Advanced Database

Course Title: Advanced Database
Course No: CSC461
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course includes advanced concept of database system. The main topics covered are advanced concept of relational data model, Extended E-R model, new database management technologies, query optimization, NoSQL database and big data processing techniques.

Course Objectives:
At the end of the course students should be able to know new developments in database technology, interpret and explain the impact of emerging database standards, evaluate the contribution of database theory to practical implementations of database management systems. Also, students should be able to develop more advanced application using MapReduce and Hadoop.

Course Contents:

Unit 1: Enhanced Entity Relationship Model and Relational Model (8 Hrs.)
Entity Relationship Model Revised; Subclasses, Superclasses and Inheritance; Specialization and Generalization; Constraints and characteristics of specialization and Generalization; Union Types; Aggregation; Relational Model Revised; Converting ER and EER Model to Relational Model; SQL and Advanced Features; Concepts of File Structures, Hashing, and Indexing

Unit 2: Object and Object Relational Databases (10 Hrs.)
Object Database Concepts; Object Database Extensions to SQL; The ODMG Object Model and the Object Definition Language ODL; Object Database Conceptual Design; Object Query Language OQL; Language Binding in the ODMG Standard

Unit 3: Query Processing and Optimization (7 Hrs.)
Concept of Query Processing; Query Trees and Heuristics for Query Optimization; Choice of Query Execution Plans; Cost-Based Optimization

Unit 4: Distributed Databases, NOSQL Systems, and BigData (12 Hrs.)
Distributed Database Concepts and Advantages; Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design; Types of Distributed Database Systems; Distributed Database Architectures
Introduction to NOSQL Systems; The CAP Theorem; Document-based, Key-value Stores, Column-based, and Graph-based Systems; BigData; MapReduce; Hadoop

Unit 5: Advanced Database Models, Systems, and Applications (8 Hrs.)
Active Database Concepts and Triggers; Temporal Database Concepts; Spatial Database Concepts; Multimedia Database Concepts; Deductive Database Concepts; Introduction to Information Retrieval and Web Search

Laboratory Works:
Students should implement different concepts of database system studied in each unit of the course during lab time and should submit a mini project at the end the course.

Recommended Books:

1. Elmasri and Navathe, Fundamentals of Database Systems, Pearson Education.
2. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill
3. Korth, Silberchatz, Sudarshan, Database System Concepts, McGraw-Hill.
4. Peter Rob and Coronel, Database Systems, Design, Implementation and Management, Thomson Learning.
5. C. J. Date & Longman, Introduction to Database Systems, Pearson Education
6. Tiwari, Shashank and Safari, professional Nosql, O'Reilly Media Company.
7. Gunarathne, Thilina Hadoop MapReduce v2 Cookbook: Explore the Hadoop MapReduce v2.
8. Ecosystem to Gain Insights from very Large Datasets, 2nd Edition, PACKT Publishing.

Internship

Course Title: Internship
Course No: CSC462
Nature of the Course: Internship
Semester: VIII

Full Marks: 160+40
Pass Marks: 64 +16
Credit Hrs: 6

Course Description: This course covers the real-world practice in industry. It includes using theoretical and practical knowledge while working in industry together with the understanding of industry culture.

Course Objectives: The objective of this course is to allow students into market industry and gain real world experience. The course is expected to make students more pragmatic and professional.

Course Details:

Nature of Internship:

The internship work should be relevant to the field of computer science and information technology. The nature internship may include design and development of software, hardware, network services, database systems etc. The internship duration should be minimum of 180 hours or ten weeks. The internship should be started tentatively by the 3rd week of start of eighth semester. The internship host organizations can be software/hardware development companies, telecommunications companies, network and internet service providers, financial organizations, health organizations etc.

The internship is an individual activity. The student should be responsible for the timely completion of all the activities and projects assigned, maintaining the professional quality. Each student should be facilitated with a mentor at the intern organization and a supervisor at the college/campus. Student should inform the status of all assignments to the mentor and supervisor. The student is expected to communicate frequently with the advisors on the progress and status of intern project(s)/activities. Each student must prepare and submit individual internship report on the basis of his/her work done during the internship period. Students working in group at the same organization should be able to distinguish their nature of work.

Phases of Internship:

The following are the phases of internship evaluation:

1. **Proposal Submission:** Students must submit and present internship proposal plan after 2nd week of start of the internship.

2. **Mid-Term Submission:** Students must submit progress report and defend midterm progress of their internship work in the 11th week of the eight semester.

3. **Final Submission:** Students must submit and defend the internship work during last week of the eight semester but before final board examination. The final defense will be followed

a viva voice conducted by an evaluation committee. Students must have to submit the internship final report to their respective department of college/campus before at least 10 days of final defense date. The report should be submitted in standard format as prescribed. The hard/soft copy of report should be made available to the external before a week of presentation date.

