Ph.D. Syllabus for Computer Science

(1) Data structure and algorithm

❖ Introduction to Data Structures

Primitive Data Structures, String Manipulation & Pattern Matching, Storage, Representation of Strings, Text Handling.

❖ Linear Data Structures

Arrays, Storage Structure for Arrays, Structures & Arrays of Structures, Stack, Applications of Stacks, Queues, Simulation, Priority Queues, Pointers & Linked Allocation, Linked Linear Lists, Circularly Linked Linear Lists, Doubly Linked Linear Lists, Applications of Linked Linear Lists.

❖ Nonlinear Data Structures

Trees , Operations on Binary Trees , Storage Representation & Manipulation of Binary Trees, Conversion of General Tree to Binary Trees , Sequential & Other Representation of Trees , Application of Trees - Manipulation of Arithmetic Expression , Multi-linked Structures - Sparse Matrices.

❖ Sorting & Searching

Introduction, Selection Sort, Bubble Sort, Merge Sort, Heap Sort, Quick Sort, Radix Sort, Sequential Searching, Binary Searching, Search Trees – Height Balanced, 2-3 Trees, Weight Balanced, m-ary Trees, Tree Structures, Search Methods.

❖ Hashing and File Structure

Hashing: The symbol table, Hashing Functions, Collision-Resolution Techniques, Dynamic hashing techniques (organizing direct files with hashing, linear hashing, virtual hashing) extendible hashing, modified dynamic hashing, spiral hashing.
File Structure: Concepts of fields, records and files, Sequential, Indexed and Relative/Random File Organization, Indexing structure for index files, direct files, Multi-Key file organization and access methods.

(2) Computer Organization and Architecture

❖ Number System & basics of computer

Number system (Binary, Octal and Hexadecimal), Conversion from one number system to another including decimal, Operations on binary number system (Addition, subtraction, multiplication, complementation etc.), Integer and floating point representation.
Block Diagram of a Personal Computer, Introduction to Processor, Memory, Bus, I/O controllers, Storage devices: Magnetic disks, optical disks, internal external hard disk, memory sticks, Input/Output devices – Mouse, keyboard, trackball, scanner, touch pad, touch screen, all kind of monitors, all kind of printers, plotter.

❖ Gates and Boolean algebra

Gates, Fundamentals of Boolean algebra, Truth Tables, Preparing truth table for given circuit, Preparing circuit for given truth table (SOP & POS), De Morgan's Theorems, Gate Minimization (using Boolean mathematics, using Karnaugh map technique)

❖ **Processors, Memory**

Instruction Execution, CPU organization (Stack Organization (Intro.), Instruction Formats, Addressing modes), ALU design, Overview of Microprocessor chips, memory chips & Buses, Example of a typical Microprocessor chip and a memory chip, ISA bus, PCI bus, Universal Serial Bus (USB), Architecture of PC with multiple type of buses, I/O chips. Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware, Structure of 2D Memory. Memory: Understand different type of memory (RAM, ROM, EPROM, EEPROM, Flash RAM etc.], Measuring computer memory
(Bit, Byte, KB etc.).

❖ **Basic Digital Logic Circuits**

Integrated circuits, Combinational Circuits - Encoder, Decoder, Multiplexer, DeMultiplexer, comparator, Arithmetic Circuits - Half adder, full adder, binary adder, binary adder/ subtractor.

❖ **Memory elements and counters**

Flip flops (SR Flip Flop, D-Flip Flop, JK Flip Flop), Registers (Storage Registers with Parallel Input & Serial Input, Shift Registers, Universal Register),Counters (Synchronous & Asynchronous Counters, Ripple Counter, Counters with Increment & Decrement Facility)

(3) Introduction to Web designing

❖ **Developing Web Pages Using HTML**

Introduction of HTML, HTML Tags, Heading, linking, Images, Special character and Horizontal Rules, Lists, Tables, Forms, Internal Linking, meta Elements. Designing HTML forms Webpage layout, Developing websites using the tool.

❖ **Cascading Style Sheet**

Introduction to CSS, CSS Selectors, Font attributes, Color And Background attributes, Text attributes, Border attributes, Margin attributes, Padding attributes, Font attributes, List attributes, Layers Effect, Table attributes, Float attributes, Pseudoelements, DropDown effect, Image Opacity, Rounded Corners, Shadows, Transitions, Animation, 2D / 3D Transforms.

❖ **Introduction to Java Script**

Introduction to JavaScript, Writing JavaScript into HTML, Data Types and Literal, Type Casting, Creating Variable, Incorporating Variables in a JavaScript, JavaScript Array, Operators and Expressions in JavaScript, Special Operators, Constructor, Condition Checking, Endless Loop, Functions in JavaScript, User Define Function, Dialog Boxes, The JavaScript Document Object Model, Built in objects in JavaScript, Form used By a website, Cookies.

❖ **Built in Objects in JavaScript**

Events of JavaScript, String Built in functions, Date Built in functions, Mathematical Built in functions., Windows object Properties and methods, Document object

Properties and methods, Form object Properties and methods, Form Control object Properties and method, Image object Properties, Frames object Properties and methods

❖ ***JQuery***

Introduction and Installation, Syntax, jQuery Selectors, jQuery Events, jQuery Effects (i. jQuery Hide and Show Effect, ii. jQuery Fade Effect, iii. jQuery Slide Effect, iv. jQuery Animate) , jQuery Callbacks, jQuery and HTML(jQuery Get, jQuery Set, jQuery Add, jQuery Remove, jQuery css, jQuery Width, jQuery Height), jQuery UI (Implementing Datepicker, Implementing Slider, Implementing Tabs)

(4) Computer network

❖ **Introduction of Computer Network**

Introduction to Networking, Components of Networking, Different Computing Models of Network, Centralized, Distributed, Collaborative, Networking Configuration Client/Server Based, Peer to Peer Networking, Local and Wide Area Network. Network Services, File Services, Printing Services, Application Services

Fundamentals of communication theory: Analog and Digital Signal, Periodic aperiodic signal, Peak Amplitude, bit rate, frequency, Decibel, bit Interval, Transmission Impairment, Attenuation, Distortion, Noise, thermal, Induced, cross talk, Impulse Noise, throughput, Propagation Speed, waveforms, bandwidth.

