Syllabus in respect of recruitment of various post at NIELIT

Evaluations weightage of marks is 15% for interview & 85% for written examination for the posts in GP of Rs. 5400/- and below while for the remaining posts it is 50% each for Interview and written examination.

<table>
<thead>
<tr>
<th>SR NO</th>
<th>POST</th>
<th>SYLLABUS</th>
<th>REMARKS</th>
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<tbody>
<tr>
<td>2.</td>
<td>Scientist C (GP-6600)</td>
<td>EC: Electronics and Communication Engg.</td>
<td>15% General Aptitude, 20% Engg. Mathematics, 65% on subject of respective specialization. Choices are EC / CS &amp; IT.</td>
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<td></td>
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<td>CS: Computer Sc. and Information Technology</td>
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<tr>
<td>3.</td>
<td>Scientist B (GP-5400)</td>
<td>Syllabus is placed at Annexure - I.</td>
<td>For the post @ 2&amp; 3 different question paper with choice of selection EC/CS&amp;IT</td>
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<tr>
<td>4.</td>
<td>Sr Tech Asst (GP-4200)</td>
<td>Mathematics, Computer, Electronics &amp; IT topics- Refer Annexure –IV A</td>
<td>15% General Aptitude, 20% Mathematics &amp; 65% on Computer, IT &amp; Electronics subjects. There will be option of answering either on CS &amp; IT or EC.</td>
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<td>5.</td>
<td>Tech Asst (GP-2400)</td>
<td>Mathematics, Computer, Electronics &amp; IT topics- Refer Annexure –IV B</td>
<td>Questions papers for posts at Sr no 7 &amp; 8 are different, their levels based on the job requirement.</td>
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<td>6.</td>
<td>Jr Tech Asst (GP-1900)</td>
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ANNEXURE –I

Syllabus for the post of Scientist B & Scientist C

EC: ELECTRONICS AND COMMUNICATIONS

Section 1: Engineering Mathematics

Section 2: Networks, Signals and Systems
Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton’s, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks. Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

Section 3: Electronic Devices
Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.

Section 4: Analog Circuits
Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response;
BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and opamp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

Section 5: Digital Circuits

**Number systems; Combinatorial circuits:** Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

**Sequential circuits:** latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

**Section 6: Control Systems**

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Lag, lead and lag-lead compensation; State variable model and solution of state equation of LTI systems.

**Section 7: Communications**

Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

**Section 8: Electromagnetics**

**Electrostatics; Maxwell's equations:** differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, dispersion relations; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Basics of radar; Light propagation in optical fibers.

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**CS: COMPUTER SCIENCE AND INFORMATION TECHNOLOGY**

**Section1: Engineering Mathematics**


Section 2: Digital Logic Boolean algebra.

Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).


Section 4: Programming and Data Structures Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

Section 5: Algorithms Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph search, minimum spanning trees, shortest paths.


Section 8: Operating System Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.

Section 9: Databases ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

Annexure –IV (A)

Syllabus for Senior Technical Assistant

MATHEMATICS

(Common for Electronics, Electronics & Communications / Computer Science, Information Technology)

Matrices: Identification of Matrices, Rank, systems of linear equations, consistency, eigen values, eigen vectors, Cayley Hamilton Theorem, adjoint and inverse.

Determinants: Evaluation of second and third order, minors and cofactors, solutions of simultaneous linear equation in three unknown using Cramer’s rule.

Coordinate geometry: Equations to a straight line – slope-intercept form, intercept form, Angle between two lines, condition for two lines to be perpendicular, parallel.


Differential equations: First order equation (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy’s and Euler’s equations, Initial and boundary value problems, Partial Differential Equations and variable separable method.

Probability and Statistics: Sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Discrete and continuous distributions, Poisson, Normal and Binomial distribution, Correlation and regression analysis.

Option – 1 Electronics / Electronics & Communications


**Digital circuits:** Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinatorial circuits: arithmetic circuits, code converters, multiplexers, decoders, PROMs and PLAs. Sequential circuits: latches and flip-flops, counters and shift-registers. Sample and hold circuits, ADCs, DACs. Semiconductor memories. Microprocessor(8085): architecture, programming, memory and I/O interfacing.

**Signals and Systems:** Definitions and properties of Laplace transform, continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT, z-transform. Sampling theorem. Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay. Signal transmission through LTI systems.

**Control Systems:** Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integral-Derivative (PID) control. State variable representation and solution of state equation of LTI control systems.

**Communications:** Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Analog communication systems: amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem. Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and
probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM.

**Electromagnetics:** Elements of vector calculus: divergence and curl; Gauss’ and Stokes’ theorems, Maxwell’s equations: differential and integral forms. Wave equation, Poynting vector. Plane waves: propagation through various media; reflection and refraction; phase and group velocity; skin depth. Transmission lines: characteristic impedance; impedance transformation; Smith chart; impedance matching; S parameters, pulse excitation. Waveguides: modes in rectangular waveguides; boundary conditions; cut-off frequencies; dispersion relations. Basics of propagation in dielectric waveguide and optical fibers. Basics of Antennas: Dipole antennas; radiation pattern; antenna gain.

