Annexure-A 3

East Coast Railway

Proforma of Application for ACM-30% LDCE for 2021-22

OPTION: Whether Willing/Unwilling ……..……

1. Name & Community of the candidate:
2. Father's Name :
3. Designation :
4. Station/Division/Unit
5. Date of Birth :
6. P.F. No :
7. Present Grade :
8. Date of initial Appointment & Grade :
9. Date of Apptt./Promotion to Level-6 :
10. Date of Apptt./Promotion to Level-7 :
11. Mobile No. :
12. Email ID :
13. Signature of the candidate :
14. Date :
15. Countersignature of the controlling officer:

    (With Designation and seal)

(Note: Willingness/Unwillingness to be submitted on or before ……)

Proforma of statement for submission of options by Divisions to HQs.

Sl. No	Name, Design/station & PF No.	Father's Name	Comm. (UR/SC/ ST)	Present Grade	Date of Birth	Date of initial Apptt. & Grade	Date of Apptt./ promotion in Level-6	Date of Apptt/ promotion in Level-7	Date of receipt of application	Remarks (Eligible/ In eligible)

27/2/21

(495)

Syllabus for Technical subjects of Main Examination for 30% LDCE for promotion to Group-B post of AEE in Electrical Engineering Department

Maximum Marks: 100 Qualifying Marks:60	
Professional Subject (Descriptive)	100

1.0	**General -**
1.1	Net work analysis, Star/Delta, transformation Symmetrical component, transients, Basics of Control Systems.
1.2	**Analog and Digital Electronics and Circuits:** Semiconductor device physics, PN junctions and transistors, circuit models and parameters, FET, Zener, tunnel, Schottky, photo diodes and their applications, rectified circuits, voltage regulators and multipliers, switching behavior of diodes and transistors. Small signal amplifiers, biasing circuits, frequency response and improvement, multi-stage amplifiers and feed-back amplifiers, D.C. amplifiers, Oscillators. Large signal amplifiers, coupling methods, push pull amplifiers, operational amplifiers and wave shaping circuits. Multi-vibrators and flip-flops and their applications. Digital logic gate families, universal gate combinational circuits for arithmetic 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 for 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. Characteristics and operation. AC to DC Converters; 1-phase and 3-phase DC to DC Converters; AC regulators. Thyristor controlled reactors, switched capacitor networks. Inverters; Single-phase and 3-phase, Pulse width modulation. Sinusoidal modulation with uniform sampling. Switched mode power supplies.

1.5	**Communication Systems**: Types of modulation; AM. FM and PM. Demodulators. Noise and bandwidth considerations. Digital communication systems. Pulse code modulation and demodulation. Elements of sound and vision broadcasting. Carrier communication. Frequency division and time division multiplexing, Telemetry system 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. Assets, functions and duties of Electrical Inspectors (EIG), Electricity Act 2003. Energy conservation Act 2007. ECB Code, role of Lift Inspector, Lift & Escalators Rules.
2.0	**Electrical Engineering Materials-**
	Band Theory, Conductors, Semiconductors and Insulator, Super-conductivity. Insulators for electrical and electronic applications. Magnetic materials. Ferro and ferri magnetism. Ceramics; Properties and applications. Hall effect and its applications. Special semi-conductors. Insulating material classification/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, leakage, losses and efficiency.
3.2	Direct current machines; Generation of EMF, work, power, Torque equation, armature winding, armature, reaction, theory of commutation, inter-poles & compensating windings, characteristics of shunts, series and compound generators, parallel running and load sharing of generators. Construction, Excitation methods. Circuit models characteristics and performance analysis. Generators and motors. Starting and speed control. Testing. Losses and efficiency.
3.3	Synchronous Machines. Construction. Circuit model. Operating characteristics and performance analysis. Synchronous reactance. Efficiency. Voltage regulation. Salient – pole machine. Parallel operation. Hunting. Short circuit transients.
3.4	Induction machines. Construction. Principle of operation. Rotating fields, Characteristics and performance analysis. Determination of circuit model. Circle diagram, Starting and speed control, Fractional K W motors. Single- phase synchronous and induction motors, 3 phase asynchronous motors and induction motors for traction application.