❖ **Networking Standards**

Introduction to Standards, Standard Organization and the OSI rules and the Communication Process. The OSI reference Model, How Peer OSI Layer Communicates, Protocol Stacks, Conceptualizing the layers of the OSI Model, OSI physical layer, OSI Data Link Layer, Concepts of OSI Network Layer, Transport Layer, Session Layer, Presentation Layer, Application Layer, IEEE802 family standards.

❖ **Transmission Media & Multiplexing**

Transmission Media: Introduction to Transmission Media, Characteristics, Cost, Installation, Requirements, Bandwidth Band Usage, Attenuation and Electromagnetic Interference, Cable Media Coaxial Cable, Twisted-Pair Cable, Fiber Optic Cable, Summary of Cable. Unguided media- Infrared, Radio Waves Terrestrial Microwaves, Satellite Microwaves.

Multiplexing: Frequency Division Multiplexing (FDM), Wave Division Multiplexing (WDM), Time Division Multiplexing (TDM),Statistical Time-Division Multiplexing

❖ **Connectivity Devices, Network Topologies and architectures**

Connectivity Devices: Network Adapter card, Passive Hubs, Repeaters, Active Hubs, Bridges, Two-Layer Switches, Routers, Three-Layer Switches Gateway, Brouters, Routing Algorithms, Distance Vector Routing, Link State Routing. Message Switching, Packet switching.

Network Topologies and architectures: Introduction to Access Methods, Contention Polling, Token Passing, Comparing Contention and Token Passing, Demand Priority, Network Topologies, Bus Topologies, Ring Topologies and Star Topologies Mesh Topology.

❖ ***TCP/IP***

TCP/IP and internetworking, related protocols, ports and sockets, The IPv4 Address Space, Classful Addressing, Classless Addressing, address structure, IP datagram. IPv6 addresses, Structure.

(5) Database concepts and tools

❖ **Concept of Database management system**

Basic Concepts: data, database, database systems, database management system, Purpose and advantages of Database management system (over file systems), data models: Introduction; Three level architecture, Overall architecture of DBMS, Various components of a DBMS.

Relational Structure – tables (relations), rows (tuples), domains, columns (attributes), Entity sets, attributes, Types of entities, Relationships, (ER) and Types of relationships, Database modeling using entity and relationships, Enhanced entity relationship diagrams , keys: super key, candidate keys, primary key, entity integrity constraints, referential integrity constraints.

❖ **Relational data model**

Relational structure – tables (relations), rows (tuples), domains, columns (attributes), Database design process, Anomalies in a database, Functional Dependencies (Lossless decomposition, Dependency preservance, Closure set of FD, Canonical Cover, Lossless Joins), Finding Candidate keys using Armstrong rules, Stages of Normalization: 1NF, 2NF, 3NF, BCNF (with general definition also) and Multi valued Dependency: 4NF & 5NF (Project Join NF) Translation of E-R schemes

❖ **Introduction to ORACLE Server & SQL**

ORACLE Server & Instances, Database Structure & Space Management, Memory & Process Structure, Schemas & Schema Objects, Client Server Architecture – Distributed Database Processing, Database Backup & Recovery, ORACLE Utility – Import , Export.

Basic Data Types of ORACLE, Data Definition Language (DDL), Data Manipulation Language (DML), Transaction Processing Language (TPL), Data Constraints, Inbuilt Functions, queries, Subqueries , Join , Indexes , Views , Sequences , Synonyms

❖ **Introduction to PL/SQL**

Advantages of PL/SQL and Generic PL/SQL Block, Cursor – Implicit & Explicit Cursor , Cursor For Loop , Parameterized Cursor, Locking Strategy – Implicit & Explicit Locking , Lock Table, Exception Handling

❖ **ORACLE Database Object, Users , Privileges & Roles**

Stored Procedures & Functions, Packages, Triggers. Users – Create & Delete User , Grant & Revoke Command, Privileges – System & Object Privileges , Assigning , Viewing , Revoking System & Object Privileges Roles – Create , Grant , View & Delete the Roles

(6) Object oriented programming using Java

❖ Basics of classes, objects and method in Java

Procedural languages Vs Object Oriented approach, characteristics of OOL,
Java Environment, Java Features and support, Sample program & Compilation, Using block of code, Lexical Issues (White space, identifiers, Literals, Comments, Separators, Keyword), Java Class Library, Data type, Operators, Control structures, Arrays and String Class
class, object & method, Defining class, adding variables, adding methods, creating objects, Constructor, this key word, garbage collection, finalize() method, Accessing class members, methods overloading, static members, nesting of methods, Vectors & wrapper classes, Implementation of O.O.P concept in java, Inheritance, Subclasses, subclass constructor, multiple inheritance, hierarchical inheritance, overriding methods, Abstract Class, Final variables and methods, final classes, Method Using final to Prevent Overriding & overloading, finalize methods ,The Object Class, Visibility control – public access, friendly access, protected access, private protected access, rules of thumb, Method Overloading, Object as parameters, Argument Passing, Returning Objects, recursion, Access control, static, final, Nested & Inner Classes, String class, Command-Line arguments.

