Savitribai Phule Pune University(Formerly S.P.Pune University)

Department of Technology

STRUCTURE OF ONE YEAR FULL TIME POST GRADUATE DIPLOMA In Metro & Rail Technology (PGD-MRT)

(A Programme under Department of Technology, SP Pune University)

Semester I

S.NO	COURE CODE	NAME OF THE SUBJECT	TEACHINGSCHEME		
			L	T	P
1	**PGDMRTC1**	Introduction to Metro and Rail Track technology	4		
2	**PGDMRTC2**	Railway traction (E & M)	4		
3	**PGDMRTC3**	Introduction of Bridge Construction	4		
4	**PGDMRTC4**	Rolling Stock and Vibration Control	3		
5	**PGDMRTLP1**	Lab 1	3		
6	**PGDMRTRM**	Research Methodology	4		
		Total	**22**		
		Total Academic Engagement & Credits	**22**		

Semester II

S.NO	COURSE CODE	NAME OF THE SUBJECT	TEACHING SCHEME		
			L	T	P
1	**PGDMRTC5**	Metro Signal And Telecommunication Technology	2		
2	**PGDMRTC6**	Theory of Safety and Reliability	2		
3	**PGDMRTC7**	Underground Structures	2		
4	**PGDMRTC8**	Metro Technologies Operation and Maintenance	2		
5	**PGDMRTLP2**	Lab 2	2		
6	**PGDMRT IntProj**	Internship and Project Work	12		
		Total	**22**		
		Total Academic Engagement& Credits	**22**		

Eligibility Criteria:

- Any Graduates from Civil/ Mechanical/ Electrical and Electronics Engineering and allied branches are eligible to apply.
- Those appearing for their final year degree examination may also apply.

Semester I

Introduction to Metro & Rail track technology

PGDMRTC1 **Credits: 4**

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.

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

Turnouts and Crossings: Components constituting turnouts and crossings, various turnouts like 1 in 8 ½, 1 in 12, 1in 20 etc. Diamond crossings; Slip points, operation of turnouts-
mechanical & electrical, locking of turnouts.

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.

Track recording: car and track parameters in terms of alignment,unevenness, twist, cross level and gauge.Maintenance and renewal of track – (in brief) manual andmechanical maintenance and renewal.

Brief Summary of IR codes such as IR Engg. Code, Bridge code
etc.

References:

1. Indian Railways Permanent Way Manual Published by Indian Railways corrected upto 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.

Railway traction (E & M)

PGDMRTC2 **Credits: 4**

Railway traction (E & M) : History of electric traction (General):History of electric traction in India , Types of Traction – Steam (Historic), Diesel Mechanical, Diesel Electric and Diesel Hydraulic locomotives, 1,500 V DC, 25 KV 50 C/SAC 750 V DC, 3,000 V DC, 15 KV 16 2/3 C/S AC, Tractive effort, adhesion factor, weight transfer, Traction power distribution.Working of Steam Locomotive (Historic), Working of DieselElectric locomotive – power transmission, axle hung nose suspended motor, flexible drive. Different types of Diesel locomotives past and present Working of Diesel Mechanical and Diesel HydraulicLocomotive, Working of electric locomotive, Types of Traction Motors Types of electric locomotives past and presentMulti Current Locomotives. DMU (Diesel Multiple Unit) train, EMU (Electric Multiple Unit) and MEMU (Main Line Electric Multiple Unit) train. Suspension systems of Diesel locomotives and effect ontractive effort, High Adhesion Bogie. Suspension systems of Diesel locomotives and effect on tractive effort, High Adhesion Bogie. Train Lighting ,Train Air Conditioning. Maintenance manuals introduction for Diesel Loco & rolling Stock, Electrical safety for installation as well as duringmaintenance & in case of fire. Introduction of AC traction manual.

