

## Teaching Guidelines for Object Oriented Programming with Java PG-DAC September 2022

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**Duration:** 104 hours (48 theory hours + 48 lab hours + 8 revision/practice hours)

**Objective:** To reinforce knowledge of Object Oriented Programming concepts using Core Java.

**Prerequisites:** Basic knowledge of computer programming

**Evaluation:** Total 100 marks

**Weightage:** Theory exam – 40%, Lab exam – 40%, Internals – 20%

**Text Book:**

- Core and Advanced Java Black Book / Dreamtech Press

**References:**

- Java 8 Programming Black Book / Dreamtech Press
- Core Java : Volume 1 - Fundamentals by Cay S. Horstmann / Prentice Hall
- Core Java : Volume 2 - Advanced Features by Cay S. Horstmann / Prentice Hall
- Programming in Java by Sachin Malhotra, Saurabh Choudhary / Oxford University Press
- Java The Complete Reference by Herbert Schildt / McGraw Hill
- Core Java 8 for Beginners by Sharanam Shah, Vaishali Shah / Shroff Publishers
- Murach's Java Programming by Joel Murach / Mike Murach
- Object-Oriented Analysis and Design with applications by Grady Booch / Pearson
- Object-Oriented Analysis and Design Using UML - An Introduction to Unified Process and Design Patterns by Mahesh P. Matha / PHI

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(Note: Each Session is of 2 hours)

**Session 1:**

**Lecture:**

Introduction to java

Features of java

JVM Architecture

JDK and its usage

Structure of java class

Working with data types: Primitive data types

**Session 2:**

**Lecture:**

Operators

- Unary, binary, Arithmetic, Assignment, compound, relational, logical, equality

Control statements (*optional*)

- if-else-if, switch, ternary operator, for loop, while loop, do-while loop

Declaring variables and methods

Data type compatibility

**Lab 1 & 2:**

Get yourself acquainted with java environment.

Print different patterns of asterisk (\*) using loops (e.g. triangle of \*).

**Tutorial:**

Compare syntactical similarities and dissimilarities between Java and C++.

**Session 3:****Lecture:**

Static variables and methods

Accessing static variables and methods of different class

Introduction to reference data types

Reference variables and methods

Difference between reference data types and primitive data types

Difference between reference variable and static variable

**Session 4:****Lecture:**

Constructors, initializing reference variables using constructors

Pass by value v/s pass by reference

Re-assigning a reference variable

Passing reference variable to method

Initializing reference variable of different class

Heap memory and stack memory

**Lab 3 & 4:**

Print default values of static & instance variables for different data types.

Build a class Employee which contains details about the employee and compile and run its instance.

Build a class which has references to other classes. Instantiate these reference variables and invoke instance methods.

**Tutorial:**

Understand role of stack and heap memory in method invocation and object creation.

**Object Oriented Programming Concepts****Session 5:****Lecture:**

Introduction to OOP concepts

Encapsulation

Inheritance: single & multilevel

**Session 6:****Lecture:**

Inheritance: Hierarchical

Association, Aggregation and Composition

Polymorphism: Compile time and runtime polymorphism

Rules of overriding and overloading of methods

super and this keywords

**Lab 5 & 6:**

Create a class Employee and encapsulate the data members.  
Create demo applications to illustrate different types of inheritance.

**Session 7:****Lecture:**

Upcasting & downcasting of a reference variable  
Abstract class and abstract methods  
Interface (implementing multiple interfaces)

**Session 8:****Lecture:**

Final variables, final methods and final class  
Functional interface  
New interface features (Java 8 & above)  
Arrays  
Enumerations

**Lab 7 & 8:**

Create an Array of Employee class and initialize array elements with different employee objects.  
Try to understand the no of objects on heap memory when any array is created.

