



रास्ट्रीय प्रौद्योगिकी संस्थान, वरंगल
NATIONAL INSTITUTE OF TECHNOLOGY
WARANGAL - 506 004, Telangana State, INDIA

SYLLABUS FOR THE WRITTEN TEST AND PROFICIENCY
TEST FOR THE POST OF SCIENTIFIC/TECHNICAL
OFFICER TO BE HELD ON 30.04.2021

Scheme of Examination

Levels of Exams:

Level 1:

It is the subject knowledge test designed to test the candidate's knowledge in the IT or relevant areas. The questions will be objective/descriptive/numerical type. This test carries a maximum of 100 marks and maximum duration of exam is 2 hours.

Level 2:

It is the coding test to assess the knowledge of the candidate. This test carries a maximum of 100 marks and maximum duration of exam is 3 hours.

Level 3: Personal Interview for the shortlisted candidates based on level-1 and 2:

** The standard of questions for the tests will generally be in conformity with education standard prescribed for the post.*

I. Scientific/Technical Officer (MIS/IT):

Level 1:

Basic Computer Fundamentals, Programming in C and JAVA - sequence, selection and repetition statements, Recursion, Arrays, Problems involving arrays - Error identification – debugging,

Data Structures – Stacks, Queues, Linked Lists, Trees, Binary Search Trees, Binary Heaps, Graphs.

Operating Systems – Processes, Threads, Inter-Process Communication, Concurrency and Synchronization, Deadlock, CPU Scheduling, Memory Management and Virtual Memory, File Systems.

Databases – E-R Model, Relational Model: Relational Algebra, Tuple Calculus, SQL, Integrity Constraints, Normal Forms, File Organization, Indexing: B and B++ Trees, Transactions and Concurrency Control.

System maintenance and troubleshooting – Windows and Linux OS installation procedures - Dual boot – Reserving space for User/ System while installing OS – Trouble shooting issues related to OS, device drivers – Installing packages through apt- get install – using GUI

Computer Networks – Creating LAN using switches – Understanding switching tables -

Networking commands – ping, netconfig, IP lookup, traceroute – IP settings – DHCP – DNS - Wi- Fi settings – Wired LAN – Wireless LAN – Access points, Concepts of Layering, Flow and Error Control Techniques, Switching, IPv4/IPv6, Routers and Routing Algorithms: Distance Vector and Link State, TCP/UDP and Sockets, Congestion Control, Application Layer Protocols: SMTP, POP, FTP, HTTP, Network Security: Authentication, Basics of Cryptography, Digital Signatures and Certificates, Firewalls, Basic Concepts of Client Server Programming

Website design and maintenance – database connectivity – applications involving HTML, XML, PHP (python) and MySQL PostgreSQL database, Web Security and Configuring SSL

Latest industry trends in the field of IT.

Level 2: Proficiency Test

System Development Test: To analyze, design, develop a small module with respect to any aspect of MIS modules in any backend and frontend.

II. Scientific/Technical Officer (Automation):

Level 1:

Basics of Circuits and Measurement Systems:

Kirchoff's laws, mesh and nodal Analysis. Circuit theorems. One-port and two-port Network Functions. Static and dynamic characteristics of Measurement Systems. Error and uncertainty analysis.

Transducers, Mechanical Measurement and Industrial Instrumentation:

Resistive, Capacitive, Inductive and piezoelectric transducers and their signal conditioning. Measurement of displacement, velocity and acceleration (translational and rotational), force, torque, vibration and shock. Measurement of pressure, flow, temperature and liquid level. Measurement of pH, conductivity, viscosity and humidity.

Analog Electronics:

Characteristics of diode, BJT, JFET and MOSFET. Diode circuits. Transistors at low and high frequencies, Amplifiers, single and multi-stage. Feedback amplifiers. Operational amplifiers, Instrumentation amplifier. Precision rectifier. V-to-I and I-to-V converter. Oscillators and signal generators.

Digital Electronics:

Combinational logic circuits, minimization of Boolean functions. IC families, TTL, MOS and CMOS. Comparators, Schmitt trigger, timers and mono-stable multi-vibrator. Sequential circuits, Multiplexer, S/H circuit. A/D and D/A converters. Microprocessor applications, memory and input-output interfacing. Microcontrollers.