❖ Packages, Interfaces and Exception Handling

Defining package, understanding CLASSPATH, Access protection, Importing Packages, Defining Interfaces.
Exception Types, Uncaught Exceptions, Multiple catch Clauses, Nested try Statements, Throw, Throws, Finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses

❖ Multithreaded programming

Creating threads, run() method, new thread, thread class, stopping & blocking threads, Life cycle of thread – newborn, runnable, running, blocked, dead, waiting, sleeping, suspended, blocked, Using thread methods, thread exceptions, thread priority, synchronization, Implementing the 'Runnable' interface

❖ Applet and Event Handling

What is an Applet, Applet Lifecycle, Applet class, AppletContext class, passing parameters to applet, Use of java.awt.Graphics class and its various methods in an applet Event elegation Model or Event Class Hierarchy, All classes and interfaces of Event Delegation Model, Programmes related to event handling covering all types of events

❖ JDBC (Java Database Connectivity)

Introduction of JDBC, JDBC Architecture, Data types in JDBC, Processing Queries, Database Exception Handling, Discuss types of drivers.

❖ **Java Network Programming**

Networking Basis – TCP/IP models, Network Addressing, Domain Name Services(DNS), Ports, Sockets, Simple Client Server Program using TCP, Simple Client Server Program using UDP, Introduction to RMI Architecture, Object Serialization, Implementing Remote class & Interfaces, Client Server Program using RMI

❖ **Servlets**

Introduction of Servlet, HTTP Servlet Basics, Type of Servlet and Life cycle, Retrieving Information into Servlet , Making session and cookies into Servlet , Servlet with JDBC, Methods (getWriter(), getInitParametor(), getInitParametorNames(), getServletContext(), getServletName(), getServletInfo(), limit(), forward(), service, getAttribute(), getAttributeNames()

❖ **JSP**

Introduction JSP and JSP Basics, Directives (page, include, taglib), Scripting Elements (Declaration, scriptlots, expressing), Standard Action (JSP: useBean, JSP:getProperty, JSP:setProperty, JSP:param, JSP:include, JSP:Forward, JSP:plugin), Life cycle of JSP, JSP and Java Beans, JSP:session & cookies, Error Handling with JSP, JDBC with JSP

(7) Programming in C# & forms

❖ **Components of the .NET Architecture**

MS .NET Runtime, Managed / Unmanaged Code, Intermediate Language, Common Type System, MS .NET Base Class Library (BCL), Assemblies, Metadata, and Modules, Just In Time Compilation, Garbage Collection.

Introduction to C# : .Net language, C# Program Console Application Development, Compiling and Executing, defining a Class, Declaring the Main () Method, Organizing Libraries with Namespaces, Using the using Keyword, Adding Comments.

C# Data Types, Value Types-Primitive DataTypes, Reference Types, C# Control Structures -Using the if Statement, Using the if else Statement, Using the switch case Statement, Using the for Statement, Using the while Statement, Using the do while Statement, Using the break Statement, Using the continue Statement, Using the return Statement, Using the goto Statement.

❖ **C# Properties Delegates, Interface, Inheritance and Generics**

Delegates in C# - Single Cast, Multicast Delegates. Inheritance, Interfaces in C#, Structures in C#, Operator Overloading in C#, Using Generics in C#.

❖ **Exception, Threading**

Exception Handling in C# -Using the try Block, Using the catch Block, Using the finally Block, Using the throw Statement.

Multithreading -Getting started with threads, managing thread lifetimes, destroying threads, scheduling threads, communicating data to a thread.

❖ **Introduction to ADO.NET**

Introduction to ADO.NET, ADO.NET Architecture, Understanding the ConnectionObject, Building the Connection String, Understanding the CommandObject, Understanding DataReaders, Understanding DataSets and DataAdapters, DataTable, DataColumn, DataRow, Working with System.Data. OleDb, Using DataReaders, Using DataSets

❖ **C# Windows form and Controls**

General Controls with important properties, events and Methods (Label, text box, button, listbox, combo box, check box, radio button picture box, date time picker progress bar, timer. Status strip, user defined controls), Containers (Group box, panel, split container, tab control, tab layout panel, flow layout panel),Menu and Tools Bars, Menu strip, context menu strip, status strip, tool strip, Dialogs (Colour dialog, folder browser dialog, font dialog, open file dialog, save file dialog)

(8) Web programming

❖ **Introduction to PHP**

Introduction to PHP, how PHP works, The PHP .ini File, Basic PHP syntax :
PHP tags, PHP statements and whitespace comments, PHP functions, Variable types, variable names (identifiers, type strength, variable scope, super, globals, constants, variable – testing and manipulation functions), First PHP script, PHP operators, Creating Dynamic pages: Single Quotes Vs. Double Quotes, Passing variables on the URL, passing variables via the Query String, Flow Control, Arrays.
PHP and HTML Forms, HTML Forms, how HTML Forms work, processing form input. String Manipulation, Formatting Strings, /Concatenation, String Manipulation Functions, Examples of string functions, working with string manipulation functions, magic quotes Reusing Code and Writing Functions, including files, require, require_once, auto_prepend_file and auto_append_file, user functions, defining and calling functions, default values, variable scope, by reference vs.. By value, form processing code organization, code organization, and conclusion.

❖ **Database connectivity, sending mail, regular expression**

Managing Data, querying a database, inserting, updating deleting, searching Records mysql functions.
Sending Email with PHP, mail(), shortcomings of mail(), PHPMailer, Sending a password by Email
Regular expressions, Regular Expression Syntax, Start and End (^$), Number of occurrences (? +*{}), Common Characters (.\d\D\w\W\s\S), Grouping ([]), Negation (^), Subpatterns(()), Alternatives(|), Escape Character (\), Form Validation functions with regular expressions.

❖ **Session, cookies & File system**

Session Control and /Cookies , Sessions, Configuring Sessions, Session Functions, Cookies, Authentication with Session Control.
File System Management, Opening a file, fopen(), Reading from a file, fgets(), writing to a file, fwrite(), writing to a file, file locking, flock(), uploading files via an HTML

form, getting file information, more file functions, directory Functions getting a directory listing, creating a resume management page.

