SYLLABUS

JUNIOR TECHNICIAN – ELECTRICAL ENGINEERING

Written Test (JT Recruitment)

Syllabus for Power Electronics and Power Systems Stream

Arithmetic: 10%

1. Ratio and proportion.
2. Arithmetic progression and geometric progression.
3. Permutation and combination.
4. Logarithm and exponential series.
5. Complex numbers.

General English: 10%

1. Parts of speech.
2. Types of sentences.
3. Numbers, genders, persons, tenses, articles, and degrees.
4. Direct speech and indirect speech.
5. Active voice and passive voice.

Work-related topics: 80%

1. Electrical circuit analysis

a. Network theorems.
b. Resistive DC circuit analysis.
c. Transient analysis and the initial value calculation for RLC circuits.
d. Phasor, impedance, power factor, r.m.s value, active power and reactive power.
e. Steady-state frequency response of RLC circuits.
f. Two-port network modelling and analysis.
g. Three-phase AC circuit analysis.

2. Electrical machines

a. Per unit transformation.
b. Transformer principle and equivalent circuit.
c. Core loss, copper loss and inrush current phenomenon in a transformer.
d. Open circuit, short circuit and polarity tests of a transformer.
e. Three-phase transformer connections.
f. Winding arrangements of a DC and AC rotating machines.
g. Analysis of separately excited, series excited, shunt excited and compound excited DC machines.
h. Concept of rotating MMF in an AC machine.
i. Steady-state modelling and analysis of synchronous and induction machines.

3. Power electronics

a. Power electronic devices such as diode, thyristor, GTO, IGBT and MOSFET.
b. Filter and snubber circuits.
c. Thyristor commutation.
d. Diode-bridge single-phase and three-phase rectifier circuits.
e. Thyristor-bridge single-phase and three-phase converter circuits.
f. Buck, boost, buck-boost converters.

g. Harmonic analysis and THD calculation.

4. Control system

a. Concept of the linear time-invariant (LTI) system.
b. Laplace transformation, convolution, initial value theorem and final value theorem.
c. Block diagram, impulse response, transfer function and characteristic equation.
d. Routh-Hurwitz criterion for the stability analysis of an LTI system.
e. Maximum overshoot, rise time and settling time.
f. Nyquist criterion, Bode plot, gain margin and phase margin.
g. PID, lead-lag and washout controllers.

Syllabus for the Microelectronics and VLSI Stream

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General English: 10%

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Work-related topics: 80%

1. Electronic Devices and Circuits

a. Network theorems.
b. Diode IV characteristics
c. MOSFET IV and operating regimes
d. Integrated Circuits, Scaling of semiconductor technology

2. Laboratory Instrumentation and Measurements

a. Impedance, sampling rate, settling time and other common instrument parameters
b. Oscilloscopes - Digital and analog, Function generators
c. Familiarity with low-current and high-speed measurements and necessary precautions
d. Understanding of Signal grounding, routing and noise reduction.
e. EMI

3. PCB Design and Testing

a. High-speed high-performance PCB board design
b. Types of connectors and interfaces
c. ESD Protection
d. Parasitics

4. Computer skills

a. Basic programming skills (C and Python), pseudo-code
b. Types of interfaces for automating measurements (GPIB/USB/LXI)

5. Miscellaneous Topics

a. Basic principles of common electronic/electrical devices in every-day life (e.g. communication devices, inverters, chargers, monitors, etc)
b. Application of signal processing techniques for measurements

Syllabus for the Communications and Signal Processing Stream

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General English: 10%

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Work-related topics: 80%

1. Computing Skills: Basic programming constructs: data types, arrays, pointers, linked lists and trees, statements, I/O, conditionals, loops, functions, class/object.
2. Communication Technologies: Communication Standards, 2G/3G/4G/5G, ZigBee, BLE, Wi-Fi, LTE, IEEE 802.11x, data rates, coverage/range, power, computations, bandwidth, sensing, processing, communication powering, communication networking, topologies, layer/stack architecture, QoS.
3. Communications System: Physical layer description of communication systems, quantization, data formatting and framing, capacity of a point-to-point link, link budget analysis, multiple access techniques, network routing
4. Data Analytics: Combinatorics, Probability on finite sample spaces, Joint and conditional probabilities, independence, total probability; Bayes' rule and applications.
5. Digital Communications: Passband representation, Baseband equivalent AWGN Channel, Data Modulation and Demodulation, Synthesis of the Modulated Waveform, Discrete Data Detection, The Additive White Gaussian Noise (AWGN) Channel, Signal-to-Noise Ratio (SNR) Maximization with a Matched Filter, Error Probability for the AWGN Channel, MAP and ML detection, Digital Modulation Techniques, Wireless signal propagation and channel models.
6. Digital Signal Processing: Sampling, continuous and discrete-time transforms, Frequency Domain Analysis of LTI Systems, implementation of FFT, algorithms, Filter Design: IIR and FIR filters, sampling rate conversion.

Syllabus for the Systems and Control Stream

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General English: 10%

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Work-related topics: 80%

1. Linear Algebra, Calculus, Differential equations, Analysis of complex variables, Probability and Statistics, Numerical Methods
2. Electrical Circuits,
3. Signals and Systems
4. Control Systems, Feedback principles, signal flow graphs, transient response, steady-state-errors, Bode plot, phase and gain margins, Routh and Nyquist criteria, root loci, design of lead, lag and lead-lag compensators, time-delay systems; P, P-I, P-I-D, cascade, feedforward, and ratio controllers.
5. Analog Electronics, Digital Electronics
6. Measurements, Sensors and Industrial Instrumentation
7. Communication and Optical Instrumentation
8. State space representation, controllability, observability, state feedback control, pole-placement.
9. Programming skills