3.5	Transformers: Construction and testing. Equivalent circuits. Losses and efficiency. Regulation. Auto-transformer. 3-phase transformer. Parallel operation. Methods of cooling, Tap changing, parallel operation, polarity and phase sequence testing, protection Instruments, PTs & CTs, etc. Scott connection transformer.
4.0	**Generation, Transmission & Utilisation-**
4.1	Sources of energy, heat value of fuel , steam power station, Hydro Elect. Station, Nuclear power station. Pumped storage plants. Economics and operating factors.
4.2	Power transmission lines. Modeling and performance characteristics. Voltage control. Load flow studies. Optimal power system operation. Load frequency control. Symmetrical short circuit analysis. Z-Bus formulation. Symmetrical Components. Per Unit representation. Fault analysis. Transient and steady-state 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 design & economical layout of service building, workshop & yards. Various sources of light-fluorescent tubes etc.
4.4	Electric traction : Advantages & disadvantages, speed time traction motor, starting & speed control of DC series motors, pre-consumption, Regenerative breaking, advantages and disadvantages of AC traction over DC traction, Tractive effort, Breaking effort.
4.5	Group & Individual drive. Choice of drive & motors for various usages.
5.0	**Measurement & instrumentation-**
5.1	Units and Standards. Error analysis Measurement of resistance (High & Low), potentiometer, wheat stone & Kelvin bridge, meggers insulation resistance & earth resistance.
5.2	Voltmeters, ammeter, power factor meter, single phase watt meter measurements of three phase power 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 electrical quantities like temperature, pressure, flow displacement, acceleration, noise level, etc. Date acquisition systems A/D and D/A converters.
6.0	**Mechanical Engineering Refrigeration etc.**
6.1	Various types of drives, belt, tooth gearing , rope and chain drive. Helical gears. Different types of bearings, ball, roller etc.
6.2	Heat pump cycle, vapour compression, estimation of coach heating levels and plant capacities, calculation of psychology charts, condensers cooling and dehumidification, refrigerant and properties.
7.0	**Logical Reasoning-**
	The test is given to the candidates to judge their power of reading spread in verbal and non verbal areas. The candidates should be to think logically so that they perceive the data accumulation understand the relationships correctly, figure out the missing of words, and to apply rules to new and different contexts. Indicators are measured through performance on such tasks as detecting missing 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 information 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 identify 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 following the same rule. The candidate is required to follow the rule and identify the missing figures.
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 which obeys the rule and forms the correct series.
8.0	**General Services-**
8.1	General power supply arrangements, air conditioning etc.

8.2	Power Supply: HT & LT sources, power supply network, substation layout, overhead & under ground distribution, maintenance & operation of transformers, switch gears, protective devices & distribution lines.
8.3	Construction, erection & commissioning of new sub station distribution lines, line calculations etc.
8.4	House wiring metering & safety precautions.
8.5	Tariff & agreement, Relative merits of obtaining HT & LT supply, step to reduce maximum demand, measurement of power, power factor, measuring demand etc.
8.6	Water supply & requirement of water planning of water supply system, sources of water pipe line frictional & other losses, discharge calculations.
8.7	Reciprocating centrifugal & turbine pumps, relative merit, choice of VS & HS pumps, characteristic curve of pumps, efficiency Drives Elect. Connections & protections. Cavitations & priming of pumps measurement of output with V-Notch & nozzle, necessity of multi stage pumping, storage capacity and purification of water.
8.8	Preventive maintenance, special failure of pumps and motors, periodical overhaul.
8.9	**Air-Conditions and Refrigeration :**
	Central air-conditioning plant & package type system, refrigeration cycle, air changes, planning for capacity and drives for refrigeration plants, refrigerants and ducting.
8.10	Specification, design & testing of water coolers, central as well as package plants. Requirements of water coolers, window coolers & refrigerators.
8.11	Standby arrangement: DG sets, both petrol & diesel as also diesel pumps for water supply arrangements. Operation maintenance and overhauling.
8.12	Illumination, yard lighting, street lighting & town supply net work. Drives for workshop machinery.
8.13	Earthing & Bonding.
8.14	Commissioning & maintenance aspect of conventional & maintenance free earthing arrangement for general service application.

8.15	Maintenance of various equipment of sub-station, Energy Management, Important Instructions issued by Railway Board and RDSO.
8.16	Energy Consumption, Renewable Energy, Solar, Wind and biomass
9.0	**Traction Distribution-**
9.1	Systems of electrification in use and advantage and disadvantages of the different systems with emphasis on 2X25 KV system.
9.2	Feasibility studies and justifications for track electrifications, preliminary planning and design, procedure followed in taking up electrification scheme, working drawing for execution of OHE wiring plans and OHE layout plans.
9.3	Planning of layout of overhead equipments, Techno economic survey for electrification of new lines, foot by foot survey, prepegging plan precautions to be taken while wiring new lines, foundation & the types & use of wiring trains, final checking safety checks of certification, energizing of new lines, principles of preparation of lay out plans, provision of return conductors.
9.4	Overhead equipments – Types of overhead equipments, regulated and unregulated systems, stitches OHE, speed potential of various types of OHE, Centenary, contact wire, Dropper & Jumper Overlaps, clearances, Mast & portals, schedules of Dimensions etc.
9.5	Maintenance problems with OHE, Foot Patrolling, current collection and use of tower wagons, ladders & ladder trolleys, seasonal & cyclone checks, maintenance Schedule, Insulator cleaning, straightening of out of plumb masts, earthing and bonds, return conductor preventive maintenance Tools, types of Blocks & Procedure.
9.6	Breakdowns, TRD works during breakdown and accident restoration procedure both temporary and permanent.
9.7	Overhaul schedule & anti-theft measures.
9.8	Organization & working of maintenance depots, repair workshop training of staff safety measurements and precautions.
9.9	**Power supply installation:** Power supply arrangements, traction sub stations, feeding station SSP & SPs, 132 KV transmission lines, Railway owned sub station, transformer maintenance, circuit breakers, current and potential transformers, protective relays, auxiliary transformers, interrupter and isolators.

