

**STRUCTURE OF ONE YEAR FULL TIME POST GRADUATE DIPLOMA In Rail &  
Metro Technology (PG-DRM)  
(A Programme under Department of Civil Engineering COE, Pune)**

**Each Semester is of 16 weeks followed by examination in subsequent week.**

**Semester I**

S. NO	COURSE CODE	NAME OF THE SUBJECT	TEACHING SCHEME			EXAMINATION SCHEME			Credits	
			L	T	P	T1	T2	ESE		
1	PG-DRM 1	Introduction to railways and Track technology	4		2	20	20	60	4	
2	PG-DRM 2	Railway traction Mechanical	4		2	20	20	60	5	
3	PG-DRM 3	Railway traction Electric	4		2	20	20	60	5	
4	PG-DRM 4	Railway Rolling Stock	4		2	20	20	60	5	
5	PG-DRM 5	Elevated structures	4		2	20	20	60	4	
6	PG-DRM 6	Lab 1	0		2	20	20	60	2	
		<b>Total</b>	<b>20</b>		<b>12</b>				<b>25</b>	
		<b>Total Academic Engagement &amp; Credits</b>		<b>32</b>					<b>Total</b>	<b>25</b>

**Semester II**

S.NO	COURSE CODE	NAME OF THE SUBJECT	TEACHING SCHEME			EXAMINATION SCHEME			Credits	
			L	T	P	T1	T2	ESE		
1	PG-DRM 7	Signal And Telecommunication Engineering	4		2	20	20	60	5	
2	PG-DRM 8	Metro Rail Engineering-1	4		2	20	20	60	5	
3	PG-DRM 9	Metro Rail Engineering-2	4		2	20	20	60	5	
4	PG-DRM 10	Project Work	4		2	20	20	60	4	
5	PG-DRM 11	Underground Structures	4		2	20	20	60	4	
6	PG-DRM 12	Lab 2	0		2	20	20	60	2	
		<b>Total</b>	<b>20</b>		<b>12</b>			<b>Total</b>	<b>25</b>	
		<b>Total Academic Engagement &amp; Credits</b>		<b>32</b>						<b>25</b>
								<b>Course Total Credit</b>	<b>50</b>	

**(PG-DRM 1) Introduction to Railways & track technology– 1<sup>st</sup> Semester**

**Teaching Scheme :**

Lectures : 4 hrs/ week

Tutorial :

**Examination Scheme :**

Assignments/ Quiz – 40 Marks

End – Sem Exam – 60 Marks

**Course Outcomes :**

Students will be able to

1. To acquire & comprehend Principals of Guided form of Transport.

S.NO.	UNIT	CONTENT IN BRIEF	Hrs.
01	I	Origin of Railways, Definition/uniqueness of railways, gauge of railway track, standard gauge, gauges other than standard gauge such as Broad, Narrow etc., over view of railway systems of different countries, unconventional railways, atmospheric railway, mountain railways, rack railways etc.	9
02	II	Basic track structure – Formation, Gauge, type of rails, sleepers, rail joiners, rail & sleeper fasteners, special joints, insulated joints, expansion allowance and expansion joints, check rails, sleeper spacing, short welded rails (SWR), long welded rails(LWR) & continuous welded rails(CWR), ballast	9
03	III	Turnouts and Crossings – Components constituting turnouts and crossings, various turnouts like 1 in 8 ½, 1 in 12, 1 in 20 etc. Diamond crossings; Slip points, operation of turnouts-mechanical & electrical, locking of turnouts.	9
04	IV	Curved Track – classification of curves, measurement of radius, transition curve, true curve, super elevation on curves, cant deficiency, movement of vehicle on curves, speed on curves, check rails, gauge widening on curves. Gradients / Vertical Curves	9
05	V	Track recording car and track parameters in terms of alignment, unevenness, twist, cross level and gauge. Maintenance and renewal of track – (in brief) manual and mechanical maintenance and renewal.	9
06	VI	Brief Summary of IR codes such as IR Engg. Code, Bridge code etc.	9

**References :**

1. Indian Railways Permanent Way Manual Published by Indian Railways corrected up to 2004
2. Developments In High-Speed Track Design 1994 By Professor in Railway Engineering Delft University of Technology Delft, The Netherlands
3. Notes on Curves for Railways by Prof V B Sood \_ Indian Railways Institute of Civil Engineering Pune.

