout layout (1:12/16.5); worn crossing reconditioning; inspection/maintenance per IRS.	**8**
Module 7	**Track Geometry & Alignment-** Curves (superelevation, transition spirals), gradients, alignment standards; geotechnical soil sampling, drainage for subgrade stability.	**8**
Module 8	**Maintenance & Sustainability**- Importance of maintenance**,** Periodic deep screening, tamping post-BCM; electrification (99% BG); net-zero goals via solar, green ballast.	8

Practical List:- Perform any 10 practical from given list.

1. Study of Indian Railway Gauges and Uni-Gauge Conversion
2. Identification and Study of Rail Sections (52 kg / 60 kg)
3. Demonstration and Study of Rail Welding Processes (AT & Flash-Butt)
4. Study of Long Welded Rails (LWR) and Continuous Welded Rails (CWR)
5. Study of Different Types of Sleepers (PSC / Wooden / Steel / CI)
6. Testing and Gradation Study of Ballast Materials
7. Study of Rail Fastenings, Fishplates and Joints
8. Calculation of Super elevation and Transition Curve Length
9. Investigation of Subgrade and Formation Soil Properties
10. Study of Ballastless Track Systems (Metro / HSR)
11. Study of Mechanized Track Construction and Relaying Systems
12. Study of Track Recording and Monitoring Systems
13. Study of Switches, Crossings and Turnout Layouts
14. Study of Track Maintenance Techniques (BCM, Tamping etc.)
15. Study of Railway Electrification, Sustainability and Green Initiatives

Reference Books & Resources
Textbooks:

1. Satish Chandra & M.M. Agarwal – *Railway Engineering* (Oxford University Press)
2. S.C. Saxena & S.P. Arora – *Railway Engineering* (Dhanpat Rai Publications)

Reference Books & Handbooks:
1. RDSO – *Permanent Way Manual (P-Way)*
2. Indian Railways – *Permanent Way Track Handbook* (Latest Edition)
3. AREMA Manual – *Track Design and Maintenance* (Selected chapters for ballast less tracks)

Monographs / Other Material:
1. IRICEN Monographs on LWR/CWR Track, Ballast less Track Systems
2. NHSRCL Bulletins – Mumbai–Ahmedabad High-Speed Rail track design updates

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RCEPCC-02: Railway Earthwork, Drainage & Structures

Duration: 45 hrs Theory + 90 hrs Practical

Course Objectives

By the end of this course, students will be able to:

1. To provide knowledge of soil classification and its role in designing railway embankments and cuttings.
2. To introduce soil improvement techniques used for stabilizing track formations in challenging ground conditions.
3. To impart an understanding of surface and sub-surface drainage design for safe and durable railway tracks.
4. To study the design and construction of minor structures such as culverts, retaining walls, and ROB/FOB approaches.
5. To analyze common failures in earthwork and drainage systems and understand their remedial measures.
6. To train students in inspection methods and preventive maintenance of earthwork and drainage structures.

Course Outcomes (COs)

After completing this course, the learner will be able to:

CO1: Classify soils and design suitable embankments and cuttings for railway tracks.

CO2: Apply soil stabilization techniques using geotextiles, chemical stabilizers, and stone columns.

CO3: Design surface and sub-surface drainage systems for railway corridors.

CO4: Understand the construction and purpose of minor structures (culverts, retaining walls, ROB/FOB approaches).

CO5: Analyze failure mechanisms (washouts, settlement, slope instability) and propose corrective measures.

CO6: Plan inspections and preventive maintenance for earthwork and drainage assets.

