	• Develop quick and foolproof solutions to practical problems using abstract data types.

Session	Tasks
1	Practice Programs – Pointers, Dynamic Memory Allocation, Program Implementation using Make file
2	Implementation of a singly linked list with insert and other operations
3	Implementation of a singly linked list with delete and other operations
4	Implementation of a doubly linked list with insert , delete and other operations.
5	Implementation of a stack using a singly linked list.
6	Parentheses matching using stack data structure.
7	Infix to Postfix conversion.
8	Implement a queue using a singly linked list.
9	Implement a circular queue using an array.
10	Implement Stack and Queues using Arrays
11	Implementation of a BST and tree traversals methods.
12	Construction of a max-heap.
13	Implementation of a Priority Queue using a min-heap

UE18CS208A: OPERATION LINUX

# of Credits: 2 **# of Hours: 28**

Start your own internet company with Linux

Start your own internet start-up company in the 3rd Semester and add impressive lines to your resume. The Unix and Linux operating system, often collectively referred to as **nix* has been around for quite some time. Though unrecognizable to many, **nix* can be found almost ***anywhere and everywhere*** ranging from your gaming console, car's infotainment system to the immensely and insanely powerful servers of ***AWS*** *and et al.* This course will aim to introduce you to the applications of **nix* in the real world of companies like Amazon, Google and Startups, etc. It will focus on a practical approach to learn the world of internet infrastructure which is essential for every developer to know. This course will emphasize the synergy of the ***dev-ops (developer- operations)*** model which is necessary for success of every project/initiative at any company you might work in. If you however decide to be an entrepreneur it will teach you to configure your own internet company infrastructure with zero licensing costs.

Course Learning outcomes

- **Introduction to Linux/Unix and Shell Programming:**
  - ***Introduction to *nix*:** Salient Features, Layered Architecture, Concept: Shell & Kernel, File System

- ***File System Related Commands*:** Creating and Removing Directories and Files, Viewing the Content of the File, Copying/Moving Files, Hard/Symbolic Links, inode Structure, View Directory
- ***Types of Files*:** Regular Files, Directories, Character/Block Device, Named Pipes, Socket Files
- ***File Permissions/Time Stamp*:** File Permissions, EUID, Sticky bit, effect on Different Commands
- ***Process*:** Process Related Commands, Concept of Process, Process Status, Child and Parent Process, Process ID, Orphan and Zombie, bg/fg Processes, Executing Command at a Particular Time.
- ***Shell Programming***: Meta Characters, Redirection and Piping, Filters, Variables – Input/ Output and Assignment, Quoting, Shell Scripts, Environment Variables – Export Command, Relational and Logical Operators, Looping. Command Line Arguments and Shift Command, Arithmetic in Shell Programs, Calling Another Shell Program Within Another Shell Program – user Defined Functions.

- **Learn the tier'ed infrastructure of internet companies like Google, Amazon and startups**
- **Configure your own Internet Company with Zero License Costs:**
  - *Install and Configure the following devices*
  - ***Linux*** – Install Ubuntu Linux, learn basic commands, install packages, IP/DNS
  - ***Firewalls*** – Install and learn how to keep the bad away from the good when connected to the fun and useful yet incredibly dangerous
  - ***Load balancers*** – Install ngnix and learn these devices which are responsible for distributing the millions of requests Google or Amazon receives, to one of their million back end servers
  - ***Webservers*** – Install apache. These are machines with as many as 16 cores and 64GB of RAM used for lightning fast responses to requests of the client
  - ***Application Servers*** – Install Django - Develop and deploy apps via frameworks
  - ***Database Servers*** – Install mysqli. Learn to organize, store and secure your data
  - ***IDS*** (Intrusion Detection Services) – Install and learn how to spy on your network
  - ***tcpdump*** - Learn the basics of how to track and trap your network packets
- **Basic world of "How to Trouble shoot nix" and RAS capability of nix**
- **Configure a basic application on your own Internet Company Infrastructure**
  57. Learn the basics of an internet application and its working
  58. Configure an internet application on the above infrastructure and start to sell/market
- **At the end of this course – You will improve your resume and register a company to your name**

Grading: 4 assignments – 60% ISA; ESA – 40% ***project based, no final exam***. Instructor and peer reviews

References: "UNIX Concepts and Applications", Sumitabha Das, 4th Edition, McGraw Hill & YouTube

Pre-requisites: Must bring a laptop to class and should be a motivated self-learner.