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**Option – II Computer Science / Information Technology**


**Computer Organization and Architecture:** Multiprocessors and microcomputers, Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Cache and main memory, Secondary storage, Semiconductor memory – Internal organization, SRAM, DRAM, SDRAM, Rambus memory, ROM technology, virtual memory, Instruction sequencing, Instruction execution, Hardwired control and microprogrammed control, micro instructions, Instruction pipelining.

**Programming and Data Structures:** Programming in C; Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps.

**Algorithms:** Analysis, Asymptotic notation, Notions of space and time complexity, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide-and-conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes P, NP, NP-hard, NP-complete.

**Graph Theory:** Connectivity, covering, colouring, planarity, isomorphism. Computer Graphics: Line drawing, circle drawing, filling, hatching, 2D/3D transformations, projections, hidden surface removal.

**Theory of Computation:** Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability.
Object Oriented Programming: Object oriented design concepts, programming in C++, Java.

Databases: ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

Set Theory: Sets, relations, functions, groups, partial orders, lattice, algebraic structures.

Theory of Computation: Regular languages and finite automata, context-free languages & pushdown automata, recursively enumerable sets & Turing machines, undecidability.

System Software: Compiler design, lexical analysis, parsing, syntax directed translation, code generation and optimization, Assemblers, linkers and loaders, macroprocessors, operating systems – processes, threads, inter-process communication, synchronization, deadlocks, CPU scheduling, memory management and virtual memory, file systems, I/O systems, protection & security. Module

Information Systems and Software Engineering: information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project, design, coding, testing, implementation, maintenance.


Web technologies: HTML, XML, basic concepts of client-server computing, web server, proxy server, web application development, MVC architecture, e-commerce, web services.
Annexure –IV B

Syllabus for Technical Assistant & Junior Technical Assistant

**MATHEMATICS** (*Common for Electronics, Electronics & Communication Computer Science/IT*)

**ALGEBRA**

-Determinants and Matrices: Definition, Order, Expansion of 2nd & 3rd order Determinants, Cramer’s rule, Determinant value of a square matrix. Singular and non singular matrices, Adjoint of a matrix. Problems, Cayley – Hamilton’s theorem, Inverse of a matrix

-Binomial Theorem: Meaning of nCr and its value. Binomial theorem for (x + a) n, Expansion. Finding constant term, co-efficient of x n, particular term and middle term(s).


**TRIGONOMETRY**

-Definition of an angle, radian, Relation between degree & radian, Trigonometric identities. Trigonometric ratios of standard angles, Meaning of allied angles. Trigonometric ratios of allied angles in terms of 0, Complimentary angles and relation between trigonometric ratios of complimentary angles, Express sum or difference of Sine and Cosine of an angles in to product form, Express product of Sine and Cosine of angles in to sum or difference form, relation between sides of a triangle and Sines, Cosines and Tangents of any angle (Sine rule, Cosine rule and Tangent rule), Projection rule, Half angle formulae in terms of sides of a triangle, Inverse Trigonometric functions

**ANALYTICAL GEOMETRY:**

-Definition of a point in a plane, Specification of a point using co-ordinate system, Points on X-axis and Y-axis, Derivation of distance formula. Section formulae, Mid point formula, Centroid, area of a triangle and collinear points, Problems. Locus of a point with respect to a fixed point and with respect to two fixed points and its equations, Inclination of a line with horizontal line and its slope, Intercept of a straight line, Slope of a line parallel to X-axis and Y-axis, Derivation of conditions for two lines to be parallel and perpendicular, Angle between two lines, Point of intersection of lines.
CALCULUS :

Limits : Variables and Constants. Definition of function, Types of function, Direct and Inverse functions, Explicit and implicit function, Odd and even functions, Definition of limit of a function.


Option -1 Electronics / Electronics & Communication (Diploma Level)


Communication Systems : Elements of communication system, TDM, FDM, Noise, Signal to noise ratio, Modulation techniques, AM & FM receivers. Transmission Lines and Wave Propagation, Electromagnetic waves, wave polarization and its types, reflection, refraction, diffraction, ground wave propagation, space wave propagation (LOS), sky wave propagation, ionosphere layers, critical frequency, MUF, virtual height, troposcatter propagation, Digital Modulation, Sampling theorem, pulse modulation, pulse code modulation, delta modulation, data compression, Data coding, asynchronous transmission, synchronous transmission, error detection and correction, Amplitude shift keying(ASK), frequency shift keying (FSK), phase shift keying (PSK), quadrature amplitude modulation (QAM), Multiplexing and multiple access techniques,
Telephone modem, fax modem and data modem, cable modem, digital subscriber lines, ADSL, multiplexing and multiple access, FDM and TDM, FDMA and TDMA, spread-spectrum, code-division multiple access (CDMA). Telephone System. Public switched telephone network(PSTN), manual and electronic equipment, EPABX, digital EPABX, FAX, Internet telephony. Antennas. Isotropic, half wave dipole antennas, Antenna arrays – broadside, end fire, Yagi Uda, log periodic, turnstile antennas, Parabolic reflectors, Dish antennas, VSAT and Cellular antennas. Microwave devices & Radars, Pulsed Radars, Duplexer, CW radar, radar Beacons, instrument landing system, Satellite Communication, Microwave link, classification of satellites, Geo-stationary Satellites, Fibre Optic Communication, Optical fibre, fibre optic cables, Splices, connectors, optical couplers, optical emitters (LED & LASER diode), optical detectors (PIN diode & APD), Submarine cables, Cable television applications,

**Mobile Communication:** Evolution of Mobile Radio Communication, Cellular systems operation, Digital cellular mobile system, GSM standard, GSM architecture, CDMA systems, EDGE technology.