Provision of Supervision:

There should be a regular faculty member of the college assigned as a supervisor. The role of supervisor is to supervise the students throughout the internship period. A supervisor can supervise at most four internship students in a section.

Provision of Mentorship:

There should be a regular employee of the intern providing organization assigned as a mentor. The role of mentor is to guide the students throughout the internship period at the organization.

Evaluation Scheme:

1. **Proposal Defense** - 5% Marks of 200 (5 Marks Head/Program Coordinator + 5 Marks Supervisor)
2. **Midterm** - 15% Marks of 200 (5 Marks Head/Program Coordinator + 25 Marks Supervisor)
3. **Final Defense -** 80% Marks of 200 (100 Marks Mentor + 20 Marks Supervisor + 40 Marks External)

The evaluation committee and evaluation criteria should be as follow;

a. Evaluation committee

- HOD/Coordinator
- Project Supervisor
- Mentor
- External Examiner

b. Marks Distribution:

- Head / Program Coordinator – 10
- Supervisor – 50
- Mentor – 100
- External Examiner – 40
- Total – 200

c. Focus of the evaluation

- Presentation Skills
- Level of Work Done and Understanding of Internship Activities
- Internship Report
- Viva/Question Answer

Report Contents:

1. **Prescribed content flow for the project proposal**

    1. Introduction
    2. Problem Statement
    3. Objectives
    4. Description of Internship Work/Project
    5. Internship Plan
    6. Expected Outcome of Internship Activities
    7. References

2. **Prescribed content flow for the internship report**

    1. Cover & Title Page
    2. Certificate Page
        i. Mentors' Recommendation from Company
        ii. Supervisors' Recommendation
        iii. Examiners' Approval Letter
    3. Acknowledgement
    4. Abstract Page
    5. Table of Contents
    6. List of Abbreviations, List of Figures, List of Tables, List of Abbreviations
    7. Main Report
    8. References
    9. Bibliography (if any)
    10. Appendices (Screen Shots/ Source Codes/ Work Logs etc…)

3. **Prescribed chapters in the main report**

    1. **Chapter 1: Introduction**
        1.1. Introduction (Introduce the project/ work done during internship)
        1.2. Problem Statement
        1.3. Objectives
        1.4. Scope and Limitation
        1.5. Report Organization

    2. **Chapter 2: Organization Details and Literature Review**
        2.1. Introduction to Organization
        2.2. Organizational Hierarchy
        2.3. Working Domains of Organization
        2.4. Description of Intern Department/Unit
        2.5. Literature Review / Related Study (if any)

    3. **Chapter 3: Internship Activities**
        3.1. Roles and Responsibilities
        3.2. Weekly log (Log should contain the list of technical activities performed)
        3.3. Description of the Project(s) Involved During Internship

3.4. Tasks / Activities Performed (Technical details of the activities done during the internship)

4. Chapter 4: Conclusion and Learning Outcomes

4.1. Conclusion

4.2. Learning Outcome

Students should be able to relate and contextualize the above-mentioned concepts with their project work/activities done during internship at the host organization.

Citation and Referencing

The listing of references should be listed in the references section. The references contain the list of articles, books, URLs that are cited in the document. The books, articles, and others that are studied during the study but are not cited in the document can be listed in the bibliography section. The citation and referencing standard should be APA referencing standard. The text inside the document should be cited accordingly. The APA referencing standard can be found in the web at https://apastyle.apa.org/

Report Format Standards

A. Page Number

The pages from certificate page to the list of tables/figures/abbreviations/approvals should be numbered in roman starting from i. The pages from chapter 1 onwards should be numbered in numeric starting from 1. The page number should be inserted at bottom, aligned center.

B. Page Size and Margin

- The paper size must be a page size corresponding to A4. The margins must be set as

  Top = 1; Bottom = 1; Right = 1; Left 1.25

C. Paragraph Style

- All paragraphs must be justified and have spacing of 1.5.

D. Text Font of Document

- The contents in the document should be in Times New Roman font
- The font size in the paragraphs of document should be 12

E. Section Headings

- Font size for the headings should be 16 for chapter headings, 14 for section headings, 12 for sub-section headings. All the headings should be bold faced.

F. Figures and Tables

- Position of figures and tables should be aligned center. The figure caption should be centred below the figure and table captions should be centred above the table. All the captions should be of bold face with 12 font size.

Final Report Binding and Submission:

No of Copies: 3 (College Library + Self + Dean Office)

Look and Feel: Golden Embracing with Black Binding

A final approved signed copy of the report should be submitted to the Dean Office, Exam Section, Institute of Science and Technology, Tribhuvan University

Text Book: None

Advanced Networking with IPv6

Course Title: Advanced Networking with IPv6
Course No: CSC463
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course covers principles underlying IPv6 Network Design, Internet routing protocols (unicast, multicast and unidirectional) with IPv6, algorithmic issues related to the Internet, IPv6 Migration, measurement and performance, next generation Internet (IPv6, QoS) and applications.

