

## **Syllabus for Junior Software Engineer entrance examination – May 2017**

### **Computer Organisation**

#### **1. Basic Concepts**

Registers, stacks, ALU, Control Unit, Instruction types, Instruction formats, instructions sets and addressing modes, RISC processor and CISC processor

#### **2. Basic Mathematical Operations**

Concept of fixed and float numbers, and their representation, fixed point addition, subtraction and multiplication, floating point addition and subtraction

#### **3. Control Unit**

Concept of Hard wired and Micro Instruction based Control Units. Principles of instruction decoding and implementation. Horizontal and vertical classes of micro instructions, identifying micro-instructions, minimising micro-instruction size, parallelism in micro-instructions, encoding control instructions. Timing cycles and clock generation.

#### **4. Memory Organisation**

Main memory, memory hierarchy, memory references, address mapping, relocation mechanism, concept of memory paging and segmentation, associative memory, principles of virtual memory paging, segmentation, cache memory.

#### **5. Input-output organisation**

Memory mapped and I/O mapped input-output. Modes of Data transfer - polled, Interrupt and DMA. Multiple I/O - Daisy Chaining, Polling and Parallel Priority Control.

#### **6. Parallel Processing**

Classification (SISD, SIMD, MISD and MIMD), principles of pipeline processing.

### **Data Structures**

#### **1. Problem solving concepts:**

Top down and bottom up design, structured programming & debugging technique, program testing and documentation.

#### **2. Data type and data structures**

Concept of data type and data structure, difference between data type and data structure, view of data structure at logical level, implementation level, application level, built-in data structures and user-defined data structures

#### **3. User defined data structures**

Difference between user-defined and Built-in data structures. Linear linked list creation, insertion, deletion, traversal, array, circular link list, creation, insertion,

deletion, traversal. Doubly linked list: creation, insertion, deletion, traversal and their application.

**4. Stacks:**

Stack definition and examples, representation of stacks as an array, stack operation, pointer implementation of lists, comparison of two implementation, linked list representation of stacks, application of stacks

**5. Queues**

Queues definitions and examples, representation of queues using arrays, queues operation, linked list representation of queues, application of queues, dequeue.

**6. Non-linear data structures:**

Trees, terminology of trees, concepts and application of binary trees, linked representation of binary trees, tree traversal technique and algorithms using recursion and non-recursive methods, creation of binary tree, inserting a node in binary tree and deletion a node from a binary tree and searching in a binary tree

**7. Searching and sorting**

Searching techniques - Sequential search and binary search. Sorting techniques: insertion sort, selection sort, bubble sort, quick sort, merge sort, heap sort and their efficiency consideration

**Operating Systems**

**1. Brief introduction to system software:** Compiler, Assembler, Loader, Operating System

**2. Overview of Operating System:** Operating System as resource manager, operating system services. System calls. Operating system classifications: single user, multi-user, batch-processing, time-sharing, real-time Operating System, multi-processing, distributed operating system, network operating system.

**3. Memory Management:** Single Contiguous allocation, partitioned allocation, relocatable partitioned allocation. Paged allocation, segmentation.

**4. Processor Management:** Processor overview, process states, multiprogramming, levels of scheduling, deadlock, necessary conditions for deadlock prevention.

**5. File Management:** File supports, access methods, contiguous, linked and indexed allocation, directory systems, single level, two levels, tree structure, graph directory system and file protection.

**6. Device Management:** Dedicated, Shared and Virtual devices, sequential access. Direct access devices. Interrupt processing, idea of spooling, disk scheduling.