9.10	Liaison with power supply authorities, monthly meter reading, control over maximum demand, emergency power supply arrangements. Automated Meter Reading.
9.11	Maintenance of switching stations.
9.12	Remote control system, remote control equipment for AC substation and its working. Operation and maintenance of remote control. Specialized equipments for remote control work.
9.13	Remote control centre, traction power control organization, permit work, emergency arrangements, coordination with operating and other departments. Liaison with supply authorities, emergency phones, safety precautions for electrified section.
9.14	Miscellaneous: Traction, stores and their accountal, regulation for electrical crossing of railway tracks.
9.15	Important instructions issued by Railway Board, RDSO's SMI./MS.TCs and related Investigation Reports.
10.0	Train lighting and air conditioned coaches.
10.1	Designs, construction, principles of working schematic circuits diagrams of train lighting equipments used in train lighting system.
10.2	Coach wiring, under frame wiring, schedule of rewiring, couplers, lamp resistance, junction boxes and fuses, Generation to non-generation ratio, lights, fans and water raising apparatus.
10.3	Self generating coaches, End on –Generation, Head on Generation, power cars, electrical and mechanical components, layout, operation and maintenance procedures for slip coaches.
10.4	Train lighting batteries their maintenance, defects analysis of causes of failures and remedial measures. Simplified system of train lighting use of alternators, anti-theft measures.
10.5	Fires in trains, preventive measures and precautions.
10.6	Periodic over haul and heavy repairs to train lighting equipment.

10.7	Broad outlines of types of equipments used in 110V and 415 Volt air conditioned coaches, scheme of refrigerated vans. Drives and their problems, maintenance and operational problems Refrigeration, compressors their types in service and their problems, gear boxes, their maintenance and alignment.
10.8	Maintenance schedule for AC coaches , partial AC coaches, AC I, II/III coaches, Sleeper Coaches. Running repairs.
10.9	Coordination with Mechanical, Operating and Security Department.
10.10	Important instructions issued by Railway Board, RDSO's SMIs, TCs and related investigations reports.
11.0	**Electric Locos:-**
11.1	Description of locomotives in service, principles of operation and characteristics of different types of locos used in electric traction on the Indian Railways.
11.2	Power, Auxiliary and control circuits: Their equipment, functioning, maintenance/overhauling schedules.
11.3	Various types of bogies and bogie suspension and their components, power transmission from traction motor to axles, traction motor mounting arrangement i.e. Jacqueman drive, Quill drive, WN coupler: their equipments, functioning, maintenance/overhauling schedules.
11.4	Air, vaccum and Dual Brake System, Air Compressors, regenerative and rheostatic breaking, their equipment, functioning, maintenance/overhauling schedules.
11.5	Function of electric loco sheds and electric loco workshops.
11.6	Schedule inspection of locos i.e. IA, IB, IC, AOH, IOH and POH.
11.7	Records and registers maintained in loco shed, planning and progress organization, statistical data, rolling stock organization in sheds and shops, fire prevention, safety checks and history cards.
11.8	Important instruction issued by Railway Board, RDSO's SMI/MS/TCs and related investigation reports, AC Traction Manual.
12.0	**EMU/MEMU/Metros**
12.1	Utility of EMU trains for urban and suburban services vis-à-vis locomotives, various types of EMUs stock-AC, DC and AC-DC, their salient features, rake formation.

12.2	Power circuits, auxiliary, control circuit, break systems, bogies and other mechanical components, their equipment, functioning, maintenance/overhauling schedules.
12.3	Inspection schedules of EMUs/MEMU/Metros, troubleshooting sequence.
12.4	Safety precautions and fire prevention checks.
12.5	Maintenance and overhaul organization and liaison with other department.
13.0	**Electric Loco and EMU operation:-**
13.1	Operation of electric locos with single unit and multiple unit and with rheostatic and regenerative breaking.
13.2	Safety features to be followed in the operation of electric locos and EMUs.
13.3	Failures of electric locos and EMUs, their cause, investigation and remedial measures for avoiding failures.
13.4	Inter-relation between Electric, Mechanical and Operating department in functioning of electric locos and EMUs.
13.5	Function of traction loco control organization.
13.6	Preparation of engine links and driver links-power plan.
13.7	Compilation of operating statics for electric locos and EMUs operation.
13.8	Outstation organization for maintenance of electric loco and EMU.
13.9	Working rules for preparation/operation of elect. Rolling stock.
13.10	Recruitment and training of running staff –conversion training etc.
13.11	Accidents and re-railing technique of locos and EMUs.
14.0	**Stores Matters:-**
14.1	Procedure relating to procurement of stock items, non-stock items, distribution and accountal of stores.

14.2	Receipt and custody of stores.
14.3	Sale of surplus stores.
14.4	Inventory control.
14.5	Schedule of Powers.
15.0	**Engineering Matters:-**
15.1	Estimates
15.2	Execution of Work
15.3	Contracts for work
15.4	Procedure for traffic and engineering surveys.
16.	**Disaster Management- Role of Electrical Officer:**

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Syllabus for Technical subjects of Pre-Qualifying Examination for 30% LDCE for promotion to Group-B post of AEE in Electrical Engineering Department

Maximum Marks: 100 Qualifying Marks:75	
Technical Subject General Knowledge including optional Questions on Official Language Policy Establishment & Financial Rules	: 40 marks : 30 marks : 30 marks