Module	Module Title & Topics	Hours
Module 1	**Railway Earthwork – Soil Classification, Embankment & Cutting Design** Soil classification as per IS & Indian Railway standards. Soil properties: bearing capacity, permeability, plasticity index. Embankment design: height considerations, slope stability, compaction requirements. Cutting design: types of cuttings, safe slope design, and erosion protection. Earthwork cross-sections for different track categories (BG, high-speed, heavy-haul).	**7**

Module 2	**Soil Improvement Techniques** Challenges in weak soil subgrades: swelling clays, peat, loose sands. Soil stabilization: lime, cement, and chemical stabilization methods. Geosynthetics in railways: geotextiles, geogrids, and geocells – applications in embankment reinforcement and drainage. Stone columns: design and execution for ground improvement. Case studies: use of geosynthetics in Indian Railway embankments.	**8**
Module 3	**Drainage Design for Railway Tracks** Importance of drainage in track stability and service life. Surface drainage: side drains, catch drains, and cross-drainage arrangements. Sub-surface drainage: blanket layers, subsoil drains, and longitudinal/perforated pipes. Design considerations for high-speed and heavy-haul corridors. RDSO guidelines for track drainage and failure prevention.	**7**
Module 4	**Minor Structures – Culverts, Retaining Walls, ROB/FOB Approaches** Culverts: types (box, pipe, slab), design considerations, hydraulic capacity. Retaining walls: types, design principles for cuttings and approach embankments. ROB/FOB approaches: geometric design, slope transitions, and safety measures. Inspection and maintenance of minor structures.	**8**
Module 5	**Failures in Earthwork & Drainage – Causes & Remedies** Common failures: embankment settlements, slips, track washouts, and erosion. Causes: poor compaction, inadequate drainage, subgrade failure. Failure analysis through case studies (monsoon-induced failures in Indian Railways). Remedial measures: re-compaction, re-grading, drainage improvements, and soil reinforcement	**7**
Module 6	**Maintenance of Earthwork & Drainage** Routine inspection schedules for embankments and cuttings. Maintenance techniques for side drains and sub-surface drains. Preventive measures: vegetation control, slope protection, and erosion prevention. Use of modern inspection tools: drones, LiDAR, and geotechnical sensors. Preparation of inspection checklists and reporting.	**8**

Practical List:- Perform any 10 practical from given list.

1. Study of Soil Classification as per IS and Indian Railway Standards
2. Determination of Soil Index Properties (LL, PL, PI) for Railway Subgrade
3. Determination of Permeability and Bearing Capacity of Railway Subgrade Soil

4. Preparation and Interpretation of Railway Embankment Cross-Sections
5. Design and Safety Assessment of Railway Cuttings and Slopes
6. Compaction Test and Evaluation of Field Density Requirements
7. Study of Soil Improvement Techniques for Weak Railway Subgrades
8. Demonstration of Lime and Cement Stabilization Methods
9. Application Study of Geosynthetics (Geotextiles, Geogrids, Geocells) in Railway Earthwork
10. Study of Stone Columns for Ground Improvement in Railway Projects
11. Design and Layout of Railway Track Drainage Systems (Surface & Subsurface)
12. Study of Culverts, Retaining Walls, and ROB/FOB Approaches in Railway Earthwork
13. Case Studies on Railway Earthwork and Drainage Failures and Their Remedies
14. Preparation of Inspection and Maintenance Checklists for Railway Earthwork and Drainage
15. Study of Modern Inspection Tools (Drones, LiDAR, Sensors) for Railway Earthwork Monitoring

Reference Books & Resources

Textbooks:

1. Dr. B.C. Punmia – *Soil Mechanics & Foundations* (Laxmi Publications)
2. K.R. Arora – *Soil Mechanics & Foundation Engineering*

Reference Books & Handbooks:

1. RDSO – *Guidelines for Earthwork in Railway Projects*
2. Indian Railways – *Drainage Manual*

Monographs / Other Material:

1. IRC Codes – IRC:SP-13 (Guidelines for Drainage)
2. Geosynthetics in Railways – TERI/NHAI monographs

RCEMDM-03: Track Construction, Maintenance & Modern Machines with AI

Duration: 45 hrs Theory + 90 hrs Practical

Course Objectives

By the end of this course, students will be able to:

