ANNEXURE "C"

Syllabus for professional papers (Revised) for 30% LDCE for promotion to Group "B" post of AEE in Electrical Engineering Department.

Paper-I

Maximum Marks:150	**Qualifying Marks:90**
Part-I	
General	**50 Marks**
I. General Knowledge, II. Official language	
Part-II	
Professional Subject	**100 marks**

1.0	**General-**
1.1	Net work analysis, Star/Delta, transformation Symmetrical Component, transients, Basics of Control stems.
1.2	**Analog and Digital Electronics and Circuits:** Semiconductor device physics, PN junctions and transistors, circuit models and parameters, FET, ner, tunnel, Schottky, photo diodes and their applications, rectifier circuits, voltage regulators and ltipliers, switching behavior of diodes and transistors. Small signal amplifiers, biasing circuits, frequency response and improvement, multi-syage plifiers and feed-back amplifiers, D.C. amplifiers, Oscillators, Large signal amplifiers, coupling thods, push pull amplifiers, operational amplifiers and wave shaping circuits. Multi-vibrators and flip-ps and their applications. Digital logic gate families, universal gate combinational circuits for thmetic and logic operation, sequential logic circuits. Counters, registers, RAM and RGMs.
1.3	**Micro-processors:** Micro-processor architecture Instruction set and simple assembly language programming. Interfacing memory and I/O. Applications of Micro-processors in power system.
1.4	**Power Electronics:** Power semi-conductor devices. Thyristor, Power transistor (IGBT), GTOs, and MOSFETs. haracteristic and operation. AC to DC Converters: 1-phase and 3-phase DC to DC Converters: AC gulators. Thyristor controlled reactors, switched capacitor networks. Inverters: Single-phase and 3-phase. Pulse width modulation. Sinusoidal modulation with uniform mpling. Switched mode power supplies.
1.5	**Communication Systems:** Types of modulation: AM. FM and PM. Demodulators. Noise and bandwidth considerations. Digital mmunication systems. Pulse code modulation and demodulation. Elements of sound and vision oadcasting. Carrier communication. Frequency division and time division multiplexing, Telemetry stem in power engineering. Fibre optic cable communication system.
1.6	**Indian Elect. Acts & Rules;** Application of these to Railway working, checks to be carried out before commissioning Elect. sets, functions and duties of Electrical Inspectors (EIG), Electricity Act 2003. Energy Conservation t 2007, ECB Code, role of Lift Inspector, Lift & Escalators rules.
2.0	**Electrical Engineering Materials-**

	Band Theory, Conductors, Semiconductors and Insulators, Superconductivity. Insulators for electrical d electronic applications. Magnetic materials. Ferro and ferri magnetism. Ceramics: Properties and plications. Hall effect and its applications. Special semi-conductors. Insulating material ssification/Thermal affect, Solar PV modules.
3.0	**Theory and performance of Electrical Machines & equipment-**
3.1	Basic concepts in rotating machines. EMF, torque, basic machine types. Construction and operation, kage, losses and efficiency.
3.2	Direct current machines : Generation of EMF, work, power, torque equation, armature winding, mature, reaction, theory of communication, Inter-poles & compensating windings, characteristics of unts, series and compound generators, parallel running and load sharing of generators. Construction, citation methods. Circuit models characteristics and performance analysis. Generators and motors. arting and speed control. Testing. Losses and efficiency.
3.3	Synchronous Machines. Construction. Circuit model. Operating characteristics and performance alysis. Synchronous reactance. Efficiency. Voltage regulation. Salient-pole machine. Parallel eration. Hunting Short circuit transients.
3.4	Induction Machines, Construction. Principle of operation. Rotating fields, Characteristics, and rformance analysis. Determination of circuit model. Circle diagram, Starting, and speed control, actional KW motors. Single-phase synchronous and induction motors, 3 phase Asynchronous motors d induction motors for traction application.
3.5	Transformers: construction and testing. Equivalent circuits. Losses and efficiency. Regulation. Auto-nsformer. 3-phase transformer. Parallel operation. Methods of cooling, Tap changing, parallel eration, polarity and phase sequence testing, protection Instruments, PTs & CTs, etc. Scott connection nsformer.
4.0	**Generation, Transmission & Utilisation-**
4.1	Sources of energy, heat value of fuel, steam power station. Hydro Elect. Station, Nuclear power tion. Pumped storage plants. Economics and operating factors.
4.2	Power transmission lines. Modeling and performance characteristics. Voltage control. Load flow dies. Optical power system operation. Load frequency control. Symmetrical short circuit analysis. Z-s formulation. Symmetrical components. Per Unit representation. Fault analysis. Transient and steady-te stability of power systems. Equal area criterion. Power system Transients. Power System Protection Circuit breakers. Relays. HVDC transmission.
4.3	Illumination standards of light, polar curve, Reflection and absorption, lighting calculations including sign & economical layout of service building, workshop & yards. Various sources of light-fluorescent pes etc.
4.4	Electric traction : Advantages & disadvantages, speed time curve-traction motor, starting & speed ntrol of DC series motors, power, consumptions, regenerative breaking, advantages and disadvantages AC traction over DC traction, Tractive effort, Breaking Effort.
4.5	Group & individual drive. Choice of drive & motors for various usages.
5.0	**Measurements & instrumentation-**
5.1	Units and Standards. Error analysis Measurement of resistance (high & low), potentiometer, wheat ne & Kelvin bridge, meggers for insulation resistance & earth resistance.
5.2	Voltmeters, ammeter, power factor meter, single phase watt meter, measurements of three phase wer recording instruments, maximum demand meter. Watt hour meter, shunt, CT, PT.
5.3	Check meter
5.4	Transducers and their applications to the measurement of non-electrical quantities like temperature, essure, flow-rate displacement, acceleration, noise level, etc. Date acquisition systems. A/D and D/A nverters.

