

**FURTHER DETAILS REGARDING MAIN TOPICS OF  
PROGRAMME NO. 08B/2015 (Item Nos. 7, 8 & 9)**

**SUB ENGINEER (ELECTRICAL)**

**(NCA Notification)**

**KERALA STATE ELECTRICITY BOARD**

**(CATEGORY NO. 325/2011, 326/2011 & 327/2011)**

**PART I: ELECTRICAL ENGINEERING**

**BASIC ELECTRICAL ENGINEERING**

**Electrical Circuits and Networks**

Electric current, Voltage, Resistance- Definition and units, Laws of resistance- Sp: resistance- Conductance and Conductivity, Effect of temperature on resistance- Temp. coefficient.

D. C. Circuits- Ohm's law- series, parallel, series- parallel circuits.

Network theorems- Kirchoff's Law, Super position theorem, Thevenin's theorem, Norton theorem- Electric power and Energy in DC circuits, their units etc.

Heating effect of electric current- Joules law

**Electrostatics Magnetism**

Static electricity- Absolute and relative permittivity of a medium, Dielectric constant- Laws of electrostatics.

Electric field, Field strength, Electrostatic Induction- Electric flux density- potential and potential difference- potential of a charged sphere- Equipotential surfaces, Potential gradient- Breakdown voltage and dielectric strength.

Capacitor and Capacitance- Capacitance of an isolated sphere, spherical capacitor and parallel plate capacitor, variable capacitors, capacitors in series and parallel, Energy stored in a capacitor.

Faraday's Laws of Electrolysis, Electroplating, primary and secondary cells, comparison of lead acid and alkaline cells, Initial charging and commissioning of new batteries, Charging methods, Ampere hour, and Watt hour efficiencies, Galvanizing and Anodizing, Extraction of zinc and aluminium, field application of Electrolysis.

Absolute and relative permeability, Field strength magnetizing force, flux and flux density, Relation between flux density and magnetizing force, B. H. curve, Methods of magnetization.

Force on a current carrying conductor in a magnetic field- Magnetizing force of a long straight conductor, long solenoid.

Magnetic circuit- magnetomotive force, reluctance, Ampereturns, Permeance, Reluctivity. Comparison of magnetic and electrical circuits- Faraday's laws of electromagnetic induction- direction of induced emf and current, statically and dynamically induced emf. Expression for dynamically and statically induced emf, self and mutual inductance, Coefficient of coupling, Energy stored in a magnetic field.

### **AC Fundamentals**

Generation of alternating voltage and current- instantaneous values of voltage and current, Simple and complete waveforms, Definition of cycle, frequency, time period, amplitude value, average value, R. M. S value, form factor, peak factor, phase difference, relation between frequency, poles and speed.

AC through R, L and C- voltage, current, power, P. F in pure resistive, inductive, capacitive, single phase circuits- active, reactive and apparent power, Q- factor, Resonance in R- L- C circuits- parallel AC single phase circuits- vector, phasor method, resonance in parallel circuit- Q- factor.

Generation of poly phase voltage- advantages, Phase sequence. Interconnection of three- phases, star and delta connection. Relation between phase and line voltages and current in star and delta- power in three- phase system in star and delta. Power, current and power factor in a three- phase balanced system. Balanced and unbalanced three- phase system. Balanced star- delta and delta- star conversion, Three- phase power measurement- single, three and two- watt meter methods.

## **DESIGN ESTIMATING AND COSTING**

### **Domestic Wiring**

Define estimate- essential elements- calculation of conductor size- current rating of copper and aluminium cables- simple core- wiring accessories- layout preparation, wiring, diagram and estimates for house, office building, schools, cinema theatre.

Define terms used in illumination- Laws of illumination- various lighting schemes- illumination level for various places- space height ratio- utilization factor- Depreciation factor- Maintenance

factor- Design of lighting schemes for various rooms- arrangements of lamps- design of flood lighting schemes. Types of lamps- incandescent- gas filled lamps, advantages over vacuum lamps- types of gases used- Arc lamps- Principle and uses- Hlaogen lamps- CFL working and uses- discharge lamps- sodium lamps- HMPV and LMPV lamps- neon lamps- fluorescent lamps and the field application of each.