1. To familiarize students with digital pre-construction techniques and ballasted track laying using BIM, IoT, and computer vision for precise alignment and material management.
2. To enable understanding of ballastless track systems like Rheda 2000, integrating embedded sensors and wireless protocols for real-time quality assurance.
3. To develop skills in designing and maintaining embankments, bridge approaches, and transition zones using FEM software, ML slope analysis, and SCADA monitoring.
4. To impart knowledge of track geometry parameters and advanced measurement technologies, including inertial sensors, YOLO-based vision, and RDSO tolerances.
5. To explore predictive maintenance strategies employing AI/ML, IoT sensors, and telecom networks for proactive track defect detection and LWR/CWR management.
6. To introduce mechanized construction machines with automation, deep learning flaw detection, and SCADA oversight for enhanced safety and efficiency.

Course Outcomes (COs)

After completing this course, students will be able to:

1. Apply BIM and IoT for pre-construction planning and execute ballasted track laying with computer vision-verified geometry within RDSO tolerances.
2. Design and implement ballastless tracks using Rheda systems, performing sensor-based quality checks on alignment, level, and gauge via MQTT protocols.
3. Analyze embankment stability with ML models and geotextiles, designing ROB approaches while integrating drone inspections and SCADA alerts.
4. Measure and correct track geometry parameters like superelevation and cross-levels using on-board sensors and computer vision, adhering to IRPWM standards.
5. Develop predictive maintenance models with AI on OMS/IoT data, enabling fault prediction and corrective actions for track failures as in Vande Bharat cases.
6. Operate tamping/renewal machines with IoT integration and evaluate mechanization impacts on safety using ultrasonic YOLO detection and efficiency metrics.

Module	Module Title & Topics	Hours
Module 1	Digital Pre-Construction and Ballasted Track Laying Pre-construction integrates BIM for alignment marking via GIS-digital twins and earthwork readiness with ML-optimized soil compaction models; material stacking uses RFID/IoT for inventory tracking. Ballasted track laying employs sleeper-rail assembly with robotic automation, crane-based panel laying, elastic fastening, and sensor-monitored ballast packing to 300mm cushion. Computer vision verifies geometry tolerances (±2mm alignment, RDSO standards) during assembly.	**7**
Module 2	Ballastless Track Systems and Quality Assurance Ballastless methods cover Rheda 2000® with embedded bi-block sleepers in monolithic slabs (no continuous reinforcement for signaling compatibility) and precast/in-situ slab techniques. Electronics enable embedded strain/vibration sensors for real-time quality checks on alignment (±2mm), level, and gauge via wireless telecom protocols (MQTT/CoAP). Metro/high-speed case studies highlight IoT-integrated digital twins for deflection monitoring.	**7**
Module 3	**Embankment, Bridge Approaches, and Geotech Integration** Railway embankments use geotextiles with FEM software for soil selection/compaction under train loads (AREMA specs); cuttings apply ML slope stability predictions. Transition zones near ROBs/yard entries incorporate BIM for reinforcement design challenges. Maintenance employs drone-based computer vision inspections and SCADA for real-time deformation alerts via telecom networks.	**8**
Module 4	**Track Geometry Parameters and Measurement Technologies** Track geometry ensures safety via BG/MG/NG gauges (tolerances: straight -6/+6mm, curves up to +20mm per IRPWM/RDSO); cross-levels, alignments, and superelevation calculations use 20m chord measurements. Electronics/telecom enable on-board inertial/optical sensors and YOLOv4 computer vision for real-time detection (94.4% mAP). Predictive apps adjust cant via ML algorithms on OMS data	**8**
Module 5	**Maintenance Strategies and Predictive Analytics** Preventive patrolling uses AI-OMS for defect detection; corrective involves sensor-guided rail/sleeper renewal, tamping, re-ballasting. Predictive maintenance deploys IoT (acoustic/ultrasonic sensors) with ML for LWR/CWR monitoring, alerting via SCADA/telecom (email <2s). Case studies cover Vande Bharat AI fault prediction (15% uptime gain) and track failure mitigations.	**7**