## (PG-DRM 2) Railway Traction Mechanical– 1<sup>st</sup> Semester

### Teaching Scheme :

Lectures : 4 hrs/ week

Tutorial :

### Examination Scheme :

Assignments/ Quiz – 40 Marks

End – Sem Exam – 60 Marks

### Course Outcomes :

Students will be able to

1. To acquire & understand & compare fundamental Principles of different types of wheeled transport system.
2. To understand interaction between guide way & wheels being made of same material (steel)
3. Apply the knowledge for increasing overall efficiency of traction.

S.NO.	UNIT	CONTENT IN BRIEF	Hrs.
01	I	Types of Traction – Steam (Historic), Diesel Mechanical, Diesel Electric and Diesel Hydraulic locomotives, Tractive effort, adhesion factor, weight transfer	09
02	II	Working of Steam Locomotive (Historic), Working of Diesel Electric locomotive – power transmission, axle hung nose suspended motor, flexible drive. Different types of Diesel locomotives past and present Working of Diesel Mechanical and Diesel Hydraulic Locomotive	09
03	III	DMU (Diesel Multiple Unit) train	09
04	IV	Suspension systems of Diesel locomotives and effect on tractive effort, High Adhesion Bogie	09
05	V	Fire & safety audit introduction.	09
06	VI	Maintenance manuals introduction for Diesel Loco & rolling stock.	09

### References :

1. Introduction hand book on general motor diesel locomotive \_Camtech Gwalior – Indian Railways 2006
2. Diesel-Electric Locomotive SD90MAC with Three-Phase Drive - Siemens AG
3. Transportation Systems Group Locomotives P.O. Box 32 40 D-91050 Erlangen  
Diesel Locomotives, The Railway Technical Website, PRC Rail Consulting Ltd. UK
4. Maintenance Manual for Diesel Locomotives – Indian Railways -2013

## (PG-DRM 3 ) Electric Traction – 1<sup>st</sup> Semester

### Teaching Scheme :

Lectures : 4 hrs/ week

Tutorial :

### Examination Scheme :

Assignments/ Quiz – 40 Marks

End – Sem Exam – 60 Marks

### Course Outcomes :

Students will be able to

1. To acquire & to comprehend the basic knowledge of electric traction system adopted in Indian Railway.
2. To acquire the knowledge of incoming EHS supply system for traction sub station & converting it to level of Elect. Traction system & regarding the distribution system of it through over head equipment.
3. To apply the knowledge to design & adopt the system for any type of traction.

S.NO.	UNIT	CONTENT IN BRIEF	Hrs.
01	I	History of electric traction (General) History of electric traction in India	9
02	II	Types of traction systems - 1,500 V DC, 25 KV 50 C/S AC 750 V DC, 3,000 V DC, 15 KV 16 2/3 C/S AC Traction power distribution	9
03	III	Working of electric locomotive, Types of Traction Motors Types of electric locomotives past and present Multi Current Locomotives	9
04	IV	EMU (Electric Multiple Unit) and MEMU (Main Line Electric Multiple Unit) train	9
05	V	Train Lighting ,Train Air Conditioning	9
06	VI	Electrical safety for installation as well as during maintenance & in case of fire. Introduction of AC traction manual.	9

### References :

1. Electric Locomotive / Electric Traction Control / Electric Traction Control The Railway Technical Website PRC Rail Consulting Ltd. UK
2. Electrical Engineering – Indian Railways Manual Railway Electrification Systems and Engineering – Sheila Frey - 2012
3. Network Rail, Guide to Overhead Electrification – British Rail 2015 Details of Mechanical Equipment of AC Conventional Locomotives Indian Railways.
4. What Drives Electric Multiple Units – Hiroshi Hata – 1998

**(PG-DRM 4 ) Railway Rolling Stock – Other Than Traction Unit – 1<sup>st</sup> Semester**

**Teaching Scheme :**

Lectures : 4 hrs/ week

Tutorial :

**Examination Scheme :**

Assignments/ Quiz – 40 Marks

End – Sem Exam – 60 Marks

**Course Outcomes :**

Students will be able to

1. To acquire & understand the mass transportation system.
2. To acquire & understand advantages of Railway transport system over other forms of land & water transport system.

