BHEL Examination Pattern –for Engineer/ Executive Trainees – General Section (Common Sections)

i) Questions on Test of Reasoning - 50 Questions
Venn Diagrams 10
Similar Pairs/ Analogies 10
Data Interpretation 10
Passage – True/False statements/ analogies 5
Logical Reasoning 5
Basic Maths/ Aptitude 5
Integers/ Percentages/ Prime Numbers etc 5

ii) Questions on General Knowledge - 20 Questions
Self-Explanatory – as per current trends, history, geography, political, sports etc

iii) Questions on General English - 50 Questions
10 Questions on closest meaning words/ Synonyms/ Antonyms
10 Questions on Reading Comprehension/Small Passages
10 Questions on sentence re-arrangement
10 Questions on sentence completion/ preposition use
10 Questions on misspelling/ wrong usage of word

Mechanical Engineering–Syllabus

Topic 1: Engineering Mechanics & Design

Solid Mechanics, Strength of Materials, Mechanics of Machines, Design of Mechanical Drives, Turbomachines, Mechanics of Materials, Theory of Machines, Vibrations, Machine Design, Optimization in Engineering Design.

Topic 2: Fluid Mechanics and Thermal Sciences

Fluid Mechanics, Heat-Transfer and Thermodynamics, Combustion Engineering, refrigeration & Air Conditioning, Fundamentals of Heat & Mass Transfer, Thermal Engineering.

Topic 3: Materials, Manufacturing and Industrial Engineering

Engineering Materials, Casting, Forming and Joining Processes, Machining and Machine Tool Operations, Metrology and Inspection, Computer Integrated Manufacturing (CAD/CAM), Production Planning and Control, Inventory Control and Operations research.

Topic 4: Mechanical Electives -I

Advanced IC Engines, Mechatronics, Industrial Robotics, Dynamics of Machinery, Vehicle Dynamics, Nano Technology, Industrial tribology, MEMS Devices – Design & fabrication, Principles of Turbo machinery.

Topic 5: Mechanical Electives - II

Welding Technology, Industrial Safety Engineering, Coil Hydraulics & Pneumatics, Vibration Analysis & Control, Cryogenic Engineering

Electrical Engineering–Syllabus

Topic 1: Electrical Circuits

Network graph, KCL, KVL, Transient response of dc and ac networks, Ideal current and voltage sources, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem, Two-port networks, Three phase circuits, Power and power factor in ac circuits.

Topic 2: Electromagnetic Fields

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magneto motive force, Reluctance, Magnetic circuits

Topic 3: Signals and Systems & Control Systems

Continuous and discrete-time signals, Shifting and scaling operations, Linear Time Invariant and Causal systems, Fourier series representation of continuous periodic signals, Sampling theorem, Fourier Transform, Laplace Transform and z-Transform.
Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Stability analysis, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model, State transition matrix.

Topic 4: Electrical Machines

Single phase transformer: equivalent circuit, open circuit and short circuit tests, Three phase transformers, Auto-transformer, DC machines, Three phase induction motors, single phase induction motors, Synchronous machines, synchronous motor.

Topic 5: Power Systems

Power generation concepts, ac and dc transmission concepts, transmission lines and cables, Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Bus admittance matrix, Gauss-Seidel and Newton-Raphson methods, Voltage and Frequency control, Power factor correction, Symmetrical and unsymmetrical fault analysis,Circuit breakers.

Topic 6: Analog and Digital Electronics

Characteristics of diodes, BJT, MOSFET, Simple diode circuits, clipping, clamping, rectifiers; Amplifiers, Biasing, , Oscillators and Feedback amplifiers, Operational amplifiers, Simple active filters, VCOs and Timers, Combinational and Sequential logic circuits, Multiplexer, Demultiplexer, Schmitt trigger, Sample and hold circuits, A/D and D/A converters,, 8085Microprocessor: Architecture, Programming and Interfacing.

Topic 7: Power Electronics

Diode, Thyristor, Triac, GTO, MOSFET, IGBT; DC to DC conversion, Buck, Boost and Buck-Boost converters, Single and three phase uncontrolled rectifiers, Line commutated thyristor based converters, Bidirectional ac to dc voltage source converters, Single phase and three phase inverters.

Topic 8: Electrical Electives

Fuzzy Systems & genetic Algorithms, High Voltage Engineering, EHV AC DC Transmission, Artificial Neural Networks, Micro Computing Systems.

Electronics Engineering–Syllabus

Section 1: Engineering Mathematics

Linear Algebra: Vector space, basis, linear dependence and independence, matrix algebra, eigen values and eigen vectors, rank, solution of linear equations – existence and uniqueness.