Module 6	**Mechanized Machines and Automation Systems** Tamping (plain/turnout), ballast regulators/cleaners, and renewal trains integrate IoT for operation; ultrasonic flaw detectors use deep learning (YOLO). Track recording cars/OMS leverage computer vision and AI for geometry logging. Mechanization boosts safety via SCADA oversight and telecom for efficiency (20% cost reduction)	**8**

Practical List:- Perform any 10 practical from given list.

1. Study of BIM–GIS–Digital Twin Integration for Railway Alignment and Pre-Construction Planning
2. RFID/IoT-Based Tracking of Track Materials and Inventory Management
3. Simulation of ML-Optimized Soil Compaction for Earthwork Readiness
4. Study of Robotic / Mechanized Ballasted Track Panel Laying Systems
5. Demonstration of Elastic Fastening Systems and Sensor-Enabled Ballast Packing
6. Computer-Vision Verification of Track Geometry Tolerances (Alignment & Level)
7. Study of Ballastless Track Systems (Rheda 2000®, Precast & In-situ Slabs)
8. IoT-Based Embedded Sensor Monitoring of Track Deflection, Vibration, and Strain
9. FEM-Based Analysis of Railway Embankments and Transition Zones
10. Drone-Based Digital Inspection of Track and Earthwork Assets
11. Measurement of Track Geometry Parameters Using Inertial/Optical Sensors
12. AI/ML-Enabled Track Defect Detection and Predictive Maintenance Systems
13. Study of SCADA-Integrated Railway Monitoring and Alert Systems
14. Demonstration of Mechanized Track Maintenance Machines and Automation Systems
15. Case Studies on AI-Driven Railway Reliability, Availability, and Failure Prevention

Reference Books & Resources

Textbooks:

3. Satish Chandra & M.M. Agarwal – *Railway Engineering* (Oxford University Press)
4. S.C. Saxena & S.P. Arora – *Railway Engineering* (Dhanpat Rai Publications)

Reference Books & Handbooks:

4. RDSO – *Permanent Way Manual (P-Way)*
5. Indian Railways – *Permanent Way Track Handbook* (Latest Edition)
6. AREMA Manual – *Track Design and Maintenance* (Selected chapters for ballast less tracks)

RCEPP-04: Track Surveying, Alignment & GIS Applications

Duration: 45 hrs Theory + 90 hrs Practical

Course Objectives

By the end of this course, students will be able to:

1. To introduce students to route selection and alignment design for new railway lines considering curves, gradients, and operational requirements.
2. To provide knowledge of modern surveying techniques (Total Station, DGPS, Drone mapping) for track layout and design.
3. To impart understanding of GIS and BIM applications in railway project planning and alignment visualization.
4. To familiarize students with earthwork, formation design, and drainage requirements for high-speed and heavy-haul railway corridors.

Course Outcomes (COs)

After completing this course, the learner will be able to:

1. Select and design appropriate railway routes considering topography, operational, and economic factors.
2. Use and interpret data from Total Station, DGPS, and Drone mapping for railway alignment surveys.
3. Apply GIS and BIM tools for railway alignment planning, visualization, and data management.
4. Design basic earthwork, formation, and drainage systems for conventional, heavy-haul, and high-speed railway tracks.