1.0	**General -**
1.1	Net work analysis, Star/Delta, transformation Symmetrical component, transients, Basics of Control Systems.
1.2	**Analog and Digital Electronics and Circuits:** Semiconductor device physics, PN junctions and transistors, circuit models and parameters, FET, Zener, tunnel, Schottky, photo diodes and their applications, rectified circuits, voltage regulators and multipliers, switching behavior of diodes and transistors. Small signal amplifiers, biasing circuits, frequency response and improvement, multi-stage amplifiers and feed-back amplifiers, D.C. amplifiers, Oscillators. Large signal amplifiers, coupling methods, push pull amplifiers, operational amplifiers and wave shaping circuits. Multi-vibrators and flip-flops and their applications. Digital logic gate families, universal gate combinational circuits for arithmetic and logic operation, sequential logic circuits. Counters, registers, RAM and RGMs.
1.3	**Power Electronics:** Power semi-conductor devices. Thyristor. Power transistor (IGBT), GTOs, and MOSFETs. Characteristics and operation. AC to DC Converters; 1-phase and 3-phase DC to DC Converters; AC regulators. Thyristor controlled reactors, switched capacitor networks. Inverters; Single-phase and 3-phase, Pulse width modulation. Sinusoidal modulation with uniform sampling. Switched mode power supplies.
1.4	**Indian Elect. Acts & Rules:** Application of these to Railway working, checks to be carried out before commissioning Elect. Assets, functions and duties of Electrical Inspectors (EIG), Electricity Act 2003. Energy conservation Act 2007. ECBB Code, role of Lift Inspector, Lift & Escalators Rules.

2.0	**Electrical Engineering Materials-**
	Band Theory, Conductors, Semiconductors and Insulators, Super-conductivity. Insulators for electrical and electronic applications. Magnetic materials. Ferro and ferri magnetism. Ceramics; Properties and applications. Hall effect and its applications. Special semi-conductors. Insulating material classification/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, leakage, losses and efficiency.
3.2	Direct current machines; Generation of EMF, work, power, Torque equation, armature winding, armature, reaction, theory of commutation, inter-poles & compensating windings, characteristics of shunts, series and compound generators, parallel running and load sharing of generators. Construction, Excitation methods. Circuit models characteristics and performance analysis. Generators and motors. Starting and speed control. Testing. Losses and efficiency.
3.3	Synchronous Machines. Construction. Circuit model. Operating characteristics and performance analysis. Synchronous reactance. Efficiency. Voltage regulation. Salient – pole machine. Parallel operation. Hunting. Short circuit transients.
3.4	Induction machines. Construction. Principle of operation. Rotating fields, Characteristics and performance analysis. Determination of circuit model. Circle diagram, Starting and speed control, Fractional K W motors. Single- phase synchronous and induction motors, 3 phase asynchronous motors and induction motors for traction application.
3.5	Transformers: Construction and testing. Equivalent circuits. Losses and efficiency. Regulation. Auto-transformer. 3-phase transformer. Parallel operation. Methods of cooling, Tap changing, parallel operation, polarity and phase sequence testing, protection Instruments, PTs & CTs, etc. Scott connection transformer.
4.0	**Generation, Transmission & Utilisation-**
4.1	Sources of energy, heat value of fuel , steam power station, Hydro Elect. Station, Nuclear power station. Pumped storage plants. Economics and operating factors.

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4.2	Power transmission lines. Modeling and performance characteristics. Voltage control. Load flow studies. Optimal power system operation. Load frequency control. Symmetrical short circuit analysis. Z-Bus formulation. Symmetrical Components. Per Unit representation. Fault analysis. Transient and steady-state 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 design & economical layout of service building, workshop & yards. Various sources of light-fluorescent tubes etc.
4.4	Electric traction : Advantages & disadvantages, speed time traction motor, starting & speed control of DC series motors, pre-consumption, Regenerative breaking, advantages and disadvantages of AC traction over DC traction, Tractive effort, Breaking effort.
4.5	Group & Individual drive. Choice of drive & motors for various usages.
5.0	**Measurement & instrumentation-**
5.1	Units and Standards. Error analysis Measurement of resistance (High & Low), potentiometer, wheat stone & Kelvin bridge, meggers insulation resistance & earth resistance.
5.2	Voltmeters, ammeter, power factor meter, single phase watt meter measurements of three phase power 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 electrical quantities like temperature, pressure, flow displacement, acceleration, noise level, etc. Date acquisition systems A/D and D/A converters.
6.0	**Mechanical Engineering Refrigeration etc.**
6.1	Various types of drives, belt, tooth gearing , rope and chain drive. Helical gears. Different types of bearings, ball, roller etc.
6.2	Heat pump cycle, vapour compression, estimation of coach heating levels and plant capacities, calculation of psychology charts, condensers cooling and dehumidification, refrigerant and properties.

7.0	**General Services-**
7.1	General power supply arrangements, air conditioning etc.
7.2	Power Supply: HT & LT sources, power supply network, substation layout, overhead & under ground distribution, maintenance & operation of transformers, switch gears, protective devices & distribution lines.
7.3	Construction, erection & commissioning of new sub station distribution lines, line calculations etc.
7.4	House wiring metering & safety precautions.
7.5	Tariff & agreement, Relative merits of obtaining HT & LT supply, step to reduce maximum demand, measurement of power, power factor, measuring demand etc.
7.6	Water supply & requirement of water planning of water supply system, sources of water pipe line frictional & other losses, discharge calculations.
7.7	Reciprocating centrifugal & turbine pumps, relative merit, choice of VS & HS pumps, characteristic curve of pumps, efficiency Drives Elect. Connections & protections. Cavitations & priming of pumps measurement of output with V-Notch & nozzle, necessity of multi stage pumping, storage capacity and purification of water.
7.8	Preventive maintenance, special failure of pumps and motors, periodical overhaul.
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	Central air-conditioning plant & package type system, refrigeration cycle, air changes, planning for capacity and drives for refrigeration plants, refrigerants and ducting.
7.10	Specification, design & testing of water coolers, central as well as package plants. Requirements of water coolers, window coolers & refrigerators.
7.11	Standby arrangement: DG sets, both petrol & diesel as also diesel pumps for water supply arrangements. Operation maintenance and overhauling.
7.12	Illumination, yard lighting, street lighting & town supply net work. Drives for workshop machinery.