❖ **Ajax and XMLDOM**

Ajax with PHP, Ajax overview, Ajax Technology Stack, Ajax Implementations, Installing and configuring HTML Ajax Pear Module, Ajax Server, Ajax Client.
PHP XML Support, Simple XML Objects, executing X path Queries, DOM Interoperability, Using X path, Installing and Configuring LIBXSL, Applying server side XSL Transformations, Using XML in N-Tier Architecture, Mixing PHP Objects and XML.

❖ **Web services**

PHP Web Services, Web service Technology Stack, SOAP Soup, Web services with PHP, Installing NuSOAP, Building a SOAP SERVER, Consuming a Web service, Generating WSDL Dynamically, Understanding Generated WSDL, WSDL and SOAP Proxies. Web Services with JSON.

(9) Operating systems

❖ **Introduction**

What is OS, General categories of OS – Desktop system, Multiprocessor systems, Distributed systems, clustered systems, Real time systems, Handheld systems
Computer system structure - I/O structure, Hardware protection
Operating system concepts, Services, System calls for (process management, signaling, file management, directory management, protection, time management), Operating system structure (monolithic system, layered system, virtual machine, client server model)

❖ **Process management**

Process concepts - States of process, Scheduling, Threads – User & Kernel Threads, Single & Multi-Threaded, Processes, Multi-Threading Models, Inter process communication (race condition, critical selection, mutual exclusion with busy waiting, sleep and wakeup, semaphore, monitors, message passing),
Process scheduling: Round robin scheduling, priority scheduling, multiple queue, shortest job first, guaranteed scheduling, lottery scheduling, real time scheduling, two level scheduling, policy versus mechanism.

❖ **Deadlock and Memory Management**

Deadlocks: criteria for deadlock arise, resources, principles of deadlock, detection and recovery, deadlock prevention, deadlock avoidance – The Banker's algorithm for a single resource, resource trajectories, Bankers algorithm for multiple resources.
Memory management: Logical and physical address, Swapping, Contiguous Memory, Allocation, Paging, Segmentation, Segmentation with paging, Virtual memory – Demand Paging, Page replacement algorithms

❖ **File Management**

File Concept – Access Methods, Directory Structure

File System Structure
Allocation methods
Free space management, Directory implementation
Overview of I/O system – Application I/O Interface, I/O hardware, kernel I/O subsystem
Disk scheduling algorithms

❖ **Security and Applications of OS**

Security: The security environment, famous security flaws, generic security attacks, design principles for security, user authentication
Protection: Protection domains, access control lists, capabilities, convert channels
The dining philosophers problem
The reader and writers problem
The sleeping and barber problem
The Ostrich algorithm for deadlock

(10) Programming in python & machine learning

❖ **Introduction**

Introduction to Python: The basic elements of Python ,Features & Installation of Python, expressions and numerical data types, Variables and identifiers, IDLE, input output statements, keywords, operations Arithmetic, Relational, Unary, Assignment etc.
Branching and Control Structure: Branching programs, Control Structures, Iteration, Strings and Input, Built-In String Functions. Python Input and Output Functions, Import command.

❖ **Functions & Modules**

Functions: Defining a Function, Calling a Function, Returning Results from a Function, Returning Multiple Values from a Function, Functions are First Class Objects, Pass by Object Reference, Formal and Actual Arguments, Positional Arguments, Keyword Arguments, Default Arguments, Variable Length Arguments, Local and Global Variables, The Global Keyword, Passing a Group of Elements to a Function, Recursive Functions, Anonymous Functions or Lambdas.
Modules: Module definition, need of modules, Creating a module, Importing module, Path Searching of a Module, Module Reloading, Standard Modules, Python Packages.

❖ **Python Native Data Types & Files**

Python Native Data Types: Lists, Tuples, Sets, Dictionary, Arrays Tuples — Unchanging Sequences of Data, Lists — hangeable Sequences of Data, Dictionaries — Groupings of Data Indexed by Name, Special String Substitution Using Dictionaries, Arrays ,treating a String Like a List, Working with Sets.
Files: Files, Types of Files in Python, opening a File, closing a File, Working with Text Files, Reading and Writing to/from File, Containing Strings, Knowing Whether a File Exists or Not.

❖ **Classes and Object-Oriented Programming**

Classes and Object-Oriented Programming: The concept of OOPS in Python, designing classes, creating objects, accessing attributes, editing class attributes, Abstract Data Types and classes, Inheritance (Single, Multi-Level, Hierarchical,

Multiple), Encapsulation and polymorphism (method overloading and overriding) Exception Handling: Exceptions, Built-in exceptions, Exception handling, User defined exceptions in Python.

❖ **Advanced Topics & Data automation:**

Data Frame (Creating Data Frame from an Excel Spreadsheet, Creating Data Frame from .csv Files, Creating Data Frame from a Python Dictionary, Creating Data from Python List of Tuples, Operations on Data Frames), Openpyxl package, Excel sheet management, creating rows, column, sheet, charts etc.

❖ **Machine Learning:**

What is machine learning? Application of Machine learning, machine learning application steps, useof numpy, pandas, MatPlotLib, scikit-learn library. Use of Jupyter and notebook along with anaconda.

(11) Mobile programming language

❖ **Android Introduction**

Android versions, features of android, architecture of android, android devices, required tools (Android SDK, Installing the android SDK tools, configuring the android SDK manager, Introduction android studio, android development tools (ADT), creating android virtual devices)

Activities: The life cycle of an activity, Applying styles and themes to an activity, hiding the activity title, display a dialog window, displaying a progress dialog, linking activities using intents, resolving intent filter collision, returning results from an intent, parsing data using an intent object,

Fragments: Adding fragments dynamically, life cycle of fragment, interactions between fragments, calling built in applications using intents, intent objects, intent filters, categories and notifications.

❖ **Android user interface**

Components of screen: views and ViewsGroups, LinearLayout, AbsoluteLayout, TableLayout, RelativeLayout, FrameLayout, ScrollView. Anchoring view, resizing and repositioning.