S.NO.	UNIT	CONTENT IN BRIEF	Hrs.
01	I	Passenger carrying vehicles (Coaches), development of coaches, 4 wheeled coaches, 6 wheeled coaches, bogie coaches, categories of coaches, Pullman coaches, special coaches in very brief.	9
02	II	Suspension systems of passenger coaches, development from leaf springs to pneumatic suspension systems.	9
03	III	Goods carrying vehicles – Wagons, 4 wheeled wagons, bogie wagons, multi axle wagons, covered wagons, open wagons, flat wagons, well wagons, container wagons etc.	9
04	IV	Brake systems – vacuum brake (historic), Air brake (current), Electro Pneumatic Brakes, Tread brakes, Disc brakes etc.	9
05	V	Buffing and Draw Gear – Common to Locomotives and other Rolling Stock	9
06	VI	Introduction of maintenance manuals of various types of rolling stock.	9

**References :**

1. Maintenance Manual for BG Coaches – Indian Railways – 2002
2. Maintenance Manual for LHB Coaches – Indian Railways – Year Not Available
3. Air Brake System – South Central Railway
4. Hand Book on Air Brake System for Freight Stock – Indian Railways – 2012
5. Maintenance of Air Suspension Systems of Coaching Stock – Indian Railways – 2010
6. Air Suspension Systems \_ Contitech – Company Brochure
7. Vacuum Brake System \_ South Central Railway
8. Vehicle Suspension Systems – The Railway Technical Website PRC Rail Consulting Ltd. UK
9. Electro-Pneumatic Brakes The Railway Technical Website PRC Rail Consulting Ltd. UK
10. Pneumatic Brakes The Railway Technical Website PRC Rail Consulting Ltd. UK

**(PG-DRM 5 ) ELEVATED STRUCTURES- 1<sup>st</sup> Semester**

**Teaching Scheme :**

Lectures : 4 hrs/ week

Tutorial :

**Examination Scheme :**

Assignments/ Quiz – 40 Marks

End – Sem Exam – 60 Marks

**Course Outcomes :**

Students will be able to

1. To acquire knowledge regarding Elevated structures in Railways and Metro Construction system.
2. To understand various techniques in Elevated Structures.
3. To select and apply appropriate elevated structure at appropriate situation.

S.NO.	UNIT	CONTENT IN BRIEF	Hrs.
01	I	Introduction, Investigation for Bridges and Culverts, Investigations for Important Bridges, Design Flood Discharge for bridges, Linear Waterway of Bridges	9
02	II	Choice of Foundation for Piers and Abutments, Types of Bridges and Loading Standards, Setting out for Piers and Abutments, Open Foundation, Pile Foundations, Well Foundation—Case Studies	9
03	III	Piers and Abutments, Superstructure—Design Aspects, Superstructure – Construction, Inspection of Bridges, Maintenance of Bridges – substructure, Maintenance of superstructure – Girders	9
04	IV	Rebuilding of Bridges, Construction Management, Grade Separators, River Training and Protection Works,	9
05	V	Embankments, Tests on Compaction, Approaches, Layers in Flexible and Rigid pavements, Quality Control Aspects	9

**References:**

1. Ponnuswamy, Bridge Engineering, Delhi.
2. V N Gharpure, Bridge Engineering.

(PG-DRM 6) LAB 1

**Teaching Scheme :**

Lectures : 2 hrs/ week

Tutorial :

**Examination Scheme :**

Assignments/ Quiz – 40 Marks

Oral: Sem Exam – 60 Marks

**Course Outcomes :**

Students will be able to

1. To understand functioning of various track elements in Railway and Metros.
2. To understand various Models of Suspension Systems of Locomotives,.
3. To understand signaling and overhead equipments.

