KERALA PUBLIC SERVICE COMMISSION

SYLLABUS FOR THE POST OF
RANGE FOREST OFFICER IN
KERALA FOREST & WILDLIFE DEPARTMENT

Optional subject- Computer Science/Engineering/Applications

Module I   Mathematical Foundations   (15 Marks)

Number systems – Binary, octal, hexadecimal number systems, arithmetic operations, number base conversions, representations of negative numbers.

Counting theory - Permutations and combinations, Binomial theorem, Pigeonhole principle.

Prime numbers – Prime-power factorization, primality testing.

Relations and functions – Binary relation, function – types, equivalence relation and partitions, partial order.

Algebraic structures – Homomorphism, isomorphism, semigroup, monoid, group, cyclic group.

Probability – Discrete and continuous probabilities, Bayes' theorem, Gaussian distribution.

Module II   Computer Hardware & Organization (15 Marks)

Basic concepts – Addressing modes, execution of a complete instruction.

Processor logic design – Design of arithmetic logic unit, design of accumulator. Booth's multiplication algorithm. Instruction and arithmetic pipelines, hazard detection and resolution.

Control unit design – Hardwired control design, microprogrammed control design, horizontal and vertical microinstructions.

I/O devices – Interrupts, direct memory access, standard I/O interfaces, RAID.

Memory - Semiconductor RAMs, semiconductor ROMs, content addressable memory. Cache memory – cache mapping schemes. Flash memory.

Module III   Data Structures & Algorithms   (20 Marks)

Analysis – Asymptotic notation, time complexity, space complexity, methods for analyzing complexity.

Arrays and linked lists – array implementation, sparse matrix, stack, queue, circular queue, priority queue. Dynamic memory allocation, linked lists (single, double, circular).

Trees – Binary trees, tree traversals, binary search tree, basic properties and operations. Self-balancing trees – AVL trees.

Disjoint set operations, union and find algorithm.

Graphs - Representation, bipartite graphs, connected graphs and components, depth first search, breadth first search. Euler graphs, Hamiltonian paths, digraphs, shortest path algorithm (Dijkstra's, Floyd-Warshall), spanning trees, Prim's algorithm, Kruskal's algorithm. Planar graphs, geometric dual. Vertex coloring, chromatic number.

Sorting and searching – Selection sort, insertion sort, quick sort, merge sort, heap sort. Linear search, binary search. Analysis and comparison of various techniques for sorting and searching.

Hashing – Hashing techniques, collision resolution, overflow handling.

Complexity theory – P, NP, NP-complete, NP-hard classes, tractable and intractable problems.

Approximation algorithms, randomized algorithms.

Module IV   Object Oriented Programming   (10 Marks)

Object oriented programming fundamentals – Object modeling using Unified Modeling Language. Classes, objects, methods, constructor/destructor, operator overloading, method overloading, objects as parameters to methods, static members.

Inheritance – Superclass, subclass, protected members, method overriding, abstract class.

Runtime environment – Bytecode, virtual machine like JVM. Dynamic binding, garbage collection, exception handling.

Threads – Multithreading, stopping and resuming threads, thread synchronization.

Module V   Digital Circuits & Microprocessors   (15 Marks)

Boolean algebra – Basic properties and theorems, Simplification of Boolean functions – Karnaugh Map method, logic gates, universal gates.

Combinational logic circuits – Binary adder, subtractor, parallel adder, BCD adder, code convertor, encoder/decoder, multiplexor/demultiplexor, parity generator/checker.

Sequential logic circuits – Flip-flops (SR, JK, T, D, Master-slave), triggering. Asynchronous/synchronous counters, shift registers, ring counter, Johnson counter.

8086 microprocessor – Addressing modes, instruction set, stack structure, interrupt handling, interfacing with memory and peripheral devices.

Module VI   System Software   (10 Marks)

System software – Assembler (one-pass, multi-pass), interpreter, macro preprocessor, linker, loader, text editor, debugger, device driver.

Compiler design – Lexical analysis, tokens, syntax analysis, parse trees. Top-down parsing – recursive descent parser, predictive parser, LL(1) grammar. Bottom-up parsing – shift-reduce parser, operator precedence parser, LR parser.

Syntax-directed translation, intermediate code generation, code optimization, code generation.

Module VII Operating Systems (10 Marks)

Operating systems fundamentals – system calls, microkernel, system boot process.

Process management – process creation and termination, process control block, inter process communication, CPU scheduling criteria and algorithms. Process synchronization – Critical section problem, mutex, semaphore, monitor, producer-consumer problem, readers-writers problem, dining philosophers' problem.

Deadlocks – Necessary conditions, resource allocation graph, deadlock prevention, deadlock avoidance – banker's algorithm, deadlock detection and recovery.

Memory management – address spaces, swapping, paging, segmentation, virtual memory, demand paging, page replacement algorithms, thrashing.

File system – Structure, File-system/directory implementation, allocation methods.

Storage management – magnetic disk structure, disk formatting, disk scheduling.

Module VIII   Database Management Systems   (15 Marks)

Types of data and DBMS, entity-relationship models.