Managing changes to screen orientation, Persisting state information during changes in configuration, detecting orientation changes, Controlling the orientation of the activity, detecting orientation changes, controlling the orientation f the activity. Action bar, adding action items to the action bar, customizing the action items and application icon. Creating the user interface programmatically, UI notifications, Overriding of method of an activity, registering events for views

❖ **Designing user interface with views**

Basic views : TextView, Button, ImageButton, EditText, checkbox, ToggleButton, RadioButton, RadioGroup, ProgressBar, AutoCompleteTextView

Picker view: TimePicker, DatePicker

List view: ListView, Spinner view, ListFragment, DialogFragment,

PreferenceFragment,
Displaying picture: Gallery and ImageView, ImageSwitcher, Creating helper methods, options menu, context menu, analogClock, DigitalClock and WebView

❖ **Android storage techniques**

Saving and loading user preferences, accessing preferences using an activity, modifying preferences values using programmatically, changing the default name of the preference file.
Persisting data to files: saving to internal storage / external storage (SD card), storage options.
Database: Creating the database, DBAdapter helper class. Adding contact to table, single/multiple retrieving content from table, update and deleting the contact, upgrading the database.

❖ **Android services, Web App. Integration Techniques & Deployment** Phone: Call, Messaging, location based service, Network Connectivity, Web API, Maps, GPS, Notification, Alarm.

JSON Parsing, XML Parsing, DOM Parsing.
Developing android services, Publish Android Application.

(12) Application development using advance java

❖ **Basics of Spring, Spring with IDE And IOC container**

- Spring with Hibernate
- Spring with JPA
- SpEL Examples
- Operators in SpEL
- variable in SpEL

❖ **Spring 3 MVC and Remoting with Spring**

- Spring with RMI
- Http Invoker
- Hessian
- Burlap
- Spring with JMS

❖ **OXM Frameworks, Spring Java Mail And Web Integration**

- Spring with JAXB
- Spring with Xstream
- Spring with Castor
- Spring with Struts2
- Login and Logout Application

❖ **Basics of Hibernate And Hibernate with IDE**

- Hibernate Introduction
- Hibernate Architecture

- Understanding First Hibernate application
- Hibernate in Eclipse
- Hibernate in MyEclipse

❖ **Hibernate Application And Hibernate Logging**

- Hibernate with annotation
- Hibernate Web application
- Hibernate Generator classes
- Hibernate Dialects
- Hibernate with Log4j 1
- Hibernate with Log4j 2

❖ **Inheritance Mapping**

- Table Per Hierarchy
- Table Per Hierarchy using Annotation
- Table Per Concrete
- Table Per Concreteusing Annotation
- Table Per Subclass
- Table Per Subclass using Annotation

❖ **Collection Mapping**

- Mapping List
- One-to-many by List using XML
- Many to Many by List using XML
- One To Many by List using Annotation
- Mapping Bag
- One-to-many by Bag
- Mapping Set
- One-to-many by Set
- Mapping Map
- Many-to-many by Map
- Bidirectional
- Lazy Collection

❖ **Component Mapping, Association Mapping,**

- One-to-one using Primary Key
- One-to-one using Foreign Key

❖ **Transaction Management, HQL and HCQL Named Query,**

- First Level Cache

❖ **Hibernate Caching and**

- Second Level Cache

❖ **Integration**

- Hibernate and Struts

- Hibernate and Spring

(13) Advance Web Development in Laravel

❖ Object Oriented Programming in PHP

The Basics, Properties, Class Constants, Autoloading Classes, Constructors and Destructors, Visibility, Object Inheritance, Scope Resolution Operator (::), Static Keyword, Class Abstraction, Object Interfaces, Anonymous classes, Overloading, Object Iteration, Magic Methods, Final Keyword, Object Cloning, Comparing Objects, Type Hinting, Late Static Bindings, Objects and references

❖ Bootstrap Basics Introduction:

File Structure, Basic HTML Template, Global Styles, Default Grid System, Basic Grid HTML, Offsetting Columns, Nesting Columns, Fluid Grid System, Container Layouts, Responsive Design, What Is Responsive Design?
Implementation**:** Typography, Code, Tables, Forms, Buttons, Images, Icons, Glyphicons, Dropdown Menus, Button Groups, Button with Dropdowns, Navigations, Navbar, Breadcrumb, Pagination, label, badges, Typographic elements, thumbnails, alerts, progress bar, wells

❖ Introduction to Laravel

What is Laravel, features, MVC architecture, structure of laravel application (laravel directory structure),

❖ Installation

Basic requirements for Laravel, Using Laravel Installer, Using Composer, how does Composer work? Installation, Linux & Windows, Finding and installing new packages

❖ Configuration

Introduction, Environment configuration, Protecting sensitive configuration, Maintenance mode, database configuration (setting database connection parameter for laravel and artisan)

❖ Artisan

Artisan Command Line Tool, database creation, artisan migration, migration structure, creation migration, Database seeding

❖ Routing in Laravel

Basic Routing, Route Parameters, Route Filters, Named Routes, Route Groups, Sub-Domain Routing, Route Prefixing, Route Model Binding, Throwing 404 Errors, Routing to Controllers

❖ Blade Template

Template inheritance, Master layout, Extending the master layout, display variables, Blade conditional statements, Blade Loops, Executing PHP functions in blade

❖ **SQL Interaction**

Introduction, Running Raw SQL Queries, Database Transactions

❖ **Eloquent ORM**

Eloquent ORM Models: Naming conventions, table name & primary keys, timestamps
Basic Operations: Create, Retrieve, Update, Delete Using Models, displaying data from models in views.
Validation
Defining The Routes, Creating The Controller, Writing The Validation Logic, Displaying The Validation Errors, Array validations, creating new validators, Error messages & custom errors
Available Validators: Accepted, After (Date), Alpha, Alpha Dash, Alpha Numeric, Array, Before (Date), Between, Boolean, Date, Date Format, Different, Digits, Digits Between, E-Mail, Exists (Database), Image (File), In, Integer, Max, Min, Not In, Numeric, Regular Expression, Required, String Custom validation rules.