S.NO.	BRANCH	TYPE OF LAB EQUIPMENT	Hrs.
01	CIVIL	Rail Wheel Interaction, Track elements, 90 R, 52 Kg, 60 Kg Flat Bottom Rail, Bull Head Rail, Cast Iron Chair, Rail Screws, Base Plate, Insulating Pad, Modified Loose Jaw, Fish Plated Joint, Insulated Joint Sleepers - Wooden, Steel Trough, Cast Iron Pot, Twin Block And Mono Block Pre Stressed Concrete Sleepers.	4
02	MECHANICAL	Models of Suspension Systems of Locomotives, WDM2, WDG4, Carriages and Wagons-CASNUB,	4
03	ELECTRICAL	25 KV Overhead Equipment, Electric Loco Pantograph, Loco Roof Top Equipment, ACB.	4
04	SIGNAL AND TELECOMMUNICATION	Historic Railway Signal Equipment, Block Instruments, Semaphore Signals, Lower and Upper Quadrant Multiple Aspect Colour Light Signaling.	4

## (PG-DRM 7) Signal & Telecommunication Technology – 2<sup>nd</sup> Semester

### Teaching Scheme :

Lectures : 4 hrs/ week

Tutorial :

### Course Outcomes :

Students will be able to

1. To acquire & understand the significance of signaling system in terms of fail safe working of railways.
2. To acquire & understand the Principles of various trains operation & protection systems to enhance the efficiency of Railway working.

### Examination Scheme :

Assignments/ Quiz – 40 Marks

End – Sem Exam – 60 Marks

S.NO.	UNIT	CONTENT IN BRIEF	Hrs.
01	I	Different types of signaling systems (historic), Semaphore (Lower & Upper Quadrant) mechanical signals, Multiple Aspect Colour Light Signals	9
02	II	Absolute Block working / Fixed Block , Intermediate Block Hut, Automatic Block working, Token less Block Working Point Detection and Interlocking of points and signals Track circuits – Train detection (occupancy of track) Panel Interlocking signaling system, Route Relay Interlocking ( RRI ) system, Electronic Interlocking Axle counters	9
03	III	Moving Block, CBTC (Communication Based Train Control), ATO (Automatic Train Operation ), ATC (Automatic Train Control)	9
04	IV	Significance of telecommunication in railway working Telephony principles & Instruments, Microcontrollers, Microprocessors, Modulation Techniques (Analog & Digital), Application of Microprocessors and Micro-controllers	9
05	V	Radio Propagation, Public Address System, Multiplexing (Analog & Digital), Passenger Information System, Public Information System, Train Traffic Control Data Communications and Networking, Mobile Communications ( VHF, GSM-R, DECT, TETRA.	9
06	VI	Introduction of S & T manual fail Proof power supply to signaling installation standby arrangement for power supply.	9

### References :

1. Glossary of Signalling and Telecommunications Terminology  
Institution of Railway Signal Engineers – January 2011
2. Indian Railways Signalling Manual Part One – 1988, Part Two 2001
3. Development of Railway Signal & Telecom Systems on IR  
M C Yadav WM/Signal/SWS Sabarmati/Western Railway
4. An Introduction to Railway Signalling & Equipment  
Andy Lawrence – 2011
5. Interlocking Principles – Railway Group Standard – June 2003
6. Indian Railways Telecommunication Manual
7. Maintenance Handbook on Automatic Signalling \_ Indian Railways



## (PG-DRM 8 ) Metro Rail Technology 1– 2<sup>nd</sup> Semester

### Teaching Scheme :

Lectures : 4 hrs/ week

Tutorial :

### Examination Scheme :

Assignments/ Quiz – 40 Marks

End – Sem Exam – 60 Marks

### Course Outcomes :

Students will be able to

1. To acquire & understand the necessity of metro system for urban transport.
2. To acquire & understand the differences between various urban transport system.
3. To understand cost effectiveness of various urban transport systems.

S.NO.	UNIT	CONTENT IN BRIEF	Hrs.
01	I	Origin of Metro Rail System, Overview of World Metro Systems	9
02	II	Metro Planning and Selection, Metro Construction Metro Track	9
03	III	Metro Electrification systems,	9
04	IV	Metro Rolling Stock	9
05	V	Metro Signaling	9
06	VI	Introduction of metro act, Report of Ministry of Urban Development on standardization of metro system.	9

### References :

1. Metro Act \_ Government of India – 2002
2. Rolling Stock – Report of Ministry of Urban Development – GOI -2013
3. Radio communication for Communications-Based Train Control (CBTC): A tutorial and survey – 2017
4. Technical Details of Metro Rolling Stock \_ Ansaldo Manual – 2016
5. Technical Details of Metro Rolling Stock – Bombardier – 2015
6. Technical Standards of Track Structure for Metro Railways/MRTS – RDSO
7. Detailed Project Reports of Various Metro Projects in India – By Delhi Metro Rail Corporation
8. Manual Of Specifications And Standards – Hyderabad Metro Government of Andhra Pradesh - 2008

**(PG-DRM 9 ) Metro Rail Technology 2 – 2<sup>nd</sup> Semester**

**Teaching Scheme :**

Lectures : 4 hrs/ week

Tutorial :

**Examination Scheme :**

Assignments/ Quiz – 40 Marks

End – Sem Exam – 60 Marks

**Course Outcomes :**

Students will be able to

1. To understand integrated operation of metro system.
2. To understand interdependency of various sub systems of metro working.