Calculus: Mean value theorems, theorems of integral calculus, evaluation of definite and improper integrals, partial derivatives, maxima and minima, multiple integrals, line, surface and volume integrals, Taylor series.

Differential Equations: First order equations (linear and nonlinear), higher order linear differential equations, Cauchy's and Euler's equations, methods of solution using variation of parameters, complementary function and particular integral, partial differential equations, variable separable method, initial and boundary value problems.

Vector Analysis: Vectors in plane and space, vector operations, gradient, divergence and curl, Gauss's, Green's and Stoke's theorems.

Complex Analysis: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula; Taylor's and Laurent's series, residue theorem.

Numerical Methods: Solution of nonlinear equations, single and multi-step methods for differential equations, convergence criteria.

Probability and Statistics: Mean, median, mode and standard deviation; combinatorial probability, probability distribution functions - binomial, Poisson, exponential and normal; Joint and conditional probability; Correlation and regression analysis.

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 op-amp 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.

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.

Civil Engineering–Syllabus

Topic 1: Structural Engineering

Solid Mechanics, Strength of Materials, Mechanics of Materials, Structural Analysis, Construction Materials and Management, Concrete Structures, Steel Structures, Optimization in Engineering Design, Analysis of Indeterminate structures, Structural Dynamics, Steel Concrete Composite Structures, Structural System Analysis, Earthquake resistant Structures, Pre-stressed Concrete Structures, Maintenance & Rehabilitation of Structures.

Topic 2: Geotechnical Engineering

Soil Mechanics and Foundation Engineering, Geotechnical Engineering, Earth & Earth retaining structures, Reinforced Earth & Geo Textiles, geotechnical Earthquake Engineering.

Topic 3: Water Resources Engineering

Fluid Mechanics, Hydraulics, Hydrology, Irrigation, Groundwater Hydrology, Applied Hydraulics Engineering, Design of Hydraulics Structures, Design of Offshore & Coastal structures, Marine Foundation Engineering, Ocean Energy.

Topic 4: Environmental Engineering

Water and Waste Water, Air Pollution, Municipal Solid Wastes, Noise Pollution, Models for Air & Water quality, Industrial Wastewater treatment, Environmental Management & Impact Assement, Air pollution Management,

Topic 5: Transportation Engineering

Transportation Infrastructure, Highway Pavements, Traffic Engineering & Safety, Pavement Analysis & Design, Transportation Planning, Railway, Airport & harbour Engineering.

Topic 6: Geomatics Engineering

Principles of surveying; Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement - Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Horizontal and vertical curves.

Photogrammetry - scale, flying height; Remote sensing - basics, platform and sensors, visual image interpretation; Basics of Geographical information system (GIS) and Geographical Positioning system (GPS).

Topic 7: Civil Electives

Urban & Regional Planning, Experimental Stress Analysis, Health Monitoring of Structures, Forensic Engineering.

CSE & IT Engineering–Syllabus

Topic 1: Introduction to Computer Programming

Machine representation, primitive types, arrays and records, objects, expressions, control statements, iteration, procedures, functions, and basic I/O, recursion, pointers, Expressions, data and control abstractions, higher order functions, state and assignment, classes, objects, encapsulation and inheritance. Inductive reasoning of functional programs, loop invariants. Abstraction and its impact on efficiency.

Programming abstractions for control and data. Classification of Programming Languages. Types in Programming Languages: Types and values. Primitive types and composite types, recursive types. Sub typing and presumption rules, Forms of Polymorphism. Static vs. dynamic typing, type-safety and type checking. Lambda Calculus. Foundations of Imperative, Object Oriented, Applicative and Declarative Programming Languages. Programming Environments and virtual machines.

Topic 2: Data Structures and Algorithms

Creation and manipulation of data structures: arrays, lists, stacks, queues, trees, heaps, hash tables, balanced trees, tries, graphs. Algorithms for sorting and searching, order statistics, depth-first and breadth-first search, shortest paths and minimum spanning tree.

Models of computation, algorithm analysis, time and space complexity, average and worst-case analysis, lower bounds. Algorithm design techniques: divide and conquer, greedy, dynamic programming, amortization, randomization. Problem classes P, NP, PSPACE; reducibility, NP-hard and NP complete problems.