Earthing- purpose- I. S. rules regarding earthing- Types of earthing, rules regarding power circuit wiring- estimates and cost of materials regarding wiring pump set in single phase and three-phase systems- estimation and costing of control panel and wiring of small workshops- estimate and costing of service connection wiring using U G cables and O H lines. Mechanical aspects of O H lines- electrical aspects of O H lines, Types of U G cables.

Extension of overhead lines- estimate and cost for extending single phase low tension distribution lines- three phase distribution lines- street lighting using O H lines- U G cables- estimate and costing of 11 kV OH line extension.

Sub-station- I E rules regarding spacing of conductor- distance from building etc- materials used for erecting 11 kV sub-station- preparation of the distribution sub- station- 4 pole mounted sub-station- P length mounted sub- stations.

Define installation scheme for 2 large industry.

Designs of ratings of back- up fuse, ACBS, MCCB, busbar, cables, capacitor banks, generator, change over mechanism, transformer etc as per rules.

## **UTILIZATION OF ELECTRICAL POWER**

### **Electrical Heating**

Electric heating and welding- advantages and types of electric heating- properties of resistance heating materials- design of heating elements- Resistance ovens- methods of temperature controls.

Induction heating- Principle- factors affecting induction heating- induction furnace- coren type and core less type- high frequency eddy current heating- dielectric heating- equivalent circuit- loss angle application of dielectric heating- Arc furnace- direct and indirect types.

Electric welding- types- resistance welding- spot welding- pre welding- seam welding- electric arc welding- electrical properties of negative resistance- types of arc welding- requirements of welding generators and transformers- use of reactor for control of welding current- third brush and bipolar welding generators- description.

## **Electrical Drives in Industry**

Mechanical features of electric motor- frame size- relation between speed and **frame** size- types of enclosures.

Electric drives- classification of electric drives- group, individual and multimotor drives- matching the drive with load- basic classes of duty- continuous- short time- intermittent periods duty, selection of electric drives- steel mills, paper mills, cement mills.

Electric traction- system of electric traction- direct electric traction- diesel electric traction- merits and demerits- factors affecting specific energy consumption.

Traction motors- DC and AC motors- properties and characteristics- control of DC motors- series parallel control systems of electric traction- DC single and three phase systems of supply- brief description.

## **DC MACHINES**

Basic electro magnetic laws- EMF generation in a rotating machine- production of torque- concepts of electric machines- common features of electric machines- types of electrical machines- torque balance- power losses and efficiency- methods of ventilation and cooling machines.

Principle and working of a practical generator and construction details- commutator assembly- emf equation- classification of generators based on methods of excitations, Armature windings- equalizer connections.

Armature reaction- effects- commutation- methods of improving commutation. Generator characteristics . critical field resistance and critical speed- uses of DC generators.

DC motor principle- back emf- voltage equation- torque equation- Types of motors- motor characteristics for DC shunt, series and compound motors. Factors controlling motor speed- methods of speed control of shunt, series and compound motors. Starting of DC motors- Starters Types and necessity.

Testing of DC motors- losses in DC machines- determination of efficiency- Swineborne test- advantages and disadvantages.

## **RENEWABLE SOURCES OF ENERGY**

Conventional sources of energy- non conventional source of energy

Description of photovoltaic effect- Electro characteristics- Application of solar energy devices.

Wind energy basics- classifications- wind energy turbines- conversion of wind energy to electrical energy brief idea. Application of wind energy devices.

Concepts of ocean energy- concepts of wave energy- methods hybrid cycles- physical principles- fixed devices and floating devices.