Module	Module Title & Topics	Hours
Module 1	**Route Selection & Alignment Design** Principles of route selection for new railway lines: operational, economic, and environmental considerations. Horizontal alignment: curves, super-elevation, transition curves, alignment for high-speed tracks. Vertical alignment: gradients, grade compensation, summit, and sag curves. Special considerations for metros, dedicated freight corridors, and high-speed rail.	**7**
Module 2	**Modern Surveying Techniques – Total Station & DGPS** Basics of railway surveying and reconnaissance. Total Station: features, field procedures, data processing for alignment design. DGPS: working principle, accuracy, and applications in railway projects. Data integration from conventional and GPS-based surveys. Field error minimization and best practices.	**7**

Module 3	**Drone Mapping & Advanced Survey Applications** Introduction to drone-based surveys: photogrammetry, LiDAR scanning, and point-cloud generation. Case studies of drone surveys in Indian railway projects (high-speed rail, metro, DFC). Advantages and limitations of UAV-based surveying for rail corridors. Data post-processing and integration with CAD/GIS platforms.	**8**
Module 4	**GIS & BIM in Railway Alignment Design** Introduction to GIS in railway projects: layers, spatial data management, and mapping. Use of GIS for route planning, land acquisition mapping, and utility shifting. Introduction to Building Information Modeling (BIM) for railway projects. 3D visualization and clash detection for alignment planning (examples from metro and HSR projects). Software tools overview: AutoCAD Civil 3D, ArcGIS, Bentley Open Rail.	**8**
Module 5	**Earthwork, Formation** Formation requirements for conventional, high-speed, and heavy-haul railways. Embankment and cutting design: stability, compaction, and settlement considerations. Use of soil improvement techniques (geotextiles, stone columns, soil stabilization).	**7**
Module 6	**Drainage Design** Drainage design: surface and sub-surface drainage systems for railway corridors. Failures due to poor earthwork and drainage – case studies and preventive measures.	**8**

Practical List:- Perform any 10 practical from given list.

1. Study of Principles of Route Selection and Alignment Criteria for Railway Projects
2. Horizontal Alignment Design: Calculation of Curves, Superelevation, and Transition Curves
3. Vertical Alignment Design: Gradients, Grade Compensation, Summit and Sag Curves
4. Special Alignment Considerations for Metro, DFC, and High-Speed Rail Projects
5. Field Survey Using Total Station: Data Collection and Traversing
6. DGPS-Based Railway Survey: Field Procedure and Accuracy Evaluation
7. Data Processing and Integration from Total Station and DGPS for Alignment Design
8. Drone-Based Survey and Photogrammetry for Railway Corridor Mapping
9. Preparation and Analysis of LiDAR-Derived Point Clouds for Alignment Planning
10. GIS Application in Route Planning, Land Acquisition, and Utility Mapping

11. Introduction and Application of BIM in Railway Alignment and Infrastructure Design
12. Software-Based Alignment Modelling Using Civil 3D / OpenRail / ArcGIS
13. Design of Railway Formation for Conventional, High-Speed, and Heavy-Haul Tracks
14. Study of Surface and Subsurface Drainage Design for Railway Alignments
15. Case Studies on Railway Failures Due to Poor Earthwork and Drainage and Their Prevention

Reference Books & Resources

***Textbooks**:*

Dr. B.C. Punmia – Surveying (Vol I, II & III) (Laxmi Publications)

A.M. Chandra – Higher Surveying (New Age International)

Reference Books & Handbooks:

RDSO – Guidelines for Survey & Alignment of Railway Tracks

ESRI Training Modules – GIS Applications in Transportation

Monographs / Other Material:

1. Bentley Open Rail Designer Manuals (for BIM-based railway design)
2. DGPS & Drone Survey Manuals – NICMAR/Survey of India notes

RCESEC-05: Railway Project Planning, Contracts & Quality Management

Duration: 45 hrs Theory + 90 hrs Practical

Course Objectives

By the end of this course, students will be able to:

1. To provide an understanding of the lifecycle of railway projects from conception to commissioning.
2. To develop skills for planning track projects, including new lines, doubling, sidings, and yard layouts.
3. To introduce various contracting models (item-rate, EPC, turnkey) and tendering processes used in Indian Railways and allied organizations.
4. To impart knowledge of quality control standards (RDSO/IRS) and site-based quality checks for track works.
5. To teach methods for project cost estimation, BOQ preparation, and budgeting.
6. To analyze the role of Public-Private Partnerships (PPP) and private sector involvement in modern railway projects.