Computer Science And Engineering
(Aug – Dec 2019)

UE18CS208B: PROGRAMMING WITH C++ (2-0-0-0-2)

# of Credits: 2 **# of Hours: 28**

Class #	Chapter Title / Reference Literature	Topics to be Covered	% of Portion covered	
			% of Syllabus	Cumulative %
1	Unit#1 Chapter 1,6,15	Introduction, Features of C++, Object Oriented Concepts, Composition, Polymorphism	20	20
2		Simple Input/ Output Operations, Introduction to Namespaces - Avoiding Pollution of Global Namespace, Constants and Variables		
3		User Defined Function, Function Call Mechanism, Function Overloading – Static Polymorphism, Function Call Resolution		
4		Default Parameters, Reference Parameters, Pointers and Dynamic Allocation, Alias		
5		Garbage and Dangling Reference, Reference Variable, Pointers and Reference, Efficiency and Flexibility, Inline Function, Template Function, lambda Functions.		
6	Unit#2 Chapter 15	Structure and Class	18.5	38.5
7		Data Member, Member Function, Access Specifier, Constructors and Destructors		
8		Initialization List, Dynamic Memory Management using Constructors and Destructors		
9		Copy Constructor, Copy Assignment Operator		
10		Move Semantics, Move Assignment Operator		
11		Move Copy Constructor		
12	Unit #3 Chapter 7	Friend Function, Friend Class	30	68.5
13		Operator Functions		
14		Binary Operator, Binary Operator ++		
15		Index Operator, Conversion Function		
16		Insertion and Extraction Operators		
17		Static Members		
18	Unit#4 Chapter 14,	Inheritance	15.5	84
19		Constructor and Destructor		

20	**15**	Copy Constructor, Assignment, Access Specifiers		
21		Virtual Functions and Polymorphism, Function Overriding, VTBL and VPTR		
22		Pure Virtual Functions and Abstract Base Class, Virtual Destructors		
23	**Unit #5 Chapter 16**	Multiple Inheritance	**16**	**100**
24		Virtual Base Classes		
25		Type Casting		
26		Run Time Type Identification (RTTI), Composition		
27		Class Templates		
28		Exception Handling		

Literature

Book Type	**Code**	**Title & Author**	**Publication Information**		
			Edition	**Publisher**	**Year**
Reference Book	R	C++ Primer – Stanley Lippman, Josee Lajoie, Barbara E Moo	5	Addison-Wesley	2012

UE18CS208C: PROGRAMMING WITH JAVA (2-0-0-0-2)

# of Credits: 2 **# of Hours: 28**

Class #	**Chapter Title**	**Topics to be Covered**	**% of Portion covered**	
			% of Syllabus	**Cumulative %**
	Unit 1			
1	**Java Fundamentals:**	Introduction to Programming in Java, Java Language and Java Platform, Program Structure, Translation Process, Simple I/O, Constants, Variables, Type, Mixed Mode Operation, Primitive Types and Reference Types, Object based Programming, Abstraction, Encapsulation, Composition	**20**	**20**
2		Class Attributes, Behaviour, Objects, and Methods, Interface and Implementation, Instance Fields and Methods, Initialization of Fields, Role of Constructors and		