	Central air-conditioning plant & package type system, refrigeration cycle, air changes, anning for capacity and drives for refrigeration plants, refrigerants and ducting.
1.10	Specification, design & testing of water coolers, central as well as package plants. quirements of water coolers, window coolers & refrigerators.
1.11	Standby arrangement: DG sets, both petrol & diesel as also diesel pumps for water supply rangements. Operation maintenance and overhauling.
1.12	Illumination, yard lighting, street lighting, & town supply net work. Drives for work shop achinery.
1.13	Earthing & Bonding.
1.14	Commissioning & maintenance aspect of conventional & maintenance free earthing rangement for general service application.
1.15	Maintenance of various equipment of sub-station, Energy Management, Important structions issued by Railway Board and RDSO.
1.16	Energy Consumption, Renewable Energy, Solar, Wind and biomass.
2.0	**Traction Distribution-**
2.1	Systems of electrification in use and advantage and disadvantages of the different systems th emphasis on 2x25 KV system.
2.2	Feasibility studies and justifications for track electrifications, preliminary planning and sign, procedure followed in taking up electrification scheme, working drawing for execution OHE wiring plans and OHE layout plans.
2.3	Planning of layout of overhead equipments, Techno economic survey for electrification of w lines, foot by foot survey, prepegging plans, precautions to be taken while wiring new lines, undation & their types & use of wiring trains, final checking safety checks & certification, ergizing of new lines, principles of preparation of lay out plans, provision of return nductors.
2.4	**Overhead equipments** – Types of overhead equipments, regulated and unregulated systems, tches OHE, speed potential of various types of OHE, Centenary, contact wire, Dropper & mpers. Overlaps, clearances, Mast & portals, schedules of Dimension etc.
2.5	Maintenance problems with OHE, Foot Patrolling, current collection, use of Tower wagons, lders & ladder trolleys, seasonal & cycle checks, maintenance Schedule, Insulator cleaning, aightening of out of plumb masts, earthing and bonds, return conductors, Preventive aintenance Tools, Types of Blocks & Procedure.
2.6	Breakdowns, TRD works during breakdown and accidents, restoration procedure both mporary and permanent.
2.7	Overhaul schedule & anti-theft measures.
2.8	Organization & working of maintenance depots, repair workshops, training of staff safety easurements and precautions.
2.9	**Power supply installation:** Power supply arrangements, traction sub stations, feeding stations, SSP & SPs, 132 KV nsmission lines, Railway owned sub stations, transformer maintenance, circuit breakers, rrent and potential transformers, protective relays, auxiliary transformers, interrupters and olators.
2.10	Liaison with power supply authorities, monthly meter reading, control over maximum mand, emergency power supply arrangements. Automated Meter Reading.
2.11	Maintenance of switching stations.
2.12	Remote control system, remote control equipment for AC substations and its working. peration and maintenance of remote control, Specialized equipments for remote work.