7.13	Earthing & Bonding.
7.14	Commissioning & maintenance aspect of conventional & maintenance free earthing arrangement for general service application.
7.15	Maintenance of various equipment of sub-station, Energy Management, Important Instructions issued by Railway Board and RDSO.
7.16	Energy Consumption, Renewable Energy, Solar, Wind and biomass
8.0	**Traction Distribution-**
8.1	Systems of electrification in use and advantage and disadvantages of the different systems with emphasis on 2X25 KV system.
8.2	Feasibility studies and justifications for track electrifications, preliminary planning and design, procedure followed in taking up electrification scheme, working drawing for execution of OHE wiring plans and OHE layout plans.
8.3	Planning of layout of overhead equipments, Techno economic survey for electrification of new lines, foot by foot survey, prepegging plan precautions to be taken while wiring new lines, foundation & the types & use of wiring trains, final checking safety checks of certification, energizing of new lines, principles of preparation of lay out plans, provision of return conductors.
8.4	Overhead equipments – Types of overhead equipments, regulated and unregulated systems, stitches OHE, speed potential of various types of OHE, Centenary, contact wire, Dropper & Jumper Overlaps, clearances, Mast & portals, schedules of Dimensions etc.
8.5	Maintenance problems with OHE, Foot Patrolling, current collection and use of tower wagons, ladders & ladder trolleys, seasonal & cyclone checks, maintenance Schedule, Insulator cleaning, straightening of out of plumb masts, earthing and bonds, return conductor preventive maintenance Tools, types of Blocks & Procedure.
8.6	Breakdowns, TRD works during breakdown and accident restoration procedure both temporary and permanent.
8.7	Overhaul schedule & anti-theft measures.

8.8	Organization & working of maintenance depots, repair workshop training of staff safety measurements and precautions.
8.9	**Power supply installation:** Power supply arrangements, traction sub stations, feeding station SSP & SPs, 132 KV transmission lines, Railway owned sub station, transformer maintenance, circuit breakers, current and potential transformers, protective relays, auxiliary transformers, interrupter and isolators.
8.10	Liaison with power supply authorities, monthly meter reading, control over maximum demand, emergency power supply arrangements. Automated Meter Reading.
8.11	Maintenance of switching stations.
8.12	Remote control system, remote control equipment for AC substation and its working. Operation and maintenance of remote control. Specialized equipments for remote control work.
8.13	Remote control centre, traction power control organization, permit work, emergency arrangements, coordination with operating and other departments. Liaison with supply authorities, emergency phones, safety precautions for electrified section.
8.14	Miscellaneous: Traction, stores and their accountal, regulation for electrical crossing of railway tracks.
8.15	Important instructions issued by Railway Board, RDSO's SMI./MS.TCs and related Investigation Reports.
9.0	Train lighting and air conditioned coaches.
9.1	Designs, construction, principles of working schematic circuits diagrams of train lighting equipments used in train lighting system.
9.2	Coach wiring, under frame wiring, schedule of rewiring, couplers, lamp resistance, junction boxes and fuses, Generation to non-generation ratio, lights, fans and water raising apparatus.
9.3	Self generating coaches, End on –Generation, Head on Generation, power cars, electrical and mechanical components, layout, operation and maintenance procedures for slip coaches.

9.4	Train lighting batteries their maintenance, defects analysis of causes of failures and remedial measures. Simplified system of train lighting use of alternators, anti-theft measures.
9.5	Fires in trains, preventive measures and precautions.
9.6	Periodic over haul and heavy repairs to train lighting equipment.
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9.8	Maintenance schedule for AC coaches, partial AC coaches, AC I, II/III coaches, Sleeper Coaches. Running repairs.
9.9	Coordination with Mechanical, Operating and Security Department.
9.10	Important instructions issued by Railway Board, RDSO's SMIs, TCs and related investigations reports.
10.0	**Electric Locos:-**
10.1	Description of locomotives in service, principles of operation and characteristics of different types of locos used in electric traction on the Indian Railways.
10.2	Power, Auxiliary and control circuits: Their equipment, functioning, maintenance/overhauling schedules.
10.3	Various types of bogies and bogie suspension and their components, power transmission from traction motor to axles, traction motor mounting arrangement i.e. Jacqueman drive, Quill drive, WN coupler: their equipments, functioning, maintenance/overhauling schedules.
10.4	Air, vaccum and Dual Brake System, Air Compressors, regenerative and rheostatic breaking, their equipment, functioning, maintenance/overhauling schedules.
10.5	Function of electric loco sheds and electric loco workshops.
10.6	Schedule inspection of locos i.e. IA, IB, IC, AOH, IOH and POH.