## **Database Management Systems**

### **I. Introduction**

1. View of data, data model - ER model, relational model, Database language - DDL, DML

2. Database user and administrator - Database system Vs File system

3. Database system applications

### **2. Database System Concepts And Architecture**

1. Schemas, instances and database state

2. DBMS architecture

3. Data independence - logical and physical data independence

### **3. Entity Relationship Model**

1. Entity and attributes

2. Entity types and entity sets

3. Weak entity types

4. Key - primary key, foreign key, candidate key and super key

5. Relationship among entities

6. ER diagram

### **4. Relation Model**

1. Domains, attributes, tuples and relations

2. Domain constraints

3. Key constraints and constraints on null

4. Entity integrity, referential integrity and foreign key

5. Relational algebra- SELECT, PROJECT, JOIN

### **5. Relation Database Design**

1. First normal form

2. Functional dependency

3. Decomposition

4. BCNF

5. Third normal form

6. Fourth normal form

### **6. Emerging Database Technologies**

1. Data warehouse

2. Data mining

3. Multimedia Database

4. Distributed database concept

5. Database Security & authorization concept

## **Programming in C**

1. Introduction of 'C' language- Structure of a 'C' program, some simple C programs, procedure to execute a 'C' program. Data type, constants and variables
2. C Character sets, Identifiers and keywords, data types, constants, variables, expression, statement, symbolic constants.
3. Operators and expressions  
Arithmetic operators, Relational and logical operators, Unary Operators, Assignment operators, Conditional operators.
4. Data Input and output Library functions, unformatted and formatted input output
5. Control statements and loop structure  
Branching: The if-else statement, looping: while, do-while, for. Nested control structure, Switch statement, break, continue, exit, Comma operator. Jumping: go to statement.
6. Functions Introduction  
Inductions to function, need of functions, function definition, function declaration and prototype, passing arguments to function. Passing arguments by name and value, recursion.
7. Arrays  
Introduction to Arrays. Array declaration, single and multidimensional array, array order reversal, removal of duplicates from an ordered array, binary search, matrix multiplication.
8. Strings  
Introduction to strings, string constants, variables, input, output of string data, standard library string function strlen (), strcat (), strcpy (), strcmp ()
9. Pointers  
Introduction to pointers, address operator and indirection operator, declaring and initialize pointers, pointers in parameter passing, call by reference, pointers and one dimensional array, operation on pointers and one dimensional arrays, dynamic memory location malloc, calloc.
10. Structures and unions  
Introduction to structures, declaration of structure, accessing structure, members initialization. Arrays of structures, user defined data type (typedef). Introduction to unions.
11. Files  
Introduction to file handling - fopen, fclose, fscanf, fprintf, getc, putc. Additional features of C: Enumerations, macro, c pre-processor.

## **Object Oriented Programming**

### **1. Introduction**

- Problems with procedure oriented Programming technique ● Concepts of OOPs
- Characteristics of OOPs □ Advantages and application of OOPs

### **2. C++ Programming Basics**

- Basic Data types ● Type Compatibility ● Operators in C++ ● Scope resolution operator ● Control Structure

### **3. Function C++**

- Function Prototyping ● Call by reference ● Inline function ● Function overloading ● Library Function

### **4. Class and Objects**

- Comparison of Class and C - Structure ● Creating objects ● Arrays within Class ● Arrays of object ● Objects as Function Arguments

### **5. Constructor and Destructor**

- Constructor and its characteristics ● Parameterized Constructor ● Multiple Constructor in a class ● Copy Constructor ● overloaded constructor ● Destructor and its characteristics.

### **6. Operator Constructor**

- Overloading of unary ● Operator of binary operator ● Manipulation of Strings using operator ● Type conversion - basic type to class & class to basic type.

### **7. Inheritance**

- Type of Inheritance ● Need of inheritance ● Application of inheritance

### **8. Managing Console I/O operation**

- Unformatted I/O operation ● Formatted I/O operation: fill, precision, width ● I/O streams

### **9. File Operation**

- Opening & Closing a file ● Programming with files

### **10. Virtual & friend function**

- Pointers to objects ● This pointers ● Pointer to derived classes ● Virtual functions ● Pure virtual functions ● Concept of late & early binding

## **Programming in Java**

### **1. Introduction to Java**

The Basics of Java, A brief history of Java, The Java Architecture, Java Features. Importance of Java to the Internet, Java Applets and Applications, Fundamentals of Object Oriented Programming, Concepts of OOP, Benefits of OOP, Java and C++.