Signals, Systems and Communications:

Periodic and aperiodic signals. Impulse response, Convolution, correlation and characteristics of linear time invariant systems. IIR and FIR filters. AM and FM and demodulation. Sampling theorem, PCM. TDM, FDM, SK, FSK and PSK for digital modulation.

Electrical and Electronic Measurements:

Bridges and potentiometers, measurement of R,L and C. Measurements of voltage, current, power, power factor and energy. A.C & D.C current probes. Extension of instrument ranges. Q-

meter and waveform analyzer. Digital voltmeter and multi-meter. Time, phase and frequency measurements. CRO. Serial and parallel communication. Shielding and grounding.

Control Systems and Process Control:

Feedback principles. Signal flow graphs. Transient Response, steady-state-errors. Routh and Nyquist criteria. Bode plot, root loci. Time delay systems. Phase and gain margin. State space representation of systems. P, P-I, P-ID, feed forward and derivative controller, Fuzzy controllers.

Analytical, Optical and Biomedical Instrumentation:

Mass spectrometry. UV, visible and IR spectrometry. Optical sources and detectors, LED, laser, Photo-diode, photo-resistor and their characteristics. General introduction of medical instrumentation, its problems and specialty. Sensing devices for biomedical instruments, EEG, ECG and EMG. Clinical measurements. Ultrasonic transducers and Ultrasonography.

Non-Destructive Testing

Surface feature inspection and testing: General, Visual, Chemical, and Mechanical. Optical - laser probe, holography, and ultrasonic surface wave probing, Magnetic - magnetization, flux, and Electro potential, Electrical resistivity, Electromagnetic – eddy current techniques, Penetrant, Radiation backscatter, etc.

Sub - surface (Internal feature inspection and Testing: Thermal - temperature sensing,

Electric circuits

Network elements: ideal voltage and current sources, dependent sources, R, L, C, M elements; Network solution methods: KCL, KVL, Node and Mesh analysis; Network Theorems: Thevenin's, Norton's, Superposition and Maximum Power Transfer theorem; Transient response of dc and ac networks, sinusoidal steady-state analysis, resonance, two port networks, balanced three phase circuits, star-delta transformation, complex power and power factor in ac circuits.

Analog and Digital Electronics

Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers: characteristics and applications; single stage active filters, Active Filters: Sallen Key, Butterworth, VCOs and timers, combinatorial and sequential logic circuits, multiplexers, demultiplexers, Schmitt triggers, sample and hold circuits, A/D and D/A converters.

Power Electronics

Static V-I characteristics and firing/gating circuits for Thyristor, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost Converters; Single and three-phase configuration of uncontrolled rectifiers; Voltage and Current commutated Thyristor based converters; Bidirectional ac to dc voltage source converters; Magnitude and Phase of line current harmonics for uncontrolled and thyristor based converters; Power factor and Distortion Factor of ac to dc converters; Single-phase and three-phase voltage and current source inverters, sinusoidal pulse width modulation.

Control Systems:

Mathematical modeling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady- state analysis of linear time invariant systems, Stability analysis using Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Lag, Lead and Lead- Lag compensators; P, PI and PID controllers; State space model, Solution of state equations of LTI systems

Electrical and Electronic Measurements:

Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor;

Instrument transformers, Digital voltmeters and multimeters, Phase, Time and Frequency measurement; Oscilloscopes, Error analysis.

Level 2: Proficiency Test

Measurement of DC voltage and current
Measurement of AC voltage and current
Measurement of resistance, Capacitance and Inductance
Using CRO for voltage, frequency and phase angle measurement
Measurement of phase and frequency using Lissajous figure by CRO
Testing of transistors using transistor tester
Testing of digital IC's using IC tester
Testing flip flops, counters, registers
Seven-segment display testing (LED and LCD)
Using digital frequency meter
Working with rectifiers and filters
Measurement of temperature, flow, pressure, stress, weight
Measurement of velocity, speed, vibration
Electric circuits
Analog and Digital Electronics
Power Electronics
Control Systems:
Electrical and Electronic Measurements:

III. Scientific/Technical Officer (Maintenance):

Level 1:

Thermal Engineering:

Thermodynamics: Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle, properties of pure substances, calculation of work and heat in ideal processes

Power Engineering: Steam Tables, Rankine, Brayton cycles with regeneration and reheat. I.C. Engines: air-standard Otto, Diesel cycles.