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Explain the stages of a railway project lifecycle and prepare preliminary project documents.
CO2: Plan railway track projects including yard layouts, new lines, and siding facilities.
CO3: Differentiate between various contracting models and tendering processes in railway projects.
CO4: Implement quality control procedures as per RDSO and IRS specifications for materials and site works.
CO5: Estimate project costs and prepare basic BOQs for track projects.
CO6: Analyze PPP frameworks and private sector roles in Metro, DFC, and freight corridor projects.

Module	Module Title & Topics	Hours
Module 1	**Project Lifecycle – From Concept to Commissioning** Railway project stages: reconnaissance survey, detailed survey, feasibility study. DPR preparation: technical, financial, and environmental considerations. Approval process: Ministry of Railways, NITI Aayog, and other stakeholders. Execution stages: procurement, construction, testing, and commissioning. Case study: Lifecycle of a Metro or high-speed rail project.	**7**
Module 2	**Railway Track Project Planning** New line planning: alignment considerations, land acquisition challenges. Doubling and tripling projects: planning and integration with existing infrastructure. Yard layouts: design of passenger yards, goods yards, and maintenance depots. Industrial sidings: planning for private freight facilities.	**7**

	Software tools for railway planning (AutoCAD Rail, Bentley OpenRail).	
Module 3	**Contracts & Tendering** Contract types: Item-rate, EPC, turnkey, BOT. Tendering process in Indian Railways, Metro, and PSU projects (RVNL, IRCON, DFCCIL). Prequalification criteria, technical bid, and financial bid evaluation. Case studies: EPC contracts in Metro projects, turnkey models for DFC and private sidings. FIDIC contracts – an introduction.	**8**
Module 4	**Quality Control in Railway Projects** RDSO and IRS specifications for track components (rails, sleepers, ballast). Material testing: rail ultrasonic testing, sleeper inspection, ballast gradation checks. Site quality checks: track geometry verification, welding inspection, mechanized track laying quality. Documentation: quality assurance plans (QAP) and inspection checklists. Role of third-party inspection agencies (DMRC, RITES).	**8**
Module 5	**Costing & Budgeting** Cost estimation for railway track projects: material, labor, and machinery costs. BOQ preparation: item-wise quantity estimation for earthwork, track laying, and ancillary works. Escalation and contingencies in project costing. Funding sources: budgetary allocations, multilateral funding (JICA, World Bank). Cost benchmarking using past project data (Metro, DFC, HSR).	**7**
Module 6	**PPP & Private Sector Role** Introduction to Public-Private Partnership (PPP) in railways. Private freight terminals, industrial sidings, and logistics parks. Metro rail PPP models: BOT, BOOT, and hybrid annuity models. Role of private players in DFC, HSR, and port connectivity projects. Case studies: Gati Shakti cargo terminals, Metro PPP initiatives.	**8**

Practical List:- Perform any 10 practical from given list.

1. Study of Railway Project Lifecycle: From Reconnaissance to Commissioning
2. Preparation of Feasibility Study and DPR for a Railway Track Project
3. Mapping of Stakeholder Approval Processes for Railway Projects in India
4. Planning of New Railway Line Alignment and Land Acquisition Strategy
5. Preparation of Yard Layouts for Passenger and Goods Operations
6. Planning and Layout of Industrial Sidings and Private Freight Terminals
7. Software-Based Railway Planning Using AutoCAD Rail / Open Rail