(14) NoSQL DATABASE: MongoDB

❖ **Introduction to NoSQL Database**

Define NoSQL, its characteristics and history, and the primary benefits for using NoSQL databases.
Define the major types of NoSQL databases including a primary use case and advantages/disadvantages of each type.
Describe the factors affecting return on investment for using locally hosted database vs. database-as-a-service.

❖ **Introduction to MongoDB**

MongoDB concepts – Databases, collections, and documents
Downloading Installing and running MongoDB, Installing PHP Driver for MongoDB on various OS Platforms
The Data Model and Working with Data

❖ **Learning MongoDB by implementing web Application**

Inserting documents in MongoDB, Querying documents in collection.
Doing advance queries in MongoDB, Updating documents MongoDB,
Deleting documents in MongoDB, Managing relationships between documents

❖ **Using MongoDB with relational Databases**

MongoDB and RDBMS together
Defining the relational model

❖ **Session Management**

Understanding HTTP sessions.
Understanding PHP native session handling, Implementing session handling with MongoDB.
Putting Session Manager.
Building user authentication module, creating login, logout and user profile.

❖ **Aggregation Queries** Generating Sample Data.
Understanding MapReduce,
Performing MapReduce in MongoDB and PHP, Aggregation using group() Listing distinct values for field
counting documents with count()

❖ **Web Analytics using MongoDB**
Logging with MongoDB,
Extracting analytics data with MapReduce
Real-time analytics using MongoDB

❖ **Handling Files with GridFS** What is Grid? Storing files in GridFS Serving files from GridFS
Reading files in chunks

❖ **Database**
Database Administration
Management
Optimization Replication
Sharding

(15) Application development using advanced android

❖ **Basics of Android & UI Design**
- Core building blocks, Android manifest.xml file, R.java file, Basic UI widgets, Activity, Layout, Intent

❖ **Working with view and adaptor**
- Adaptors: Array adaptor, Arraylist adaptor, Base adaptor,
- Views: GridView, ScrollView, WebView, SearchView, TabHost, DynamicListView, ExpandedListView

❖ **Multimedia API**
- Wallpapaer, Live Wallpaper,
- Audio – Recording audio, Playing audio
- Video– Recording video, Playing video
- Alarm Manager
- Camera - Capturing pictures, configuring camera mode settings, camera parameters, zooming camera.

❖ **Data Storage & SQLite**
- Shared Preferences
- Android File System
- Internal storage, External storage
- SQLite : Storing data using SQLite, Querying SQLite database, insertupdate-delete operations, Persistent database using SQLiteOpenHelper and creating a database

❖ **Content Provider, Intent & Notifications**

- Accessing built in content providers
- Searching for content
- Adding, changing, and removing content
- Creating content provider
- Sending & Receiving Broadcast
- Notifying user, Notifying with status bar

❖ **Device Connectivity**

- Bluetooth Tutorial –existence of Bluetooth, enable Bluetooth, discover devices, List Paired Devices, establishing connection between devices.
- Working with WiFi

❖ **Working with Sensor**

- Sensor API,
- Working with different sensors :Motion Sensor, Position Sensor, Environmental Sensor,
- Sensor Values, SensorManager class, Sensor Class, SensorEvent class, SensorEventListener interface, Compass Acceslerometer and Orientation Sensors
- Reading sensor data, calibrating sensors, determining device orientation

❖ **Android Web Service**

- Introduction to web service,
- Soap Vs Restful web service
- Android Restful web service example with java servlet
- Storing data into external database
- Verifying data in android with external database

❖ **JSON & XML Parsing**

- XML Parsing SAX
- XML Parsing DOM
- XML Pull Parser
- JSON Parsing
- Integrating Social Networking using HTTP

❖ **WiFi& Bluetooth**

- Monitoring and managing Internet connectivity
- Managing active connections
- Managing WiFi networks
- Controlling local Bluetooth device
- Discovering and bonding with Bluetooth devices
- Managing Bluetooth connections
- Communicating with Bluetooth

❖ **Location Based Services and Google Maps**

- Location Based Services - Finding current location and listening for changes in location, Proximity alerts, Working with Google Maps

- Showing google map in an Activity
- Map Overlays
- Itemized overlays
- Geocoder
- Displaying route on map

❖ **Drawing, Animation and Graphics programing**

- Drawing on screen – using canvas and paint
- Working with bitmap, shapes
- 2D Animation - Drawable, View, Property animation

❖ **Packaging, Deploying and distributing/ selling app**

- Signing certificate
- Distributing android app via Google Play
- Obfuscating and optimizing with ProGuard

(16) Introduction to big data and hadoop

❖ **Introduction to Big Data and Hadoop**

Introduction/Installation of Virtual Box and the Big Data VM Introduction to Linux
Why Linux?
Windows and the Linux equivalents
Different flavors of Linux Unity
Shell (Ubuntu UI)
Basic Linux Commands (enough to get started with Hadoop)

❖ **Understanding Big Data**

Understanding Big Data
3V (Volume-Variety-Velocity) characteristics
Structured and Unstructured Data
Application and use cases of Big Data Limitations of traditional large
Scale systems
How a distributed way of computing is superior (cost and scale) Opportunities and challenges with Big Data

❖ **HDFS (The Hadoop Distributed File System)**

HDFS Overview and Architecture
Deployment Architecture
Name Node, Data Node and Checkpoint Node (aka Secondary Name Node)
Safe mode
Configuration files
HDFS Data Flows (Read vs Write) How HDFS addresses fault
tolerance?
CRC Check Sum
Data replication
Rack awareness and Block placement policy
Small files problem HDFS

Interfaces
Command Line Interface File System
Administrative Web Interface Advanced HDFS features Load Balancer
DistCp
HDFS Federation
HDFS High Availability
Hadoop Archives