		Destructors		
3		Garbage Collector, Parameter Passing, Value Type and Reference Type, Overloading of Methods, Scope. Control Structures, Selection – if, switch, Looping – while, for, do while, break and continue, Nested Control Structures.		
	Unit 2			
4	**Recursion. Class Attributes and Behaviour**	Difference between Class Methods and Instance Methods, Necessity to Use Class Methods. Enumerated Data Type	**20**	**40**
5		Enumerated Data Type (cont..)Class Containing Fixed Number of Objects. Programming for Safety: Assertions, Exception Handling		
6		Exception Handling(cont..), Exception Propagation, Use and Misuse of Exception Mechanism.		
	Unit 3			
7	**Arrays as Abstract Data Type:**	Creation, Initialization, Methods on Arrays, Built-In Methods, Higher Order Arrays Strings as Abstract Data Type: Creation, Initialization	**20**	**60**
8		String Immutability, String Methods, Composition and Inheritance: **"**has a" and "is a" Relationship, LISKOV's Property of Substitution		
9		When to Use and When Not to Use Inheritance, Super and Sub Classes, Polymorphism, Overriding.		
	Unit 4			
10	**Inheritance (Continued):**	Concepts of Single Rooted Hierarchy and Interface, Abstract Class in Programming Languages, Object Class in Java.	**20**	**80**
11		**Composition**: Flexibility of Composition over Inheritance, Examples of Composition and Inheritance.		
12		**Package:** Need of Package Concept, User Defined Package, Introduction to Built-In Packages.		
	Unit 5			

13	**Nested Types:**	Need for Type within Type, Different Types of Inner Classes, Anonymous Inner Classes, Callback Mechanism. Persistence, Reading from Files, Writing into Files, Concept of Serialization.	**20**	**100**
14		**Introduction to Generics and Collections:** Generic Programming Concepts, Concept of Generic Box, List Interface, Sort and Search.		

Literature

Book Type	**Code**	**Title & Author**
Reference Book	R1	"Core Java Volume I – Fundamentals", Cay S Horstmann, Gary Cornell, 9th Edition, Pearson.
	R2	"Learning Java", Patrick Niemeyer and Daniel Leuck, 4th Edition, O'Reilly.

UE18CS208D: PROGRAMMING WITH R (2-0-0-0-2)

# of Credits: 2 **# of Hours: 28**

Class	**CHAPTER TITLE/ REFERENCE LITERATURE**	**TOPICS TO BE COVERED**	**% OF PORTIONS COVERED**	
			UNIT	**CUMULLATIVE**
1	**Unit 1: Text books: T1,T2,T3,T4, Online Resources**	Understanding R Programming environment	**18**	**18**
2		Basics of R, Overview of R,		
3		R data types and objects		
4		Reading and writing data.		
5	**Unit 2: Text books: T1,T2,T3,T4, Online**	Data Structures in R – Vectors	**26**	**44**
6		Matrices, Factors		
7		Data Frames and Lists		
8		Control structures		

9	**Resources**	Functions, scoping rules		
10		Dates and times		
11		Using Strings in R.		
12	**Unit 3:**	Loop functions: lapply() sapply() apply()	**18**	**62**
13	**Text books:**	Loop Functions - tapply() mapply()		
14	**T1,T2,T3,T4,**	Debugging in R		
15	**Online Resources**	Debugging tools		
16	**Unit 4:**	Applying Probability in R – Introduction to Probability in R and Random & Continuous Variables.	**19**	**81**
17	**Text books:**	Bernoulli, Binomial Distributions		
18	**T1,T2,T3,T4,**	Poisson Distribution		
19	**Online**	Normal Distribution		
20	**Resources**	Discussion on Other common distributions		
21		Application of generic Statistics methods using R		
22	**Unit 5:**	Graphics in R	**19**	**100**
23		Data visualization		
24	**Text books:**	Data visualization and Manipulation tricks		
25	**T1,T2,T3,T4,**	Calculation Eigen values and vectors		
26	**Online**	Introduction to PCA		
27	**Resources**	Principal component analysis		
28		Finding clusters.		

Literature

Book Type	Code	Title & Author	Publication Information		
			Edition	Publisher	Year
Text Book	T1	**An Introduction To Statistical Learning – With Applications in R**	2	Springer	2009
	T2	**R Programming For Data Science**	1	Leanpub	Updated-2018
	T3	**Exploratory Data Analysis With R**	1	Leanpub	2015
	T4	**R In Action**	3	Manning publications manning.com	Updated-2015