Topic 3: Computer Architecture

Assembly level organization: instruction formats, addressing mechanisms, Architecture and programming of 8085 and or x86 architectures, microprogramming, Arithmetic and Logic Unit, Memory systems: memory hierarchy, main memories, cache, virtual memory, Pipeline processing, Interfacing and communication: I/O, interrupts, buses. Multiprocessor and alternative architectures, Contemporary architectures

Topic 4: Operating Systems

Overview of operating systems---multiprogramming, time sharing, real time and distributed operating systems. Concurrency and parallelism. Processes and threads Process synchronization. Process deadlocks. Memory management. Memory fragmentation. Virtual memory using paging. Segmentation. File systems.

Topic 5: Database and Information Systems

Data Models, ER Model, ER Diagrams, UML Class Diagrams. Relational model and query languages (relational algebra and calculus, SQL). Integrity and Security. Database design and normalization. XML and xquery. Storage structures. Indexing and Hashing Techniques. Query processing and optimization, transactions, concurrency control and recovery. Data warehousing and data mining. Information Retrieval. Architecture of a typical DBMS. Advanced storage devices including RAID. Advanced index structures. Buffer Management. Implementation of basic and extended relational algebra operations.

Topic 6: Artificial Intelligence & Machine Learning

Basics of problem-solving: problem representation paradigms, state space, satisfiability vs optimality, pattern classification problems. Search Techniques: Problem size, complexity, approximation and search; depth, breadth and best search; knowledge-based problem solving, artificial neural networks. First order and non-monotonic logic; rule based, frame and semantic network approaches. Learnability theory, approaches to learning, Uncertainty Treatment: formal and empirical approaches including Bayesian theory, belief functions, certainty factors, and fuzzy sets. AI languages and systems, special purpose architectures.

Machine Learning and AI, Supervised and Unsupervised learning, Learning from Analogy, Explanation Based Learning, Structure Learning, Reinforcement Learning, Decision Tree Learning, Decision List Learning Identification in the Limit, Oracle Based Learning, Probably Approximately Correct (PAC) Model, Boosting Bayesian Learning: Maximum Likelihood Estimates, Parameter Estimation, Bayesian Belief Networks, Hidden Markov Models (HMM), Forward-backward Algorithm, Baum Welch Iteration, Feature Enhanced HMM Maximum Entropy Markov Models (MEMM): Motivation for Discriminative Models. Optimization Based Methods: Neural Nets, Support Vector Machines, Genetic Algorithms Applications: Text Learning, Speech Processing, Data Mining, Bioinformatics

Topic 7: Computer Networks

Networking protocols at all layers: transmission media, data link protocols, media access control, routing and congestion control, admission control, traffic shaping and policing, Internet working (IP) and transport layer protocols (TCP). Performance analysis of networks.

Topic 8: Software Engineering

Software development orientation, software development practices, processes, and architecture, software development and life cycle, software project management, estimation techniques, quality management systems, quality control: reviews, configuration management, software requirements phase, process modelling, data modelling, time frame modelling, software design phase, user interface design, computer aided software engineering, software construction phase, quality control: testing.

Topic 9: Cryptography and Network Security

Threats, vulnerabilities and attacks. Authentication, confidentiality, integrity and non-repudiation in data communication. Stream ciphers (ex. RC4) and block ciphers (DES, AES), modes of operation. Public key cryptography using RSA and elliptic curve cryto-schemes (on prime and binary fields). Linear and differential cryptanalysis, side-channel attacks. Discrete Logarithm Problem and Duffie-Hellman key exchange. Attacks (based on Pollard-rho algorithm, for example) on factorization and the discrete log. Properties, applications and attacks on the cryptographic hash. Message authentication Code (MAC) and the digital signature. Key management, digital certificates and the Public Key Infrastructure (PKI).

Topic 10: Computer Graphics

Plane projections, vanishing points, Specification of a 3D view, Image and object precision, z-buffer algorithms, area-based algorithms. Scan conversion, filling, and clipping. Modelling and formulation of optimization problems. Linear costs and convex domains.

HR Examination Syllabus

Topic-I: Schools of Management – Human Relations School, Behaviour School.

Topic-II: Personnel Management: Functions, Structure of Personnel Department, Line and Staff, Job Analysis, Manpower Planning, Recruitment and Selection, Placement and Induction, Wage and Salary Administration, Job evaluation, Methods of Wage payment linking wages with productivity, Grievance handling and Disciplinary action.

Topic-III: HRD Concepts: Evolution, Functions, Performance appraisal, Training and Development, Quality of worklife, Career planning, Quality circles, Training Programmes for workers. Management Development Programmes and Evaluation of training.

Topic-IV: Organisational Behaviour Concepts: Evolution. Role, Group dynamics, Motivation, Leadership. Job satisfaction, Morale, Patigue and Monotony Organisational change and Development, Organisational effectiveness.