**Session 9:****Lecture:**

Access modifiers (public, private, protected and default)  
Packages and import statements  
Static imports  
Constructor chaining (with and without packages)  
Accessing protected variables and methods outside the package

**Session 10:****Lecture:**

Garbage collection in java  
Requesting JVM to run garbage collection  
Different ways to make object eligible for garbage collection: (Nulling a reference variable, Re-assigning a reference variable & island of isolation)  
Finalize method

**Lab 9 & 10:**

Create a demo application to understand the role of access modifiers.  
Implement multilevel inheritance using different packages.  
Access/invoke protected members/methods of a class outside the package.  
Override finalize method to understand the behavior of JVM garbage collector.

**Sessions 11 & 12:****Wrapper Classes and String Class****Lecture:**

Wrapper classes and constant pools  
String class, StringBuffer & StringBuilder class

String pool

**Lab 11 & 12:**

Create sample classes to understand boxing & unboxing.

Use different methods of java defined wrapper classes.

Create StringDemo class and perform different string manipulation methods.

**Tutorial:**

Understand the difference between String / StringBuffer / StringBuilder.

**Sessions 13 & 14:**

**Exception Handling**

**Lecture:**

Exception hierarchy, Errors, Checked and un-checked exceptions

Exception propagation

try-catch-finally block , throws clause and throw keyword

Multi catch block

Creating user defined checked and unchecked exceptions

**Lab 13 & 14:**

Create user defined checked and unchecked exceptions .

**Session 15:**

**java.io & java.nio Package**

**Lecture:**

Brief introduction to InputStream, OutputStream, Reader and Writer interfaces

NIO package

Serialization and de-serialization

Shallow copy and deep copy

**Lab 15:**

Create a Demo class to Read & write image/text files.

Create SerializationDemo class to illustrate serialization and de-serialization process.

**Session 16:**

**Lecture:**

**Object Class & java.util Package**

Date, DateTime, Calendar class

Converting Date to String and String to Date using SimpleDateFormat class

Object Class: Overriding to String, equals & hashCode method

**Collections**

**Session 17 & 18:**

**Lecture:**

Introduction to collections: Collection hierarchy

List, Queue, Set and Map Collections

List Collection:

- ArrayList, LinkedList
- Vector (insert, delete, search, sort, iterate, replace operations)

Collections class

Comparable and Comparator interfaces  
Queue collection

**Lab 16, 17 & 18:**

Create DateManipulator class to convert String to date, date to String and to find out number of days between two dates.

Create a list of java defined wrapper classes and perform insert/delete/search/iterate/sort operations.  
Create a collection of Employee class and sort objects using comparable and comparator interfaces.  
Implement Queue data structure using LinkedList and Queue collection.

**Sessions 19 & 20:**

**Lecture:**

Set Collection:

- HashSet, LinkedHashSet & TreeSet collection
- Backed set collections

Map Collection:

- Hashtable, HashMap, LinkedHashMap & TreeMap classes
- Backed Map collections

Generics

Concurrent collections

**Lab 19 & 20:**

Create an Employee HashSet collection and override equals & hashCode methods to understand how the set maintains uniqueness using these methods.

Create a Sample class to understand generic assignments using “? extends SomeClass” , “? super someclass ” and “?”.

**Session 21:**

**Lecture:**

MultiThreading : Thread class and Runnable Interface

sleep, join, yield, setPriority, getPriority methods

ThreadGroup class

**Lab 21:**

Create multiple threads using Thread class and Runnable interfaces.

Assign same task and different task to multiple threads.

Understand sleep, join, yield methods.

**Sessions 22 & 23:**

**Lecture:**

Synchronization

Deadlock

Wait, notify and notifyAll methods

Producer & Consumer problem

**Lab 22 & 23:**

Create a Deadlock class to demonstrate deadlock in multithreading environment.

Implement wait, notify and notifyAll methods.

Demonstrate how to share threadlocal data between multiple threads.

**Session 24:****Lecture:**

Inner Class (Regular, Method local, Anonymous & static inner class)

Lambda Expression

Reflection

**Lab 24:**

Invoke private methods of some other class using reflection.

Create multiple threads using anonymous inner classes.

Create multiple threads using lambda expressions.