Java Environment, Java Development Kit, Application programming Interface (API).  
Getting started with JDK, Java program structure, Using Java with Other Tools

## **2. Language Basics**

Java tokens, Java character set, Keywords, Identifiers, Literals, Separators Constant Variables. Data types. Type casting Constants, Variables and their Scope, Operator and Expressions, Arithmetic Operators, Relational & Conditional Operators, Logical Operators, Assignment Operators, Increment & Decrement Bitwise operator, special Operators, Precedence of Operators, Control Flow statements-If & If else statements, switch Statement, for loop, while do loop, Branching.

## **3. Objects and Classes in Java**

Introduction to classes, Defining a class. Creating objects, Methods, Constructors and Access Specifics. Application of Constructor. Parameterized Constructors, Overloading Methods and Constructors, Access control Modifiers Public, Private and Protected. Static, Final and Abstract Modifiers and Method overriding, Inheritance basics

## **4. Arrays Strings and Vectors**

Arrays -- one-dimensional array, Multidimensional array, Strings, String class, Working with Strings, String Buffer class, Vector and wrapper class, Vector Constructors, Working with vector methods, wrapper Class.

## **5. Packages and Interfaces**

Using Java interfaces, Defining an interface, Implementing an interface, Extending an Interface, Using Java Packages, Defining a Package , Brief discussion on CLASSPATH, Access Protection, Importing a package, Java API Package,

## **6. Exception handling**

Introduction to Exception Handling, why use Exception Handling, Fundamentals of Exception Handling. Exceptions & their types, Common Exceptions, Using Exception Handling using try and catch, Multiple Catch Statement, Nested try Statements, Methods available to Exceptions, Throwing your own Exception.

## **7. Applet programming**

Writing Applets, The Basics of Applets, Life Cycle of an Applet, Painting the Applet, The Applet Tag, Security Restrictions when using Applets. Taking Advantage of the Applet API, Finding and Loading data Files, Displaying short Status Strings, Displaying Documents in the Browser, Playing Sounds, Defining and Using Applet Parameters

## **8. Working with Graphics**

The Graphic class, java.awt graphics, Custom painting, Drawing Lines, Drawing Rectangles, Drawing ellipses and circles, Drawing Arcs, Drawing Polygons.

#### **4. Two dimensional transformation**

1. Basic transformation - Translation Rotation. Scaling
2. Matrix representation & homogenous coordinates, Composite transformation - translation, Rotational scaling
3. Other transformation - Shear and Reflection

#### **5. Viewing and Clipping**

1. Window to viewport coordinate transformation
2. Point clipping, Cohen-Sutherland line clipping algorithm
3. Sutherland Hodgman polygon clipping

#### **6. Three Dimensional graphics**

Three dimensional transformations, introduction to wire-frame model. Bezier curves.

#### **7. Projections**

1. Parallel projections
2. Perspective projections

#### **8. Animation**

1. Conventional and computer animation
2. Design of animation sequences
3. Morphing
4. Kinematics and dynamics
5. Programming using graphic primitives in C
6. Line drawing using DDA algorithm
7. Line drawing using Bresenham algorithm
8. Bresenham's circle algorithm
9. 2D translation technique
10. 2D rotation technique
11. 2D scaling techniques
12. Creating animations

### **Multimedia Applications**

#### **1. Introduction to Multimedia**

Need of Multimedia  
Application of Multimedia  
Multimedia Hardware  
Storage for Multimedia

#### **2. Sound**

MIDI Versus Digital Audio  
Audio Compression  
Capturing Sound

#### **3. Video**

Video Application

## **Software Engineering**

### **1. Introduction to Software engineering**

Introduction, size factors, Quality and productivity factors, Management issues, models and waterfall spiral, prototyping, fourth generation techniques, software process.