Topic–V: Industrial Relations: Approaches. Industrial Relations System, Industrial disputes: Causes, Effects, Trends. Methods and Machinery for the settlement of Industrial disputes, Workers participation in Management. Code of discipline, Tripartite bodies, ILO, Industrial relations and the new economic reforms.

Topic–VI: Trade Unions: Trade Unions Meaning, Objectives, Functions. Theories, Structure of Trade Unions, Trade Union Movement in India.

Topic-VII : Labour legislation in India: Evolution of labour legislation in India, Impact of ILO, Labour legislation and Indian Constitution, Factories Act, Employees State Insurance Act, Workmen's Compensation Act, Maternity Benefit Act, Trade Unions Act, Industrial Employment (Standing orders) Act, Industrial Disputes Act, Minimum Wages Act, Payment of Wages Act, Equal Remuneration Act, Payment of Bonus Act.

Topic-VIII : Labour Welfare: Scope, Theories, Principles and approaches, Statutory and Non-statutory labour welfare: Intra-mural and extra-mural welfare. Agencies of Labour Welfare : State, Employer, Trade Unions, Voluntary Agencies.

Topic-VIII : Labour Market: Labour Market, Features, Demand and Supply of Labour, Nature and Composition of Indian Labour Force, Unemployment and Under-employment. Concepts of wages, State Regulation of wages, Fixation of wages. Wage theories, Wage differentials.

Topic-IX: Emerging HRM concept: New Challenges, Downsizing, Golden handshake, Total quality Management, Training and Management development, Organisational change and Development. Emerging HRM concept.

Finance – Examination Syllabus

Topic 1: Financial Reporting
Introduction of Indian Accounting Standards (Ind AS), Carve outs/ins in Ind ASs vis-à-vis International Financial Reporting Standards (IFRSs), Accounting for Corporate Restructuring (including inter-company holdings), Accounting and reporting of financial instruments, Share based payments, Financial Reporting by Mutual funds, Non-banking finance companies, Merchant bankers, Stock and commodity market intermediaries, Valuation and Developments in Financial Reporting

Topic 2: Strategic Financial Management
Financial Policy and Corporate Strategy, Project Planning and Capital Budgeting, Leasing decision including cross border leasing, Dividend Decisions, Indian Capital Market, Capital Market Instruments, Commodity derivatives, OTC derivatives, Security Analysis, Portfolio Theory and Asset Pricing, Financial Services, Mutual Funds, Exchange Traded Funds, Foreign Direct Investment, Foreign Institutional Investment, International Financial Management, Foreign Exchange Exposure and Risk Management, Mergers, Acquisitions and Restructuring.

Topic 3: Advanced Auditing and Professional Ethics
Auditing Standards, Audit strategy, Risk Assessment and Internal Control, Audit under computerized information system (CIS), Special audit techniques, Rights, duties, and liabilities of auditors; third party liability, Audit under Fiscal Laws, viz, Direct and Indirect Tax Laws, Cost audit, Special features in audit of public sector companies, Internal audit, Investigation and Due Diligence and Professional Ethics.

Topic 4: Company Law
COMPANY LAW & INSOLVENCY AND BANKRUPTCY CODE, 2016,

Topic 5: Allied Laws
The Securities and Exchange Board of India Act, 1992, Securities Contracts (Regulation) Act, 1956, The Foreign Exchange Management Act, 1999, The Competition Act, 2002, The Banking Regulation Act, 1949, The Insurance Act, 1938. The Insurance Regulatory and Development Authority Act, 1999. The Securitisation and Reconstruction of Financial Assets and Enforcement of Security Interest Act, 2002 and The Prevention of Money Laundering Act, 2002.

Topic 6: Advanced Management Accounting
Cost Management, Cost Volume Profit Analysis, Pricing Decisions, Budgets and Budgetary Control, Standard Costing and Variance Analysis, Transfer Pricing, Cost Management in Service Sector and Financial Decision Modeling

Topic 7: Information Systems Control and Audit
Concepts of Governance and Management of Information Systems, Business Continuity Planning and Disaster recovery planning, Auditing & Information Systems, Information Technology Regulatory issues

Topic 8: Direct Tax Laws
The Income-tax Act, 2025 and Rules thereunder

Topic 9: Indirect Tax Laws including Goods and Services Tax & Customs & Foreign Trade Policy
Goods and Services Tax (GST) Law as contained in the Central Goods and Services Tax (CGST) Act, 2017 and Integrated Goods and Services Tax (IGST) Act, 2017, Customs Law as contained in the Customs Act, 1962 and the Customs Tariff Act, 1975 and Foreign Trade Policy to the extent relevant to the indirect tax laws.