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
5. Electric Locomotive / Electric Traction Control / Electric Traction Control TheRailway Technical Website PRC Rail Consulting Ltd. UK
6. Electrical Engineering – Indian Railways Manual Railway Electrification Systemsand Engineering – Sheila Frey - 2012
7. Network Rail, Guide to Overhead Electrification – British Rail 2015 Details of Mechanical Equipment of AC Conventional Locomotives Indian Railways.
8. What Drives Electric Multiple Units – Hiroshi Hata – 1998

Introduction of Bridge Construction

PGDMRTC3 **Credits: 4**

Introduction of Bridge Construction: Introduction, Investigation for Bridges and Culverts, Investigations for Important Bridges, Design Flood Dischargefor bridges, Linear Waterway of Bridges, Choice of Foundation for Piers and Abutments, Types ofBridges and Loading Standards, Setting out for Piers and Abutments, Open Foundation, Pile Foundations, WellFoundation—Case Studies. Piers and Abutments, Superstructure—Design Aspects,Superstructure – Construction, Inspection of Bridges, Maintenance of Bridges – substructure, Maintenance of superstructure – Girders Rebuilding of Bridges, Construction, Management,Grade Separators, River Training and Protection Works, Embankments, Tests on Compaction, Approaches, Layers in Flexible and Rigid pavements, Quality Control Aspects.

References:

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

Rolling Stock and Vibration Control

PGDMRTC4 **Credits: 3**

Rolling Stock and Vibration Control : 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. Suspension systems of passenger coaches, development from leaf springs to pneumatic suspension systems. Goods carrying vehicles – Wagons, 4 wheeled wagons, bogie wagons, multi axle wagons, covered wagons, open wagons, flat wagons, well wagons, container wagons etc. Brake systems vacuum brake (historic), Air brake (current), Electro Pneumatic Brakes, Tread brakes, Disc brakes etc. Buffing and Draw Gear – Common to Locomotives and other Rolling Stock. Introduction of maintenance manuals of various types of Rolling stock. Metro Rolling Stock, Introduction of maintenance manuals of various types of Rolling stock. Metro Rolling Stock

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 ConsultingLtd. 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

LAB 1

PGDMRTLP1 **Credits: 3**

CIVIL: Rail Wheel Interaction, Track elements, 90 R, 52 Kg, 60 Kg Flat Bottom Rail, Bull Head Rail, Cast Iron Chair, RailScrews, 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.

MECHANICAL: Models of Suspension Systems of Locomotives, WDM2,WDG4, Carriages and Wagons-CASNUB,

ELECTRICAL: 25 KV Overhead Equipment, Electric Loco Pantograph,Loco Roof Top Equipment, ACB

SIGNAL AND TELECOMMUNICATION: Historic Railway Signal Equipment, Block Instruments, Semaphore Signals, Lower and Upper Quadrant MultipleAspect Colour Light Signaling.

Research Methodology

PGDMRTRM **Credits: 4**

II Semester

PGDMRT5

Metro Signal & Telecommunication Technology

PGDMRTC5 **Credits: 2**

Metro Signal & Telecommunication Technology: Different types of signaling systems (historic), Semaphore (Lower & Upper Quadrant) mechanical signals, Multiple Aspect Color LightSignals, Metro Signaling. Absolute Block working / Fixed Block , Intermediate Block Hut, Automatic Block working, Token less Block Working Point Detection andInterlocking of points and signals Track circuits – Train detection (occupancy of track) Panel Interlocking signaling system, Route Relay Interlocking (RRI)system, Electronic Interlocking Axle counters. Moving Block, CBTC (Communication Based Train Control), ATO
(Automatic Train Operation), ATC (Automatic Train Control). Significance of telecommunication in railway working Telephony principles & Instruments, Microcontrollers, Microprocessors,Modulation Techniques (Analog & Digital), Application of Microprocessors and Micro-controllers. Radio Propagation, Public Address System, Multiplexing (Analog & Digital), Passenger Information System, Public Information System, TrainTraffic Control Data Communications and Networking, Mobile Communications (VHF, GSM-R, DECT, TETRA. Introduction of Signal & Telecommunication manual fail Proof power supply to signaling, Installation standby arrangement for power supply.

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 Railwy Signal &Telecom Systems on IR M C Yadav WM/Signal/SWS Sabarmati/Western Railway
4. An Introduction to Railway Signalling & EquipmentAndy Lawrence – 2011

5. Interlocking Principles – Railway Group Standard – June 2003
6. Indian Railways Telecommunication Manual
7. Maintenance Handbook on Automatic Signalling _ Indian Railways

Theory of Safety and Reliability

PGDMRTC6 **Credits: 2**

Principles Of Safety Management: History of Safety movement–Evolution of modern safety concept-general concepts of management planning for safety for optimization of productivity-productivity.