❖ **NoSQL Databases - 1 (Theoretical Concepts)** NoSQL Concepts
Review of RDBMS
Need for NoSQL
Brewers CAP Theorem ACID vs BASE
Schema on Read vs. Schema on Write Different levels of consistency
Bloom filters
Different types of NoSQL databases Key Value
Columnar Document
Graph
Columnar Databases concepts

❖ **MapReduce – 1 (Theoretical Concepts)**
MapReduce overview
Functional Programming paradigms
How to think in a MapReduce way? MapReduce Architecture
Legacy MR vs Next Generation MapReduce (aka YARN/MRv2)
Slots vs Containers Schedulers
Shuffling, Sorting
Hadoop Data Types
Input and Output Formats
Input Splits - Partitioning (Hash Partitioner vs Customer Partitioner)
Configuration files
Distributed Cache
MR Algorithm and Data Flow
Word Count
Alternatives to MR - BSP (Bulk Synchronous Parallel)
Adhoc querying
Graph Computing Engines

❖ **Higher Level Abstractions for MR (Pig)**

Introduction and Architecture
Different Modes of executing Pig constructs Data Types
Dynamic invokers Pig streaming
Macros
Pig Latin language Constructs (LOAD, STORE, DUMP, SPLIT etc) User
Defined Functions
Use Cases

❖ **MapReduce – 2 (Practical)**

Developing, debugging and deploying MR programs
Stand alone mode (in Eclipse)
Pseudo distributed mode (as in the Big Data VM)
Fully distributed mode (as in Production) MR API
Old and the new MR API
Java Client API
Hadoop data types and custom Writables/WritableComparables
Different input and output formats
Saving Binary Data using SequenceFiles and Avro Files
Hadoop Streaming (developing and debugging non Java MR programs - Ruby and Python)
Optimization techniques
Speculative execution Combiners
JVM Reuse
Compression
MR algorithms (Non-graph)
Sorting
Term Frequency
Inverse Document Frequency
Student Data Base Max
Temperature
Different ways of joining data
Word Co-Occurrence MR algorithms
(Graph)
PageRank
Inverted Index

❖ **Higher Level Abstractions for MR (Hive)**

Introduction and Architecture
Different Modes of executing Hive queries Metastore
Implementations
HiveQL(DDL & DML Operations) External vs
Managed Tables Views
Partitions & Buckets User Defined Functions
Transformations using Non Java Use Cases
Comparison of Pig and Hive

❖ **NoSQL Databases - 2 (Practical)**

HBase Architecture
Master and the Region Server
Catalog tables (ROOT and META)
Major and Minor compaction Configuration
files
HBase vs Cassandra
Interfaces to HBase (for DDL and DML operations) Java
API
Client API
Filters
Scan Caching and Batching Command
Line Interface
REST API
Advance HBase Features
HBase Data Modeling
Bulk loading data in HBase
HBase Coprocessors - EndPoints (similar to Stored Procedures in RDBMS) HBase Coprocessors - Observers (similar to Triggers in RDBMS)

- **Spark**

Introduction to RDD
Installation and Configuration of Spark
Spark Architecture
Different interfaces to Spark
Sample Python programs in Spark

- **Setting up a Hadoop Cluster using Apache Hadoop**

Cloudera Hadoop cluster on the Amazon Cloud (Practice)
Using EMR (Elastic Map Reduce)
Using EC2 (Elastic Compute Cloud) SSH Configuration
Stand alone mode (Theory) Distributed mode (Theory) Pseudo distributed Fully distributed

- **Hadoop Ecosystem and Use Cases**

Hadoop industry solutions
Importing/exporting data across RDBMS and HDFS using Sqoop Getting realtime events into HDFS using Flume
Creating workflows in Oozie Introduction to Graph processing Graph processing with Neo4J Processing data in real time using Storm Interactive
Adhoc querying with Impala

(17) Cloud computing

❖ **Overview of Computing Paradigm**

Recent trends in Computing: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing
Evolution of cloud computing: Business driver for adopting cloud computing

❖ **Introduction to Cloud Computing**

Cloud Computing (NIST Model): Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers
Properties, Characteristics & Disadvantages: Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing
Role of Open Standards

❖ **Cloud Computing Architecture**

Cloud computing stack: Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web service:
Service Models (XaaS): Infrastructure as a Service(IaaS),Platform as a Service(PaaS), Software as a Service(SaaS)
Deployment Models: Public cloud , Private cloud, Hybrid cloud, Community cloud

❖ **Infrastructure as a Service(IaaS)**

Introduction to IaaS: IaaS definition, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM):
Resource Virtualization: Server
,Storage, Network, Virtual Machine(resource) provisioning and manageability, storage as a service, Data storage in cloud computing(storage as a service)
Examples: Amazon EC2, Renting, EC2 Compute Unit, Platform and Storage, pricing, customers, Eucalyptus

❖ **Cloud Security**

Infrastructure Security: Network level security, Host level security,Application level security
Data security and Storage: Data privacy and security Issues, Jurisdictional issues raised by Data location,Identity & Access Management, Access Control
Trust, Reputation, Risk
Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations

❖ **Platform as a Service(PaaS)**

Introduction to PaaS: What is PaaS, Service Oriented Architecture (SOA) Cloud Platform and Management: Computation, Storage
Examples: Google App Engine, Microsoft Azure,SalesForce.com, Force.com platform

❖ **Software as a Service(PaaS)** Introduction to SaaS
Web services
Web 2.0

Web OS
Case Study on SaaS

❖ **Service Management in Cloud Computing**

Service Level Agreements(SLAs)
Billing & Accounting
Comparing Scaling Hardware: Traditional vs. Cloud
Economics of scaling: Benefitting enormously
Managing Data: Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud,Large Scale Data Processing

❖ **Virtualization**

Virtualization objectives Virtualization implementation
Virtual servers introduction
Xen server-Hyper V – I, Hyper V – II, VMWare – I, VMWare – II