S.NO.	UNIT	CONTENT IN BRIEF	Hrs.
01	I	Metro Operations	9
02	II	Metro Depots , Metro Maintenance	9
03	III	Metro Station Management	9
04	IV	Public Address System , Automatic Fare Collection System	9
05	V	Passenger Information System	9
06	VI	Metro act	9

**(PG-DRM 10 ) Project Work – 2<sup>nd</sup> Semester**

**Teaching Scheme :**

Lectures : 4 hrs/ week

Tutorial :

**Examination Scheme :**

Assignments/ Quiz – 40 Marks

End – Sem Exam – 60 Marks

**Course Outcomes :**

Students will be able to

1. Apply knowledge of various subjects studied in semester 1 & semester 2.
2. Solve problems in the filed of Rail & Metro Technology.

S. NO.	CONTENT IN BRIEF	Hrs.
01	Project work is based on filed applications, experimental work, model development, application of software, etc. to solve problems related to Rail & Metro Technology	4 / week

**(PG-DRM 11 ) UNDERGROUND WORKS - 2<sup>nd</sup> Semester**

**Teaching Scheme :**

Lectures : 4 hrs/ week

Tutorial :

**Examination Scheme :**

Assignments/ Quiz – 40 Marks

End – Sem Exam – 60 Marks

**Course Outcomes :**

Students will be able to

1. To understand construction techniques in tunnelling.
2. To identify appropriate tunneling method.
3. To analyse tunnel for its shape and NATM concept.

S.NO.	UNIT	CONTENT IN BRIEF	Hrs.
01	I	Tunnelling Tunnel Engineering: Necessity, planning of tunnels, site investigation for tunnels, types of tunnels, tunnel alignment and grade, size and shape of a tunnel	9
02	II	Method of constructions, methods of tunnelling in hard rocks - full face method - heading and bench method - drift method - different methods of tunnelling in soft soils including compressed air and shield tunnelling -	9
03	III	Shafts in tunnels - ventilation of tunnel and various methods - lining of tunnels - drainage and lighting of tunnels, problems in tunnel constructions, boom tunnelling machines, full face tunnel boring machines;	9
04	IV	Support of tunnels; adverse ground conditions; ground treatment and hazards in tunnelling.	9
05	V	Study rock mechanics - RMR & Q-system of classification basic concepts,	9
06	VI	Study of joints, sequence of excavation, support systems, Shape optimization, NATM	9

**References:**

1. K. Szechy, The Art of Tunnelling, Budapest publication, Norway
2. S C Saxena, Tunnelling, Khanna Publication, Delhi.

**(PG-DRM 12) LAB 2**

**Teaching Scheme :**

Lectures : 2 hrs/ week

Tutorial :

**Examination Scheme :**

Assignments/ Quiz – 40 Marks

Oral: Sem Exam – 60 Marks

**Course Outcomes :**

Students will be able to

4. To understand functioning of various units in Railway and Metros.
5. To understand traction and braking systems.
6. To understand interlocking systems.

S. NO.	BRANCH	TYPE OF LAB EQUIPMENT	Hrs.
01	CIVIL	Turnouts and Crossings Switch Expansion Joint, Tangent Track, Transition Curve and True Curve, Super elevation.	4
02	MECHANICAL	ICF AND FIAT Vacuum Brake (Historical) Air Brake Equipment, Buffing and Draw Gear, Screw Coupling, Center Buffer Coupler	4
03	ELECTRICAL	Traction Power Supply Sub Station, Electric Multiple Unit Train Control	4
04	SIGNAL AND TELECOMMUNICATION	Panel Interlocking, Electronic Interlocking, 4 Aspect Automatic Signaling, Communication Based Train Control, Track Circuits, Axle Counters.	4