### **2. Software Engineering Metrics**

Size, Function Design Oriented metrics. Halstead's software size, McCabe complexity

### **3. Planning**

The development process. Data flow diagram

### **4. Software Cost Estimations**

Cost factors, cost estimation technique, Staffing level estimation, estimation software, maintenance costs, COCOMO

### **5. Software Requirement Definition**

Problem analysis, requirement engineering. The software Requirements Specification (SRS), formal specification techniques, characteristic of a good SRS.

### **6. Software Design and Implementation Issues.**

Fundamental design, concept design notations, design techniques, structured coding, techniques coding styles, documentation guidelines.

### **7. Verification and Validation Techniques.**

Quality assurance, walk throughs and inspections, static analysis, symbolic execution, unit testing, formal verifications, Black Box and White Box testing techniques.

### **8. Maintenance Overview.**

Configuration Management

## **Computer Graphics**

### **1. Overview of Graphics systems**

Raster scan displays. Vector scan display. Colour CRT monitors and Flat panel display, input and output devices

### **2. Output primitives**

1. Line drawing algorithms - DDA Algorithm and Bresenham's algorithm
2. Circle generating algorithm - circle algorithm, midpoint circle algorithm
3. Introduction to Region filling, flood filling and boundary filling

### **3. Graphics primitives in C**



Video Capturing  
Video Compression

#### **4. Multimedia Authoring Tools**

Card Based Authoring Tools  
Icon Based Authoring Tools  
Time Based Authoring Tools

#### **5. Text**

Fonts and Faces  
Font Manage  
Hypertext

#### **6. Images**

Image File Format  
Bitmaps  
Vector Drawing  
Image Capture Using MATLAB  
Image Compression

#### **7. Animation**

Principle of animation  
Animation File Formats  
Making Animation that Works

### **Computer Networks**

#### **1. Introduction**

Network needs & goals, Application of networks, network topologies, need of protocols, protocol and interfaces, networks services and service access points.

**2. OSI reference model, TCP/IP reference model, Comparison between OSI & TCP/IP reference model**

**3. Transmission media** - analog transmission media, digital transmission media, switching techniques.

**4. Data link layer** - functions, protocols - stop & wait, sliding window.

**5. IEEE standards** - 802.3, 802.4, 802.5, fast Ethernet, FDDI, fiber optics.

**6. Network Layer** - functions, routing algorithms, Inter-networking. Familiarization with repeater, hub, switch, bridge, router, and gateway.

**7. Transport Layer** - Functions and services, transport service primitive, sockets, elements of transport protocols, UDP.

**8. Broad Band network** - ISDN, ATM, Introduction to VSAT, ADSL.

**9. Network security** - Levels of security, introduction to cryptography, Data Encryption Standard (DES) public key cryptography, firewalls.

### **Data Communication**

#### **1. Modulation**

Need for modulation, various type of modulation (Analog + digital) their basic concept comparison of different type of modulation with regard to noise immunity and bandwidth requirement. Basic idea of radio, microwave, satellite, optical fiber, mobile communication system

#### **2. Transmission lines**

Different type of transmission lines communication their characteristics (such as bandwidth, characteristics impedance and frequency response) different kind of distortions (for both analog and digital signals) produce by transmission line and line conditioners Concept of matching. Various kinds of noises and their effect on communication SNR and channel capacity.

#### **3. Principle of data communication**

Transmission of binary data on telephone lines, simplex half-duplex and duplex mode of transmission, two and four line system. Modems and data transfer rate. Basic Block diagram of FSK, PSK, DPSK, QPSK, and QAM modem. Principle of Synchronous, Asynchronous parallel and serial communication. Multiplexing and demultiplexing (TDM & FDM)

#### **4. Data security and error detection**

Signal formats, encryption, Basic principles of error detection on correction, single parity and block parity CRC, communication using frame and packets.