Fire & safety audit introduction : Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report–review of inspection, remarks by government agencies, consultants, experts–perusal of accident and safety records, formats–implementation of audit indication-liaison with departments to ensure co-ordination–check list–identification of unsafe acts of workers and unsafe conditions in the shop floor.
Safety Education And Training: Importance of training-identification of training needs-training methods–Programmes, seminars, conferences, competitions–method of promoting safe practice-motivation–communication-role of government agencies and private consulting agencies in safety training–creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign–Domestic Safety and Training.

Reliability Concept: Reliability function–failure rate–mean time between failures (MTBF)–mean time to failure (MTTF) –A priori and a posteriori concept-mortality curve–useful life–availability maintainability–system effectiveness.

Failure data analysis: Time to failure distributions–Exponential, normal, Gamma, Weibull, ranking of data–probability plotting techniques–Hazard plotting.

Reliability Management: Reliability testing–Reliability growth monitoring–Non-parametric methods–Reliability and life cycle costs–Reliability allocation–Replacement model.

Risk Assessment: Definition and measurement of risk–risk analysis techniques–risk reduction resources–industrial safety and risk assessment.

REFERENCES:

1. Heinrich H.W. “Industrial Accident Prevention”McGraw-Hill Company, New York,1980.
2. Krishnan N.V. “Safety Management in Industry”Jaico Publishing House, Bombay,1997.
3. Lees, F.P., “Loss Prevention in Process Industries” Butterworth publications,London
4. John Ridley, “Safety at Work”, Butterworth and Co., London, 1983.
5. Srinath L.S, “Reliability Engineering”, Affiliated East-West Press Pvt Ltd, New Delhi,1998.
6. Modarres, “Reliability and Risk analysis”, Maral Dekker Inc.1993.
7. John Davidson, “The Reliability of Mechanical system” published bythe Institutionof MechanicalEngineers, London, 1988.
8. Smith C.O. “Introduction to Reliability in Design”, McGraw Hill, London, 1976 2nd edition,1990.

UNDERGROUND STRUCTURES

PGDMRTC7 **Credits: 2**

UNDERGROUND STRUCTURES: Tunnelling Tunnel Engineering: Necessity, planning of tunnels, site investigation for tunnels, types of tunnels, tunnel alignment and grade, size and shape ofa tunnel. 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 tunneling. Shafts in tunnels - ventilation of tunnel and various methods - lining of tunnels - drainage and lighting oftunnels, problems in tunnel constructions, boom tunnelling machines, full face tunnel boringmachines. Support of tunnels; adverse ground conditions; ground Treatment and hazards in tunnelling. Study rock mechanics - RMR & Q-system of classification basic concepts Study of joints, sequence of excavation, support systems, Shape optimization, NATM

References:

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

Metro Technologies Operation and Maintenance

PGDMRTC8 **Credits: 2**

Metro Technologies Operation and Maintenance : Origin of Metro Rail System, Overview of World, Metro Systems, Metro Operations, Metro Planning and Selection, Metro Construction, Metro Track , Metro Depots , Metro Maintenance, Metro Electrification systems, Metro Station Management, Public Address System , Automatic Fare, Collection System, Passenger Information System, Introduction of metro act, Report of Ministry of Urban Development on standardization of metro system, Metro act

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 tutorialand 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 AndhraPradesh - 2008

LAB 2

PGDMRTLP2 **Credits: 2**

CIVIL: Turnouts and Crossings Switch Expansion Joint, Tangent Track, Transition Curve and True Curve, Super elevation.
MECHANICAL: ICF AND FIAT Vacuum Brake (Historical) Air Brake Equipment, Buffing and Draw Gear, Screw Coupling, Center Buffer Coupler.
ELECTRICAL: Traction Power Supply Sub Station, Electric Multiple Unit Train Control
SIGNAL AND TELECOMMUNICATION: Panel Interlocking, Electronic Interlocking,
4 Aspect Automatic Signaling, Communication Based Train Control, Track Circuits, Axle Counters.

Internship and Project Work

PGDMRTIntProj **Credits: 12**

Internship and Project Work: Internship and Project work is related to field-based applications, experimental work, model development using software etc. Solving problems related to metro and railway technology to avoid technical as well as system hazards.