8. Study of Contract Types and Tendering Procedures in Railway Projects
9. Preparation and Evaluation of Technical and Financial Bids
10. Case Study of EPC / Turnkey Contracts in Metro or DFC Projects
11. Quality Control and Testing Procedures for Rails, Sleepers, and Ballast
12. Preparation of Quality Assurance Plans (QAP) and Inspection Checklists
13. Cost Estimation and BOQ Preparation for Railway Track Works
14. Study of PPP Models and Private Sector Participation in Railway Projects
15. Case Study on Metro / High-Speed Rail Project Lifecycle and Implementation

Reference Books & Resources

Textbooks:

1. Prasanna Chandra – *Project Planning, Analysis & Management*
2. B.N. Datta – *Estimating and Costing in Civil Engineering*

Reference Books & Handbooks:

1. RDSO – *Quality Assurance Handbook for Railway Projects*
2. CPWD / Indian Railways – *Works Manual & Schedule of Rates*

Monographs / Other Material:

1. IRCON & RVNL Project Guidelines – EPC/Turnkey Contracting Practices
2. World Bank & JICA Guidelines for Metro/High-Speed Rail project planning

RCECC-06 Capstone Project (Industry-Oriented)

Duration: 40 hrs (Theory + Practical combined)

Course Objective

1. To enable students to integrate knowledge from track engineering, surveying, earthwork, project planning, and quality management.
2. To develop practical project execution skills, including surveys, layouts, costing, and quality documentation.
3. To provide exposure to real-world railway/metro projects through site studies or simulations.
4. To build teamwork, reporting, and presentation skills required in railway project environments

Course Outcomes (COs)

Upon completion, students will be able to:

CO1: Plan and execute a small-scale railway track project (new siding, yard layout, or rehabilitation plan).

CO2: Conduct field surveys (Total Station/DGPS) and prepare alignment layouts using drafting software.

CO3: Prepare BOQs, project cost estimates, and quality control plans.

CO4: Analyze real project case studies (railway/metro/high-speed) and propose solutions.

CO5; Present project findings through technical reports and presentations.

Sr. No.	Project Component	Description	Hours
1	**Project Selection & Planning**	Select a project theme (examples): Design of an industrial siding or goods yard. Track rehabilitation plan for an existing line. Ballast less track layout for a metro/high-speed corridor.Define project scope, objectives, and deliverables. Prepare a project execution schedule (Gantt chart).	**65**
2	**Field Survey & Data Collection**	Conduct a reconnaissance survey for the chosen project site (real or simulated). Use Total Station/DGPS for alignment data collection (or use provided datasets). Collect soil and drainage information (field/lab or case-based).	**65**
3	**Design & Layout Preparation**	Prepare track alignment layouts (AutoCAD/Open Rail schematic).Design cross-sections for earthwork and propose drainage systems. Plan yard/siding layouts considering operational needs.	**70**
4	**Costing & Quality Planning**	Prepare a BOQ for materials (rails, sleepers, ballast, earthwork). Estimate project cost (material, labor,	**140**

		equipment). Prepare a Quality Assurance Plan (QAP) and inspection checklists.	
5	**Reporting & Presentation**	Compile findings into a technical report (drawings, costing, QAP). Prepare a PowerPoint presentation for project defense. Present the project to an evaluation panel (faculty/industry experts).	**50**
	Total		**390 Hours**

Reference Material:

1. Sample DPRs – Metro (DMRC/MMRCL) & Railway projects (IRCON/RVNL)
2. RDSO & NHSRCL Technical Bulletins – for high-speed and metro design practices
3. AutoCAD Civil 3D & Open

Teaching & Learning Methodology

- Guided project mentorship by faculty and industry experts.
- Collaborative teamwork with defined roles (developer, tester, documentation, presentation).
- Agile/scrum style iterative development encouraged.
- Regular reviews and feedback sessions.

Assessment Scheme:

Assessment Component	Weightage
Problem Definition & Requirement Analysis	10%
System Design & Architecture	15%
Implementation & Integration	40%
Testing & Validation	15%
Documentation & Presentation	20%