10.7	Records and registers maintained in loco shed, planning and progress organization, statistical data, rolling stock organization in sheds and shops, fire prevention, safety checks and history cards.
10.8	Important instruction issued by Railway Board, RDSO's SMI/MS/TCs and related investigation reports, AC Traction Manual.
11.0	**EMU/MEMU/Metros**
11.1	Utility of EMU trains for urban and suburban services vis-à-vis locomotives, various types of EMUs stock-AC, DC and AC-DC, their salient features, rake formation.
11.2	Power circuits, auxiliary, control circuit, break systems, bogies and other mechanical components, their equipment, functioning, maintenance/overhauling schedules.
11.3	Inspection schedules of EMUs/MEMU/Metros, troubleshooting sequence.
11.4	Safety precautions and fire prevention checks.
11.5	Maintenance and overhaul organization and liaison with other department.
12.0	**Electric Loco and EMU operation:-**
12.1	Operation of electric locos with single unit and multiple unit and with rheostatic and regenerative breaking.
12.2	Safety features to be followed in the operation of electric locos and EMUs.
12.3	Failures of electric locos and EMUs, their cause, investigation and remedial measures for avoiding failures.
12.4	Inter-relation between Electric, Mechanical and Operating department in functioning of electric locos and EMUs.
12.5	Function of traction loco control organization.
12.6	Preparation of engine links and driver links-power plan.
12.7	Compilation of operating statics for electric locos and EMUs operation.
12.8	Outstation organization for maintenance of electric loco and EMU.

DG

12.9	Working rules for preparation/operation of elect. Rolling stock.
12.10	Recruitment and training of running staff –conversion training etc.
12.11	Accidents and re-railing technique of locos and EMUs.
13.0	**Stores Matters:-**
13.1	Procedure relating to procurement of stock items, non-stock items, distribution and accountal of stores.
13.2	Receipt and custody of stores.
13.3	Sale of surplus stores.
13.4	Inventory control.
13.5	Schedule of Powers.
14.0	**Engineering Matters:-**
14.1	Estimates
14.2	Execution of Work
14.3	Contracts for work
14.4	Procedure for traffic and engineering surveys.
15.	**Disaster Management- Role of Electrical Officer:**

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2.9 Organisation of the Railways.

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3.2 Financial Planning & Budgeting – Budgetary and Financial Review – Appropriation Accounts.

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3.4 Works programme-financial justification of works-Surveys-preparations of Estimates-Capital Budget-Control over capital expenditure-productivity test. M & P, RSP.

3.5 Financial control over stores expenditure purchase and stores keeping procedure-Inventory Control and A.B.C Analysis, Stock & Non-stock purchase.

3.6 Financial and cost control in Railway Workshops.

3.7 Rules and procedures relating to tenders and contracts for execution of works and procurement of stores, Estimates, Arbitration.

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3.10 Passes, frauds and embezzlements.

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Syllabus for Technical subjects of Pre-Qualifying Examination for 30% LDCE for promotion to Group-B post of AEE in Electrical Engineering Department

Maximum Marks: 100 Qualifying Marks:75	
Technical Subject	: 40 marks
General Knowledge including optional Questions on Official Language Policy	: 30 marks
Establishment & Financial Rules	: 30 marks

1.0	**General -**
1.1	Net work analysis, Star/Delta, transformation Symmetrical component, transients, Basics of Control Systems.
1.2	**Analog and Digital Electronics and Circuits:** Semiconductor device physics, PN junctions and transistors, circuit models and parameters, FET, Zener, tunnel, Schottky, photo diodes and their applications, rectified circuits, voltage regulators and multipliers, switching behavior of diodes and transistors. Small signal amplifiers, biasing circuits, frequency response and improvement, multi-stage amplifiers and feed-back amplifiers, D.C. amplifiers, Oscillators. Large signal amplifiers, coupling methods, push pull amplifiers, operational amplifiers and wave shaping circuits. Multi-vibrators and flip-flops and their applications. Digital logic gate families, universal gate combinational circuits for arithmetic and logic operation, sequential logic circuits. Counters, registers, RAM and RGMs.
1.3	**Power Electronics:** Power semi-conductor devices. Thyristor. Power transistor (IGBT), GTOs, and MOSFETs. Characteristics and operation. AC to DC Converters; 1-phase and 3-phase DC to DC Converters; AC regulators. Thyristor controlled reactors, switched capacitor networks. Inverters; Single-phase and 3-phase, Pulse width modulation. Sinusoidal modulation with uniform sampling. Switched mode power supplies.
1.4	**Indian Elect. Acts & Rules:** Application of these to Railway working, checks to be carried out before commissioning Elect. Assets, functions and duties of Electrical Inspectors (EIG), Electricity Act 2003. Energy conservation Act 2007. ECB Code, role of Lift Inspector, Lift & Escalators Rules.

2.0	**Electrical Engineering Materials-**
	Band Theory, Conductors, Semiconductors and Insulators, Super-conductivity. Insulators for electrical and electronic applications. Magnetic materials. Ferro and ferri magnetism. Ceramics; Properties and applications. Hall effect and its applications. Special semi-conductors. Insulating material classification/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, leakage, losses and efficiency.
3.2	Direct current machines; Generation of EMF, work, power, Torque equation, armature winding, armature, reaction, theory of commutation, inter-poles & compensating windings, characteristics of shunts, series and compound generators, parallel running and load sharing of generators. Construction, Excitation methods. Circuit models characteristics and performance analysis. Generators and motors. Starting and speed control. Testing. Losses and efficiency.
3.3	Synchronous Machines. Construction. Circuit model. Operating characteristics and performance analysis. Synchronous reactance. Efficiency. Voltage regulation. Salient – pole machine. Parallel operation. Hunting. Short circuit transients.
3.4	Induction machines. Construction. Principle of operation. Rotating fields, Characteristics and performance analysis. Determination of circuit model. Circle diagram, Starting and speed control, Fractional K W motors. Single- phase synchronous and induction motors, 3 phase asynchronous motors and induction motors for traction application.
3.5	Transformers: Construction and testing. Equivalent circuits. Losses and efficiency. Regulation. Auto-transformer. 3-phase transformer. Parallel operation. Methods of cooling, Tap changing, parallel operation, polarity and phase sequence testing, protection Instruments, PTs & CTs, etc. Scott connection transformer.
4.0	**Generation, Transmission & Utilisation-**
4.1	Sources of energy, heat value of fuel , steam power station, Hydro Elect. Station, Nuclear power station. Pumped storage plants. Economics and operating factors.

