**Electrician Registration Examination**
**Category 1**
**Syllabus and Study Guide**

**Section 1 (40 multiple choice questions)**

1. Electrical Codes/Standards (JS 316, IBC, NEC NFPA 70/JS21) & Customer Relations
2. Electrical Safety for Industrial and High Rise facilities
3. Laws & Regulations, with emphasis on grid tie connections
4. PV design and Grid connections
5. Estimation and contractual agreements

**Section 2 (20 multiple choice questions)**

1. High Voltage Systems,
2. Metering systems
3. Motors
4. Sub-Station and Distribution transformers
5. Pole line design and safety

## Study Guide

6. **Electrical Codes/Standards (NEC NFPA 70/JS21)**

*Electrical codes*

*What the Electrical Installation provides. The necessity for regulations; safety of life and property.*

*Supply Systems, Standard Voltage: Variation of voltage and frequency. Distribution systems shown in diagrammatic form. Three phase four-wire delta.*

*Distribution of supply in buildings. Regulations for control, distribution and excess current protection.*

*Frequency and voltage standards for residential distributions*

7. **The general layout of lighting and heating circuits. Planning of final sub-circuit.** · General application of Diversity Factor. Two-way and intermediate switching. · Conductors and Cables: Types of cables used in installation work. Current-carrying capacity of cable. Regulations Heating and Voltage Drop

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8. **Joints and jointing. Flexible Cords. Connections for Flexible cords.**

9. **Wiring Systems. Screwed Conduit; Load-sheathed wiring system; P.V.C cable; M.I.C.C. Duct System; Wiring Accessories: Switches, plugs, socket outlets.**

10. **Earthing: Principle governing the Earthing of the metal portions of electrical installations with special reference to the safety of person and property.** *Construction, application and installation of earth leakage circuit breaker. Causes and prevention of corrosion.*

11. **Tests**
*Test for insulation at various stages, continuity and polarity of current-carrying conductors and for continuity of earth continuity conductors. Earth impedance tests, Tracing out circuits. Testing for location and remedying of faults. Testing for and diagnosis of fault in electrical machines and switchgear. ·Installation of electric signs.*

12. **Wiring Standards for -**
*Lightning rods installation and protection, Use of AFCI receptacles, Duplet outlet, MEM outlet and GFCI outlet*

13. **Regulations for electricity connections to residential premises**
Electrical Safety, General safety, Electrical shock and treatment, Electrical hazards, Grounding and GFCI, Wiring and protection

14. **Equipment , PV design & Grid connection**

15. **Laws & Regulations**
*As outlined in the JM-Jamaica-Electric-Utility-Sector-Book-of-Codes, As outlined in the New Electricity Regulations 212-254 (Combined)*
*Basic Electrical Theory, Basic circuit laws, Current, voltage and power*

16. **Circuit components and their dc and ac circuits:**
*resistors, Inductors and capacitors. The heating, magnetic and chemical effects of the electrical current. Examples of the applications of these effects (AC and DC).*
*Conductors and Insulators: Concepts of Resistance. Potential difference as the cause of current flow. Ohm's Law with simple exercises. Units.*
*Series and parallel circuits. The dependence of Resistance on Dimensions;*

*Restivity. The effect of temperature on the resistance of conductors and insulators. Exercises.*
*Volt, ampere and watt. Rating of lamps and heating elements. Exercises. Relationship between watt and horsepower and between the KWH and B.T.U. Heating effect of current. · Magnetic fields produced by current-carrying conductors. Magnetic materials. Magnetization of iron. Hysteresis. Electromagnetic Induction. Idea of Inductance.*
*Direct current Motors. Principle of operation. Construction; Torque; Reversal of Rotation. Characteristics of shunt, series and compound motors. Speed control; Motor starters. Efficiencies of D.C. Machines. (Descriptive treatment only)*

17. **D.C. DISTRIBUTION. Two-wire and three-wire systems.**

18. **Electric Statics – Capacitors, Inductors, Insulators**

19. · **Alternating current; R.M.S. values.**
Complexor representation of voltage and current. Phase difference. The effect of inductance and capacitance in A.C. circuit. Power factor and PF; co reaction; KW, KVA and KVAR. Simple calculation on A.C. circuits.
A.C. measuring instruments. Ammeter including clip-on type. Voltmeter, Wattmeter and KW Hour meter. Mutual inductance and applications

20. **A.C. transmission and distribution; Advantage of A.C. vs D.C.; Voltage-drop A.C. transmission lines; Three-phase four wire distribution system.**
*Cable size calculations for PVC insulated circuits*
*Determination of electrical parameters for domestic electrical installation*
*Equipment power and energy consumption*

21. **Motors & Transformers (three phase)**

22. **The general idea of three-phase alternating e.m.f. The 'Edison' system. Danger of open circuited neutral.**
*Simple construction and explanation of the operation of: Three-phase induction motor, single-phase motor and three-phase synchronous motor.*
*Simple construction and explanation of the theory and operation of the transformer. Delta and Wye networks*
*Simple description of the methods of converting alternating current to direct current. (Motor generator, thermionic rectifiers and semi-conductor*

*rectifiers). ·Losses in motors and transformers.*

23. **Understanding PV cells function and using solar energy to generate electricity, which flow in the external circuit as current.**
    The Electrical Installation and maintenance of PV systems, Electrical Parameters,
    Calculation of the output of a system, Temperature, Efficiency and Performance, Fill Factor, Maximum Power Point Tracking (MPPT)

24. **Evaluate PV Cell Equivalent Circuit**
    interpret and use standard List of Symbols

25. **Important Electrical Parameters**
    PV cells are manufactured as modules for use in installations. Electrically the important parameters for determining the correct installation and performance are:

- Maximum Power - this is the maximum power output of the PV module (see I-V curve below)
- Open circuit voltage - the output voltage of the PV cell with no load current flowing
- Short circuit current - the current which would flow if the PV sell output was shorted
- Maximum power point voltage - level of voltage on the I-V curve which produces the maximum power
- Maximum power point current - level of current on the I-V curve which produces the maximum power
- Efficiency - measure of the amount of solar energy converted to electrical peak energy
- Parameters for PV cells are measured under specified standard test conditions (STC).
- STC is generally taken as 1000 W/m2, 25 °C and 1.5 AM (air mass).
- The maximum power output is the peak power, which a solar cell can deliver at STC. While common to rate PV installations based on this value, it is unlikely these power levels will be achieved in practice.


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**Sample Practice to determine the output of a system**

**Sample Calculation**

120 solar modules, each of 250 Wp and area of 1.67 m2 are connected to form a PV system. The efficiency of the system is 0.75, and the average annual solar radiation is 1487 kWh/m2. Calculate the expected annual energy production. Using the above information.

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