#### **5. Communication standards**

Direct and handshake mode data communication, Physical aspect of different interface standards

#### **6. Communication Equipment**

Introduction to data communication, test procedure and test equipment (Line monitor, loop back method and its implementation, BERT, Protocol analyser cable tester (TDR), OTDR.

## **Network Security**

### **1. Introduction**

Why secure network- Attackers Vs Hackers; attack from within and external.

### **2. How much security**

Promoting risk analysis: developing security policy - accessibility defining security goals, justifying the policy, roles and responsibility, consequences of non-compliance, level of privacy.

### **3. Firewalls**

Defining an access control policy, definition of firewalls and types. Address translation firewall logging, firewall development.

### **4. Intrusion Detection System (IDS)**

IDS introduction: IDS limitation - teardrop attack counter measures: Host based IDS setup.

### **5. Authentication and Encryption Authentication**

Clear Text transmission, session tracking: Encryption - Methods, weaknesses. government interaction: Solutions - data Encryption standards, digital certificate servers IP security, point to point tunnelling protocol (PPTP), RSA encryption, secure socket layer (SSL), secure shell, simple key management for IP (SKIP)

### **6. Virtual Private Network (VPN)**

Basic setting of VPN, VPN diagram. Configuration of required objects, exchanging keys, modifying security policy.

### **7. Virus, Trojans and Worms**

What is virus: replication, concealment bomb, social engineering viruses, worms: Trojan horses, preventive measures - access central checksum verification, process neutering, virus scanners, Application level virus scanner deploying virus protection.

### **8. Disaster, Prevention and Recovery**

Disaster categories: network disaster - cabling topology, single point of failure, save configuration file; server disasters UPS RAID. Clustering, Backup server recovery.

## **Peripherals And Interfaces**

### **1. Display Devices**

Basic principles and working of monitor, video display adapters, overview of Raster scan and vector scan, concept of resolution and bandwidth of monitor, basic concept of PAL and NTSC standard.

### **2. Printers**

Typical printers - impact, non-impact specification, Construction & working principles of DMP, Inkjet Printers, Laser printers.

### **3. Disk Drives**

Construction and working of Hard Disk

Types of actuators - voice coil and stepper motor

Disk preparation - low level formatting, partitioning, high level formatting.

Data encoding techniques

Types of interface

Sector interleaving

**4. Input Device** - Working principle of keyboard, Mouse, Scanner, Digitizer, Touch Screen, Light Pen.

**5. Optical storage Media** - construction and working principles of CD-ROM, DVD.

**6. Other Devices** - Concept of tape drive, Pen Drive, Zip Drive.

## **Computer troubleshooting and maintenance**

### **1. Concept of servicing & maintenance**

Reliability of electronic equipment MTBF, MTTR availability of an equipment.

Preventive maintenance & need of preventive maintenance. Factors affecting the performance of computer. Preparation of preventive maintenance schedule.

Preventive maintenance requirement of a subsystem & auxiliary sub system.

### **2. Breakdown maintenance:**

Scope of field servicing, analysis of customer call reports in locating faults.

### **3. Fault location & its identification**

Various methods of locating fault like visual inspection, layman checks, diagnostic software, error logging & its use. Symptoms & remedies for common faults in peripherals like printers, monitors, FDD, HDD mouse & associated interfaces of PC based systems.

### **4. Symptoms & remedies**

For common faults in peripherals like printers, monitors FDD, HDD, Mouse Motherboard and Supporting cards.

### **5. Power supply**

Linear power supply & switch mode power supply. Significance of power good signal, block diagram & trouble shooting of switch mode power supply.

### **6. Viruses,**

Their types of detection / prevention / removal using vaccines. Familiarization with PC tools & anti virus software & their applications.