## **GENERATION, TRANSMISSION AND DISTRIBUTION, SWITCH GEAR AND PROTECTION**

Electrical power generation-economic power-power factor improvement-transmission line elements-underground cables-sag in transmission lines-distribution system(ac and dc)

Short circuit current calculation and fuses-circuit breakers-relays-protection of alternators, transformers, transmission line- earthing and lightning arresters

## **AC MACHINE, TRANSFORMERS, ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENT**

Synchronous generator-characteristics and parallel operation of alternators-voltage regulation-synchronous motors -single phase induction motors -fractional horse power motors-transformer principle-testing of transformers-special purpose transformers-principles of induction motors-speed control of induction motors-theory of measuring instrument-measurement of power and energy-measurement of R,L,C-commercial measuring instrument-CRO and transducers

## **PART II: ELECTRONICS ENGINEERING**

### **BASIC ELECTRONICS, ELECTRONIC DEVICES AND CIRCUITS & DIGITAL ELECTRONICS**

Resistor, capacitors , inductors, transformers (Types and their applications),basic network theorems, fundamentals of alternating current (Define waveform, time period, frequency and amplitude, phase difference, r.m.s. value, average value)

A.C. through resistors, inductors and capacitors, Q-factor of a coil, resonance in R-L-C -Series & parallel circuits, inductive reactance, capacitive reactance and impedance

Semiconductor materials, devices and circuits :

Conductors, insulators & semiconductors, intrinsic & extrinsic semiconductors

Diodes & Rectifiers, different types of diodes, transistors, UJT,FET, integrated circuit, opto electronic devices, Power devices – SCR, diac & triac,

Transistor Amplifiers : methods of inter stage coupling, tuned voltage amplifier, Audio power amplifiers, feed back amplifiers, Oscillators and Multi vibrators, Schmitt trigger, wave shaping circuits.

Digital electronics and Op-Amps\_:

Number systems & Digital Circuits, Boolean algebra, Introduction to logic theory, switching functions AND, OR, NOT, NAND NOR, EXOR operations, Logic families, Combinational Logic Circuits, Sequential Logic Circuits, Operational amplifiers(Circuits, Applications) Memories, Programmable Logic Devices.

Communication systems.

Modulation AM, FM, & PM, Radio Transmitters,

Demodulation and Radio Receivers, Antennas,

Microwave Communication, Satellite Communication, Fiber Optic communication, Mobile Communication.

## **POWER ELECTRONICS**

Power electronics: Power control devices, Converters and inverters , Speed control of machines, Programmable LogiControllers, Voltage Regulators and Power Supplies.

Microprocessors and Micro controller family – 8051 :

Micro Controller Architecture, Micro Controllers-interrupts & operation,

Micro Controller Programming, Micro Controller Interfacing & Applications.

Application, classification and working of computers :

Functions of hardware and software components,

working of memory and input – output devices,

provisions of windows o s and word processing,

Flow chart, Algorithm, Data Processing and Programming Methodology

## **PART III : GENERAL KNOWLEDGE, CURRENT AFFAIRS & RENAISSANCE IN KERALA**

### **Facts about India**

Geography of India- Physical Features- Climate-Soils- Rivers- Famous Sites – Etc

Demography- Economic and Social Development-Poverty Alleviation-Economy and Planning- Etc

History of India- Period from 1857 to 1947- National Movement- Etc.

### **Facts about Kerala**

Geographical Facts- Physical Features- Climate-Soils- Rivers- Famous Sites – Etc

### **Renaissance of Kerala**

#### **Important Events/ Movements/Leaders**

Brahmananda Swami Sivayogi, Chattampi Swami, Sree Narayana Guru, Vagbhatananda, Thycaud Ayya, Ayya Vaikundar, Poikayil Yohannan (Kumara Guru), Ayyankali, Pandit Karuppan, Mannathu Padmanabhan, V.T.Bhattathirippad, Dr. Palpu, Kumaranasan, Vakkom Moulavi, Blessed Kuriakose Elias Chavara, Etc

### **Current Affairs**

***NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.***