**Networking & LAN Network topologies:** bus, star, ring, circuit switching, packet switching, message switching, router, OSI Model, WLAN characteristics, Bluetooth, WAP applications, WAN and WAN Protocols, Internet, internet devices, repeaters, bridges, routers, gateways, ARPA net, www, internal architecture of ISP, high level architecture of an ISP, Ways of accessing the internet, PSTN ISDN, Leased lines, DSL, cable modems, TCP/IP, Use of IP address, IP datagrams, classes of IP addresses, ports and sockets, Web Applications Domain name system (DNS), Electronic mail, FTP, TELNET, proxy server


**Circuit Theory:** Behaviour of Passive Components and Resonance in A.C. Circuits Active and passive elements, Mesh Current and Node Voltage Analysis, Kirchoff’s laws, Mesh currents, Network theorems. Thevenin's theorem, Norton's theorem, superposition theorem, reciprocity theorem and Maximum power transfer theorem, Coupled circuits, Transient Analysis & Linear wave shaping circuits, Mutual inductance, Transient Analysis at RC & RL circuits, Transient analysis of series and parallel RLC circuits for over damping cases, pulse wave form, differentiating and integrating circuits.

**Microprocessors, Microcontrollers:** Microprocessor, Basic Microprocessor instructions, Addressing modes, instruction format, RISC versus CISC, Architecture of 8086, minimum and maximum modes, flag register, interrupts, Super scalar architecture, Architecture of 8051, registers, timers, interrupts, fetch cycle, execution cycle, machine cycle, state, Instruction set of 8051, instruction format, classification of instructions, addressing modes- Groups of instructions,
data transfer, arithmetic, logical, branch. Data transfer, single and multi byte addition and subtraction, subroutines, nesting, multiple ending and common ending, use of Input output and machine related statements, debugging, time delay program.


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**Option -2: Computer Science/Information Technology (Diploma Level)**

**Digital logic design** : Digital circuits, Digital ICs, Comparison of TTL, CMOS and ECL logic Families, Number System - Binary, Octal, Decimal, Hexadecimal number system, BCD code, BCD arithmetic (addition, subtraction), Logic gates, Basic laws of Boolean algebra, Duality theorem, De Morgan’s theorem, Combinational Logic Design, K-map representation of logical functions and minimization, standardization of SOP & POS, Half adder and full adder.
Half subtractor and full subtractor, Binary parallel adder, BCD adder, Multiplexers (4:1 and 8:1), Demultiplexer (1:4; 1:8; 1:16), Encoders and Decoder, Design of different code converter, BCD to 7 segment decoder, Comparator, Parity Checker and Generator, Flip Flops And Sequential Logic Design, One-bit memory cell, concept of clock signal, Triggering : edge triggering and level triggering, Excitation table of different Flip-Flop, Asynchronous counter (3 bit, 4 bit), mod N-counter, Synchronous counter, Shift register: SISO, SIPO, PISO, PIPO (4-bit) and Universal Shift register (4-bit), Classification of memories RAM, ROM, PROM, EPROM, EEPROM, Static and Dynamic RAM, A-D And D-A Converters

**Computer Organisation and Architecture** : Basics of Computer system, Von Neumann Architecture and its features, Structure of CPU, function of Memory unit and IO unit, Concept of PC, Laptop, workstation, Server, Super Computer, Instruction structure and addressing modes, Execution steps of a typical instruction through different parts of CPU and memory, Different addressing modes, Memory and IO devices, Memory Hierarchy model, Cache memory, Mapping technique, Hit ratio, Replacement algorithm, virtual memory technique, address translation method, TLB, Programmed IO or Status check IO, Interrupt Mechanism, DMA data transfer, IO processor, Different types of interrupt, Priority interrupt, Simultaneous interrupt, DMA transfer modes, Control unit design issue, Hardwired Control unit design, Microprogrammed Control unit design, Horizontal and vertical microprogramming, RISC, CISC architecture and pipelining, instruction pipelining.


**Data Structures using C** : Pointers, Dynamic Memory allocation, Files, data structures, The Stack, Queues, Linked lists, Trees, Sorting, Searching.


**Operating System** : Process management, Synchronization, Deadlocks, Memory management, Virtual memory management, File system.


**Web Programming**: JavaScript & XHTML Documents, Dynamic Documents with JavaScript, XML, PHP, Database Access through the Web, Ruby.

**Software Testing**: Testing levels and types, Static testing techniques, Dynamic testing, Managing the testing process, Software testing tools, Code of ethics for software professionals.