Relational algebra – Select, project operations. Types of join operations. SQL, views, triggers, data definition language, table operations.

Physical organization – Indexing, B-trees, B+ trees, indexing on multiple keys.

Normalization – Functionals dependency, Armstrong's axioms, closures. Normal forms – first, second, third, Boyce-Codd. Lossless join, dependency-preserving decomposition.

Concurrency – Transaction model, concurrent transaction processing and recovery principles, logs, checkpoints, schedules (concurrent, serializable, recoverable, cascade-less), conflict serializability, two-phase locking.

NoSQL databases – Key-value database, document database, graph database.

Module IX   Data Communication   (15 Marks)

Communication model – Simplex, half-duplex, full duplex transmission. Periodic analog signals – time and frequency domain, bandwidth.

Transmission issues – delay distortion, attenuation. Data rate limits – Nyquist bandwidth, Shannon's capacity formula.

Error detection/correction - Parity check, checksum, cyclic redundancy check, forward error correction, Hamming code.

Guided transmission media: twisted pair, Coaxial cable, optical fiber.

Modulation – Pulse Code Modulation, Delta Modulation, Amplitude/Frequency/Phase Shift Keying, Amplitude/Frequency/Phase Modulation.

Wireless transmission, terrestrial microwave, satellite microwave.

Multiplexing – Time division multiplexing, frequency division multiplexing, wavelength division multiplexing, Code division multiple access (CDMA).

Mobile communication - GSM, 4G, 5G.

Module X   Computer Networks   (15 Marks)

Network hardware devices -Hub, switch, router, bridge, repeater.

Data link layer – Design issues, Medium access control, ethernet, wireless LANs - 802.11 standards.

Network layer – IPv4, Ipv6, IP addressing – subnetting, routing – distance vector, link state. Quality of Service. ICMP, ARP, RARP, OSPF, BGP.

Transport layer – Transmission control protocol, user datagram protocol, congestion control.

Application layer – Electronic mail, MIME, SNMP, DNS, streaming protocols.

Internet of Things (IoT), Wide Area Networks, Personal Area Networks – Bluetooth.

Module XI   Theoretical Computer Science   (10 Marks)

Regular languages – Finite state automata, regular expression, closure properties of regular languages, regular grammar.

Context-free grammar – Ambiguity, closure properties, normal forms (Chomsky, Greibach), pushdown automata.

Chomsky classification of grammars, context-sensitive grammar, linear-bounded automaton.

Turing machines – recursive and recursively enumerable languages, universal Turing machine, halting problem.

Module XII Web Technologies   (10 Marks)

HTML - basic text markup, Cascading Style Sheets.

JavaScript, JSON, XML.

World Wide Web - Web browsers, plug-ins, web server, proxy server, Hypertext Transfer Protocol.

Full stack programming – ReactJS, Node.js.

Module XIII   Machine Learning & Artificial Intelligence   (15 Marks)

Supervised leaning – Linear regression, gradient descent algorithm, overfitting, classification, perceptron, naive Bayes, decision tree algorithm.

Neural Network - Multilayer feed forward network, activation functions (Sigmoid, ReLU, Softmax), backpropagation algorithm.

Unsupervised learning – Clustering. Dimensionality reduction – Principal Component Analysis.

Performance measures – Precision, recall, confusion matrix, accuracy, F-measure, receiver operating characteristic curve, area under curve.

Artificial Intelligence – Heuristic functions, minimax algorithm, Alpha-Beta pruning, constraint satisfaction problems. Knowledge representation and inference in first order logic, propositional logic, forward chaining, backward chaining.

Module XIV   Cryptography & CyberSecurity   (15 Marks)

Cipher fundamentals – Substitution ciphers, transposition ciphers, stream cipher, block cipher.

Cryptosystems – Symmetric key cryptography – triple DES, Advanced Encryption Standard. Public key cryptography – RSA, El Gamal, elliptical curve cryptosystems, Diffie-Hellman key exchange.

Key management – Symmetric key distribution, public key distribution, verifying keys, storing keys, updating keys, public key infrastructure, digital certificates.

Authentication – Hash functions, collision resistance, Hash-based Message Authentication Code, Secure Hash Algorithm, Message Digest (MD5).

Network Security fundamentals – IPSec, TLS, HTTPS, S/MIME, Security policy.

Firewalls - Types of firewalls, application layer firewalls, packet filtering firewalls, UTM.

Intrusion detection and prevention. Virtual Private Networks, managing VPNs.

Module XV   Cloud Computing   (10 Marks)

Cloud delivery models - Infrastructure-as-a-Service (IaaS), Platform-as-a-Service(PaaS), Software-as-a-Service (SaaS), XaaS (Anything-as-a-service).

Cloud deployment models- Public cloud, Community cloud, Private cloud, Hybrid cloud.

Virtualization – hardware / OS level virtualization, Hypervisors. Storage/Desktop Virtualization.

Internet Service Providers (ISP), Data center technology.

Amazon Web Services, Google Cloud, Microsoft Azure.

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the questionpaper. There is no undertaking that all the topics above may be covered in the question paper.