Refrigeration and air-conditioning: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes. Reciprocating and rotary compressors, Pelton-wheel, Francis and Kaplan turbines - impulse and reaction principles, velocity diagrams.

Heat Transfer:

Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

Materials, Manufacturing and Industrial Engineering

Casting, Forming and Joining Processes - Design of patterns, moulds and cores, Different types of castings, solidification and cooling, riser & gating design, fundamentals of hot and cold working processes, Plastic deformation and yield criteria load estimation for bulk (drawing, rolling, forging, extrusion) and sheet (deep drawing, shearing, bending), principles of powder metallurgy, metal forming processes, brazing, Principles of welding, soldering & adhesive

bonding.

Engineering Materials - Phase diagrams, structure and properties of engineering materials, heat treatment, stress-strain diagrams for engineering materials.

Machining & Machine Tool Operations - Basic machine tools, Mechanics of machining, single and multi-point cutting tools, tool life and wear, tool geometry and materials, the economics of machining, principles of work holding, principles of non-traditional machining processes, design of jigs and fixtures.

Applied Mechanics and Design

Mechanics of Materials - Elastic constants, Stress and strain, Poisson's ratio, thin cylinders, Mohr's circle for plane stress and plane strain, shear force and bending moment diagrams, deflection of beams, bending and shear stresses, torsion of circular shafts, energy methods, Euler's theory of columns, thermal stresses, testing of materials with universal testing machine, strain gauges and rosettes, testing of hardness and impact strength.

Theory of Machines - Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.

Machine Design - Design for static and dynamic loading, Failure theories, fatigue strength and the S-N diagram, gears, shafts, rolling and sliding contact bearings, springs, brakes and clutches, principles of the design of machine elements like riveted, bolted and welded joints

Vibrations - Effect of damping, Free and forced vibration of single degree of freedom systems, resonance, vibration isolation, critical speeds of shafts.

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Electrical Machines

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three-phase transformers: connections, vector groups, parallel operation; Auto-transformer, Electromechanical energy conversion principles; DC machines:

separately excited, series and shunt, motoring and generating mode of operation and their characteristics, speed control of dc motors; Three-phase induction machines: principle of operation, types, performance, torque-speed characteristics, no-load and blocked-rotor tests, equivalent circuit, starting and speed control; Operating principle of single-phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance and characteristics, regulation and parallel operation of generators, starting of synchronous motors; Types of losses and efficiency calculations of electric machines

Power Systems

Basic concepts of electrical power generation, ac and dc transmission concepts, Models and performance of transmission lines and cables, Economic Load Dispatch (with and without considering transmission losses), Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, Gauss- Seidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential, directional and distance protection; Circuit breakers, System stability concepts, Equal area criterion.

Level – 2: Proficiency Test:

Design Labs: Knowledge of Displacement, Velocity and Acceleration measurement (using accelerometers), speed measurement for rotating systems (Critical speed of shaft, torsional vibrations) and damping measurement and Tribology

Manufacturing labs: knowledge in operating the machines like Lathe, Drilling, milling, CNC, EDM and wire cut EDM, laser assisted machining, Metrology

Thermal Labs: Determination of Flash and Fire Point of given sample of oil, Distillation Test. Draw the valve timing diagram of 4-stroke diesel engine, Conduct fuel consumption test on the given Kirloskar engine at its rated speed and to draw the performance curves, Determine the frictional power of Kirloskar engine at its rated speed by retardation test, Determine the volumetric efficiency of reciprocating air compressor, Determine the thermal conductivity of composite wall, Determine the thermal conductivity of composite wall, Determine the emissivity of given nonblack plate

Electric circuits

Analog and Digital Electronics

Power Electronics

Electrical Machines

Power Systems