❖ **Case Study on Open Source & Commercial Clouds**

Eucalyptus
Microsoft Azure
Amazon EC2

(18) Web Application Development using Django

❖ **Introduction to Python and Python Syntax, Language Components /Collections & Functions,**

A Brief History of Python, Strengths and Weaknesses, Python Versions. Installing Python, Environment Variables, and Executing Python from the Command Line, IDLE, Editing Python Files, Getting Help, Dynamic Types, Python Reserved Words, Naming Conventions, Basic Syntax, Comments, String Values, String Operations, The format Method, String Slices, String Operators, Numeric Data Types, Conversions, Simple Input and Output, The print Function.
Control Flow and Syntax, Indenting, if Statement, Relational Operators, Logical Operators, True or False, Bit Wise Operators. The while Loop, break and continue, The for Loop, Lists, Tuples, Sets, Dictionaries, Sorting Dictionaries, Copying Collections, Summary, Defining Your Own Functions, Parameters, Function Documentation, Keyword and Optional Parameters, Passing Collections to a Function.

❖ **Introduction to Web**

HTTP Client-Server Request – Response, concept of web

❖ **framework and DJango DJango Template System**

framework and web application. Introduction to Django, MVC Design Pattern, Django installation, setting up database, starting project. Django project architecture, Understanding manage.py, Understanding settings.py, Understanding init .py and wsgi.py, Understanding urls.py and Python regular expression, Understanding admin.py, Understandingmodels.py, Understanding views.py ,Running Django

development server Template system basics, Using template system, basic template tags and filters, using templates in views, template loading.

❖ **Interaction with Database**

Configuring database, defining model, basic data access, inserting and updating data, selecting objects, deleting objects.

❖ **Django Admin Site & Forms, Views and URLConfs**

Activating the Admin interface, Creating super user for Admin site, Using the Admin site, Using Admin site, django.contrib package.Form basics, GET and POST methods , Form validation, Rendering forms , ModelForm, Understanding the view layer, Requesting a web page via URL, Rendering web page via view function, Render HTTPResponse to templates, Understanding context data and Python dictionary type.

❖ **Session and Cookies & Testing and Deploying web application**

Cookies: Getting and Setting Cookies. Session: Django's session framework: enabling sessions, using session in views, session outside views. Testing Django, Python's unittest2 library, Deploying Django application on GitHub / Amazon Web Service.

(19) Programming with R for Data Science

❖ **Introduction to Data Analysis and Fundamentals of R**

- Overview of Data Analytics, Need of Data Analytics
- Classification of Data: Structured, Semi-Structured, Unstructured, • Characteristics of Data, Applications of Data Analytics.
- Setup with R Studio
- R Commands, Variables, Data Types.
- Vectors ○ Sequences, Lengths, Names, Indexing vectors, Vector Recycling and Repetition
- Matrices and Arrays ○ Creating Arrays and Matrices, ○ Row, Columns and Dimensions

  ○ Row, Column and Dimension names, Array Arithmetic
- Lists ○ Creating Lists, Atomic and Recursive Variables, List Dimensions and

  Arithmetic ○ Indexing Lists, Converting Between Vectors and Lists ○ Combining Lists, NULL. Pair lists
- Data Input ○ Data Input from Keyboard, Input from files(CSV), input from files using scan, Reading data from a file using readLines, Masking Input and output formats, Checking Files from cmd.
- Data Frames ○ Creating Data Frames, Indexing Data Frames, Basic Data Frames Manipulation

❖ **Environment, Functions, String, Factors, Flow Control and Loops**

- Environments
- Functions – Creating and calling Functions, Passing functions to and from other functions, Variable scope, Commands to Functions, Functions and Functional

Programming, Function Objects and Function Calls, Debugging, Interactive Tracing and Editing, Conditions: Errors and Warnings, Testing R Software.

- Strings o Constructing and Printing Strings, Formatting Numbers, Special Characters, Changing Case, Extracting Substrings Splitting Strings, File Paths
- Factors ○ Creating Factors, Changing Factor Levels, Dropping Factor Levels, Ordered Factors, Converting Continuous Variables to Categorical, Converting Categorical Variables to continuous, Generating Factor Levels, Combining Factor Levels
- Flow Control and Loops ○ Flow Control – if and else, Vectorized if, Multiple selections ○ Loops – repeat, while, for, lapply, sapply,
- Advance Loops – Replication, Looping over Lists, Looping Over Arrays, Multiple Inputs, Split-Apply-Combine, the plyr package.

❖ **Creating Packages and working with date & time**

- Packages ○ Loading Packages – The search path, Libraries and Installed packages ○ Installing Packages ○ Maintaining Packages
- Dates and Time

❖ **Data Visualization and Graphics**

- Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files.
- Working with R Charts and Graphs: Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts

❖ **Analytics Using R**

- Big Data analytics using R.
- Business Foundation Analytics Using R
- Data Flow and Management for Business Operations and Problem Solving
- Typical Analytical Process Flow
- Data Collections Method
- Data Summarization and Presentation
- Managing Data using Analytics Tools (R)
- Data Manipulation and Report Generation Using R

Ph.D. Entrance Test - SYLLABUS

Computer Science

Part – 1 (Research Methodology)

(1) Research Methodology: An Introduction

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research

(2) Defining the Research Problem

What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem

(3) Research Design

Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs

(4) Sampling Design

Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample? ,Random Sample from an Infinite Universe, Complex Random Sampling Designs

(5) Measurement and Scaling Techniques

Measurement in Research, Measurement Scales, Sources of Error in Measurement, Tests of Sound Measurement, Technique of Developing Measurement Tools Scaling , Meaning of Scaling, Scale Classification Bases, Important Scaling Techniques, Scale Construction Techniques

(6) Methods of Data Collection

Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection of Secondary Data

(7) Processing and Analysis of Data

Processing Operations, Some Problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation Association in Case of Attributes, Other Measures

(8) Report Writing

Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation ,Mechanics of Writing a Research Report, Precautions for Writing Research Reports