4.2	Power transmission lines. Modeling and performance characteristics. Voltage control. Load flow studies. Optimal power system operation. Load frequency control. Symmetrical short circuit analysis. Z-Bus formulation. Symmetrical Components. Per Unit representation. Fault analysis. Transient and steady-state 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 design & economical layout of service building, workshop & yards. Various sources of light-fluorescent tubes etc.
4.4	Electric traction : Advantages & disadvantages, speed time traction motor, starting & speed control of DC series motors, pre-consumption, Regenerative breaking, advantages and disadvantages of AC traction over DC traction, Tractive effort, Breaking effort.
4.5	Group & Individual drive. Choice of drive & motors for various usages.
5.0	**Measurement & instrumentation-**
5.1	Units and Standards. Error analysis Measurement of resistance (High & Low), potentiometer, wheat stone & Kelvin bridge, meggers insulation resistance & earth resistance.
5.2	Voltmeters, ammeter, power factor meter, single phase watt meter measurements of three phase power 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 electrical quantities like temperature, pressure, flow displacement, acceleration, noise level, etc. Date acquisition systems A/D and D/A converters.
6.0	**Mechanical Engineering Refrigeration etc.**
6.1	Various types of drives, belt, tooth gearing , rope and chain drive. Helical gears. Different types of bearings, ball, roller etc.
6.2	Heat pump cycle, vapour compression, estimation of coach heating levels and plant capacities, calculation of psychology charts, condensers cooling and dehumidification, refrigerant and properties.

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7.0	**General Services-**
7.1	General power supply arrangements, air conditioning etc.
7.2	Power Supply: HT & LT sources, power supply network, substation layout, overhead & under ground distribution, maintenance & operation of transformers, switch gears, protective devices & distribution lines.
7.3	Construction, erection & commissioning of new sub station distribution lines, line calculations etc.
7.4	House wiring metering & safety precautions.
7.5	Tariff & agreement, Relative merits of obtaining HT & LT supply, step to reduce maximum demand, measurement of power, power factor, measuring demand etc.
7.6	Water supply & requirement of water planning of water supply system, sources of water pipe line frictional & other losses, discharge calculations.
7.7	Reciprocating centrifugal & turbine pumps, relative merit, choice of VS & HS pumps, characteristic curve of pumps, efficiency Drives Elect. Connections & protections. Cavitations & priming of pumps measurement of output with V-Notch & nozzle, necessity of multi stage pumping, storage capacity and purification of water.
7.8	Preventive maintenance, special failure of pumps and motors, periodical overhaul.
7.9	**Air-Conditions and Refrigeration :**
	Central air-conditioning plant & package type system, refrigeration cycle, air changes, planning for capacity and drives for refrigeration plants, refrigerants and ducting.
7.10	Specification, design & testing of water coolers, central as well as package plants. Requirements of water coolers, window coolers & refrigerators.
7.11	Standby arrangement: DG sets, both petrol & diesel as also diesel pumps for water supply arrangements. Operation maintenance and overhauling.
7.12	Illumination, yard lighting, street lighting & town supply net work. Drives for workshop machinery.

7.13	Earthing & Bonding.
7.14	Commissioning & maintenance aspect of conventional & maintenance free earthing arrangement for general service application.
7.15	Maintenance of various equipment of sub-station, Energy Management, Important Instructions issued by Railway Board and RDSO.
7.16	Energy Consumption, Renewable Energy, Solar, Wind and biomass
8.0	**Traction Distribution-**
8.1	Systems of electrification in use and advantage and disadvantages of the different systems with emphasis on 2X25 KV system.
8.2	Feasibility studies and justifications for track electrifications, preliminary planning and design, procedure followed in taking up electrification scheme, working drawing for execution of OHE wiring plans and OHE layout plans.
8.3	Planning of layout of overhead equipments, Techno economic survey for electrification of new lines, foot by foot survey, prepegging plan precautions to be taken while wiring new lines, foundation & the types & use of wiring trains, final checking safety checks of certification, energizing of new lines, principles of preparation of lay out plans, provision of return conductors.
8.4	Overhead equipments – Types of overhead equipments, regulated and unregulated systems, stitches OHE, speed potential of various types of OHE, Centenary, contact wire, Dropper & Jumper Overlaps, clearances, Mast & portals, schedules of Dimensions etc.
8.5	Maintenance problems with OHE, Foot Patrolling, current collection and use of tower wagons, ladders & ladder trolleys, seasonal & cyclone checks, maintenance Schedule, Insulator cleaning, straightening of out of plumb masts, earthing and bonds, return conductor preventive maintenance Tools, types of Blocks & Procedure.
8.6	Breakdowns, TRD works during breakdown and accident restoration procedure both temporary and permanent.
8.7	Overhaul schedule & anti-theft measures.