6.0	**Mechanical Engineering Refrigeration etc:-**
6.1	Various types of drives, belt, tooth gearing, rope and chain drive and Helical gears. Different types of arings, ball, roller etc.
6.2	Heat pump cycle, vapor compression, estimation of cooling and heating levels and plant capacities. lculation of psychometric charts, condensers cooling and dehumidification, refrigerant and their pperties.
7.0	**Logical Reasoning-**
	The test is given to the candidates to judge their power of reasoning spread in verbal and non verbal eas. The candidates should be able to think logically so that they perceive the data accurately, derstand the relationships correctly, figure out the missing number of words, and to apply rules to new d different contexts. These indicators are measured through performance on such tasks as detecting ssing links, following directions, classifying words, establishing sequences, and completing analogies.
7.1	**Chart logic** A chart or a table is given that is partially filled in and asked to complete it in accordance with the formation given either in the chart/table or in the question.
7.2	**Pattern perception:** Here a certain pattern is given and generally a quarter is left blank. The candidate is required to entify the correct quarter from the given four alternatives.
7.3	**Figure matrix:** In this more than one set of figures is given in the form of a matrix all of them llowing the same rule. The candidate is required to follow the rule and identify the missing figure.
7.4	**Rule detection:** Here a particular rule is given and it is required to select from the given sets of figures a set of figures hich obeys the rule and forms the correct series.

Paper-II

Maximum marks:150	**Qualifying Marks:90**
Part-I	
Establishment & Financial Rules	**50 marks**
Part-II	
Professional Subject	**100 marks**

1.0	**General Services-**
1.1	General power supply arrangements, air conditioning etc.
1.2	Power Supply: HT & LT sources, power supply network, substation layout, overhead & derground distribution, maintenance & operation of transformers, switch gears, protective vices & distribution lines.
1.3	Construction, erection & commissioning of new sub- station distribution lines, line lculations etc.
1.4	House wiring metering & safety precautions.
1.5	Tariff & agreements, Relative merits of obtaining HT & LT supply, steps to reduce aximum demand, measurement of power, power factor, measuring demand etc.
1.6	Water supply & requirement of water planning of water supply system, sources of water pipe e frictional & other losses, discharge calculations.
1.7	Reciprocating centrifugal & turbine pumps, relative merit, choice of VS & HS pumps, aracteristic curve of pumps, efficiency Drives, Elect. Connections & protections. Cavitations priming of pumps, measurement of output with V-Notch & nozzle, necessity of multi stage mping, storage capacity and purification of water.
1.8	Preventive maintenance, special failure of pumps & motors, periodical overhaul.
1.9	**Air-conditions and Refrigeration :**

2.13	Remote control centre, traction power control organization, permit to work, emergency rangements, coordination with operating and other departments. Liaison with supply thorities, emergency phones, safety precautions for electrified section.
2.14	Miscellaneous: Traction, stores and their accountal, regulation for electrical crossing of lway tracks.
2.15	Important instructions issued by Railway Board, RDSO's SMI/MS, TCs and related vestigation Reports.
3.0	Train lighting and conditioned coaches.
3.1	Designs, construction, principles of working schematic circuits diagrams of train lighting uipments used in train lighting system.
3.2	Coach wiring, under frame wiring, schedule of rewiring, couplers, lamp resistance, junction xes and fuses, Generation to non-generation ratio, lights, fans and water raising apparatus.
3.3	Self generating coaches, End on-Generation, Head on Generation, power cars, electrical and chanical components, layout, operation and maintenance procedures for slip coaches.
3.4	Train lighting batteries their maintenance, defects analysis of causes of failures and remedial asures. Simplified system of train lighting use of alternators, anti theft measures.
3.5	Fires in trains, preventive measures and precautions.
3.6	Periodic over haul and heavy repairs to train lighting equipment
3.7	Broad outlines of types of equipments used in 110 V and 415 Volt air conditioned coaches, heme of refrigerated vans. Drives and their problems, maintenance and operational problems frigeration, compressors their types in service and their problems, gear boxes, their aintenance and alignment.
3.8	Maintenance schedule for AC coaches, partial AC coaches, AC I, II/III Coaches, Sleeper aches. Running repairs.
3.9	Coordination with Mechanical, Operating and Security Department
3.10	Important instructions issued by Railway Board, RDSO's SMIs, TCs and related vestigations reports.
4.0	**Electric Locos-**
4.1	Description of locomotives in service, principles of operation and characteristics of different pes of locos used in electric traction on the Indian Railways.
4.2	Power, Auxiliary and control circuits: Their equipment, functioning, maintenance, verhauling schedules.
4.3	Various types of bogies and bogie suspension and their components, power transmission om traction motor to axles, traction motor mounting arrangement i.e. jacqueman drive, Quill ve, WN coupler: their equipment, functioning, maintenance/overhauling schedules.
4.4	Air, vacuum and Dual Break System, Air compressors, regenerative and rheostatic breaking, eir equipment, functioning, maintenance/overhauling schedules.
4.5	Function of electric loco sheds and electric loco workshops.
4.6	Schedule inspection of locos i.e. IA, IB, IC, AOH, IOH and POH.
4.7	Records and registers maintained in loco shed, planning and progress organization, statistical ta, rolling stock organization in sheds and shops, fire prevention, safety checks and history rds.
4.8	Important instructions issued by Railway Board, RDSO's SMI/MS/TCs and related vestigation reports, AC Traction Manual.
5.0	**EMU/MEMU/Metros**
5.1	Utility of EMU trains for urban and suburban services vis-à-vis locomotives, various types of

	MUs stock – AC, DC and AC-DC, their salient features, rake formation.
5.2	Power circuits, auxiliary, control circuit, break systems, bogies and other mechanical mponents, their equipment, functioning, maintenance/overhauling schedules.
5.3	Inspection schedules of EMUs/MEMU/Metros, troubleshooting sequence.
5.4	Safety precautions and fire prevention checks.
5.5	Maintenance and overhaul organization and liaison with other department.
6.0	**Electric loco and EMU operation-**
6.1	Operation of electric locos with single unit and multiple unit and with rheostaic and generative breaking.
6.2	Safety features to be followed in the operation of electric locos and EMUs
6.3	Failures of electric locos and EMUs, their cause, investigation and remedial measures for oiding failures.
6.4	Inter-relation between electric mechanical and operating department in functioning of ctric locos and EMUs.
6.5	Function of traction loco control organization.
6.6	Preparation of engine links and driver links – power plan.
6.7	Compilation of operating statics for electric locos and EMUs operation.
6.8	Outstation organization for maintenance of electric loco and EMU.
6.9	Working rules for preparation/operation of elect. Rolling stock.
6.10	Recruitment and training of running staff – conversion training etc.
6.11	Accidents and re-railing technique of locos and EMUs.
7.0	**Stores Matters-**
7.1	Procedure relating to procurement of stock items, non-stock items, distribution and accountal stores.
7.2	Receipt and custody of stores
7.3	Sale of surplus stores.
7.4	Inventory control.
7.5	Schedule of Powers
8.0	**Engineering Matters-**
8.1	Estimates
8.2	Execution of Work
8.3	Contracts for work
8.4	Procedure for traffic and engineering surveys
9.	**Disaster Management – Role of Electrical Officer:**

ESTABLISHMENT RULES & PROCEDURES:

1. Broad outlines for recruitment, training, promotion by selections and suitability tests and trade ts etc. of staff in various categories on the Railways.
2. Rules for issue of Passes and PTOs to Railway staff.
3. Discipline and Appeal Rules in force to Railways.
4. Delegation of powers in respect of Establishment matters.
5. Broad outline of payment of wages Act, Minimum Wages, Act, Workman's Compensation Act, ctory Act, Hours of Employment Rules and Apprentice's Act as applicant to the Railway orking.
6. Welfare Scheme on the Railways.
7. Broad outlines of Trade Unions- Permanent Negotiation Machinery-Staff Councils and General ealings with the unions.

8. Conditions of Services of Railway Service Conduct Rules.

ACCOUNTS & FINANCE RULES :

1. Parliamentary control over Railway Finance- Public accountability cannons of Financial ɔperty.
2. Financial planning & Budgeting- Budgetary and Financial Review-Appropriation Accounts.
3. Rules of allocation- Classification of expenditure- control over expenditure Responsibility counting- Performance Budgeting-Exchequer Control- Financial Rules of working.
4. Works Programme- Financial Justification of works – Surveys preparations of Estimates- ıpital Budget–Control over capital Expenditure- Productivity test.
5. Financial control over Stores expenditure- Purchase and Stores keeping procedure- Inventory ntrol and A,B,C, analysis.
6. Financial and cost control in Railway Workshops.
7. Rules and procedure relating to Tenders and Contracts for execution of works and procurement stores.
8. Procedure for processing and finalizing the Audit inspections and Draft Paras.
9. Delegation of Powers.
10. Passes & PTOs and embezzlements.
11. Knowledge of Official Language Rules.

N.B. 1. Regarding Questions on General knowledge

The question will be based to test the knowledge of candidates, which they would acquire by neral observation/reading without a specific study or detailed knowledge of text books. The paper ll contain questions on topics of national importance, achievements of Railways questions which ıts the awareness of candidates to developments which are taking place.

2. Ten (10%) percent of the total marks prescribed for written test should be on official ıguage policy and rules will be included in the question paper on General Knowledge (i.e Paper). Howeˆver, this question should not be made compulsory.

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