8.8	Organization & working of maintenance depots, repair workshop training of staff safety measurements and precautions.
8.9	**Power supply installation:** Power supply arrangements, traction sub stations, feeding station SSP & SPs, 132 KV transmission lines, Railway owned sub station, transformer maintenance, circuit breakers, current and potential transformers, protective relays, auxiliary transformers, interrupter and isolators.
8.10	Liaison with power supply authorities, monthly meter reading, control over maximum demand, emergency power supply arrangements. Automated Meter Reading.
8.11	Maintenance of switching stations.
8.12	Remote control system, remote control equipment for AC substation and its working. Operation and maintenance of remote control. Specialized equipments for remote control work.
8.13	Remote control centre, traction power control organization, permit work, emergency arrangements, coordination with operating and other departments. Liaison with supply authorities, emergency phones, safety precautions for electrified section.
8.14	Miscellaneous: Traction, stores and their accountal, regulation for electrical crossing of railway tracks.
8.15	Important instructions issued by Railway Board, RDSO's SMI./MS.TCs and related Investigation Reports.
9.0	Train lighting and air conditioned coaches.
9.1	Designs, construction, principles of working schematic circuits diagrams of train lighting equipments used in train lighting system.
9.2	Coach wiring, under frame wiring, schedule of rewiring, couplers, lamp resistance, junction boxes and fuses, Generation to non-generation ratio, lights, fans and water raising apparatus.
9.3	Self generating coaches, End on –Generation, Head on Generation, power cars, electrical and mechanical components, layout, operation and maintenance procedures for slip coaches.

9.4	Train lighting batteries their maintenance, defects analysis of causes of failures and remedial measures. Simplified system of train lighting use of alternators, anti-theft measures.
9.5	Fires in trains, preventive measures and precautions.
9.6	Periodic over haul and heavy repairs to train lighting equipment.
9.7	Broad outlines of types of equipments used in 110V and 415 Volt air conditioned coaches, scheme of refrigerated vans. Drives and their problems, maintenance and operational problems Refrigeration, compressors their types in service and their problems, gear boxes, their maintenance and alignment.
9.8	Maintenance schedule for AC coaches, partial AC coaches, AC I, II/III coaches, Sleeper Coaches. Running repairs.
9.9	Coordination with Mechanical, Operating and Security Department.
9.10	Important instructions issued by Railway Board, RDSO's SMIs, TCs and related investigations reports.
10.0	**Electric Locos:-**
10.1	Description of locomotives in service, principles of operation and characteristics of different types of locos used in electric traction on the Indian Railways.
10.2	Power, Auxiliary and control circuits: Their equipment, functioning, maintenance/overhauling schedules.
10.3	Various types of bogies and bogie suspension and their components, power transmission from traction motor to axles, traction motor mounting arrangement i.e. Jacqueman drive, Quill drive, WN coupler: their equipments, functioning, maintenance/overhauling schedules.
10.4	Air, vaccum and Dual Brake System, Air Compressors, regenerative and rheostatic breaking, their equipment, functioning, maintenance/overhauling schedules.
10.5	Function of electric loco sheds and electric loco workshops.
10.6	Schedule inspection of locos i.e. IA, IB, IC, AOH, IOH and POH.

10.7	Records and registers maintained in loco shed, planning and progress organization, statistical data, rolling stock organization in sheds and shops, fire prevention, safety checks and history cards.
10.8	Important instruction issued by Railway Board, RDSO's SMI/MS/TCs and related investigation reports, AC Traction Manual.
11.0	**EMU/MEMU/Metros**
11.1	Utility of EMU trains for urban and suburban services vis-à-vis locomotives, various types of EMUs stock-AC, DC and AC-DC, their salient features, rake formation.
11.2	Power circuits, auxiliary, control circuit, break systems, bogies and other mechanical components, their equipment, functioning, maintenance/overhauling schedules.
11.3	Inspection schedules of EMUs/MEMU/Metros, troubleshooting sequence.
11.4	Safety precautions and fire prevention checks.
11.5	Maintenance and overhaul organization and liaison with other department.
12.0	**Electric Loco and EMU operation:-**
12.1	Operation of electric locos with single unit and multiple unit and with rheostatic and regenerative breaking.
12.2	Safety features to be followed in the operation of electric locos and EMUs.
12.3	Failures of electric locos and EMUs, their cause, investigation and remedial measures for avoiding failures.
12.4	Inter-relation between Electric, Mechanical and Operating department in functioning of electric locos and EMUs.
12.5	Function of traction loco control organization.
12.6	Preparation of engine links and driver links-power plan.
12.7	Compilation of operating statics for electric locos and EMUs operation.
12.8	Outstation organization for maintenance of electric loco and EMU.

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12.9	Working rules for preparation/operation of elect. Rolling stock.
12.10	Recruitment and training of running staff –conversion training etc.
12.11	Accidents and re-railing technique of locos and EMUs.
13.0	**Stores Matters:-**
13.1	Procedure relating to procurement of stock items, non-stock items, distribution and accountal of stores.
13.2	Receipt and custody of stores.
13.3	Sale of surplus stores.
13.4	Inventory control.
13.5	Schedule of Powers.
14.0	**Engineering Matters:-**
14.1	Estimates
14.2	Execution of Work
14.3	Contracts for work
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