Course Objectives:
The main objective of this course is to provide knowledge of different concepts of advanced networking with IPv6 including network design, routing, migration etc.

Course Contents:

Unit 1: Introduction to Networking (6 Hrs.)
1.1.OSI Model
1.2.IPv4 addressing overview
1.3.VLSM & CIDR
1.4.Operational and managerial issues of Legacy IPv4 networking
1.5.Introduction to smart networking
1.6.Overview of Programmable networks: SDN and NFV
1.7.IPv6 network migration status

Unit 2: IP Next Generation (8 Hrs.)
2.1.Internet Protocol Version 6 (IPv6)
2.2.History of IPv6
2.3.IPv6 Header Format
2.4.Features of IPv6
2.5.IPv6 Addressing
2.5.1. Unicast addressing and its types
2.5.2. Anycast addressing
2.5.3. Multicast addressing and its scope
2.6.Static and Dynamic addressing with IPv6
2.7.IPv6 extension headers

Unit 3: ICMPv6 and Neighbor Discovery (6 Hrs.)
3.1.ICMPv6 General Message Format
3.2.ICMPv6 Error and Information Message Types
3.3.ICMPv6 features and its comparison with ICMPv4
3.4.Neighbor Cache and Destination Cache
3.5.Neighbor Discovery Processes and Messages
3.6.Path MTU Discovery
3.7.MLD overview

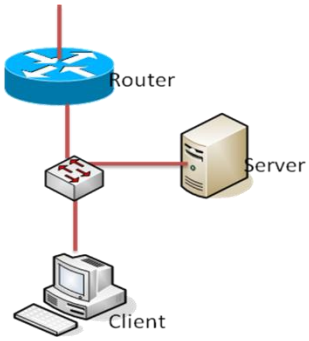
Unit 4: Security and Quality of Service in IPv6 (4 Hrs.)
4.1.Types of Threats
4.2.Security Techniques
4.3.IPSEC Framework
4.4.QoS Paradigms
4.5.QoS in IPv6 Protocols

Unit 5: IPv6 Routing (5 Hrs.)
5.1.RIPng
5.2.OSPF for IPv6
5.3.BGP extensions for IPv6
5.4.PIM-SM & DVMRP for IPv6

Unit 6: IPv4/IPv6 Transition Mechanisms (8 Hrs.)
6.1.Migration Strategies
6.2.Tunneling, dual stack and translations
6.3.Transition techniques
6.3.1. 6RD
6.3.2. Dual-stack lite
6.3.3. Stateful/Stateless AFT
6.3.4. 464XLAT, CGNAT
6.3.5. Other recent techniques

Unit 7: Future networking (8 Hrs.)
7.1.Operation of SDN and NFV
7.2.Introduction to SDN based IPv6 Networking
7.3.SDN migration methods and practices
7.4.Features of Software-Defined IPv6 Networks (SoDIP6)
7.5.SoDIP6 Network Deployment: Challenges and Risks
7.6.SoDIP6 based NGN
7.7.Routing in Multi-Domain SoDIP6 Networks

Laboratory work:
For the lab work, one PC to one student either in virtual environment or real environment will be provided. Students will be divided into group of 3 students. The working environment and machine connectivity will look like the following:



Tools Needed: TCPDUMP & WIRESHARK, VMWare Environment, Linux/FreeBSD, Windows
Lab 1: Enable IPv6 in Windows/Linux
Lab 2: IPv6 Header Analysis
Lab 3: IPv6 Packet analysis (neighbor/router solicitation/discovery)
Lab 4: Unicast Routing Implementation using Zebra-OSPF & OSPF phase analysis
Lab 5: Multicast Routing Implementation using XORP-PIM/SM & PIM/SM phase analysis
Lab 6: SDN enabled IPv6 network implementaion with Mininet
Lab 7: ONOS, SDN-IP implementation for routing implementaiotn in SoDIP6 network

Reference Books:

1. Silvia Hagen: IPv6 Essentials, O'reilly
2. Joseph Davies: Understanding IPv6; eastern economy edition
3. SDN and NFV simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization, by Jim Doherty

Prerequisite: Networking & Communications Fundamentals

Distributed Networking

Course Title: Distributed Networking
Course No: CSC464
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course covers overview of distributed networking model, client server model, communication models, internetworking, interprocess communication, fault tolerance, reliability, replication, security issues and new developments in distributed networking.

Course Objectives:
The course objective to make the students familiar with Distributed Network Systems, its models, communication paradigms, related protocols and architectures, its reliability and replication systems, and security issues. It also briefly introduces the current developments in distributed networking.

Course Contents:

Unit 1	Overview: Distributed Systems, Computer Networks, Protocols and QoS, Software for Distributed Computing, Agent – based computing model	4 Hrs.
Unit 2	Client Server Model: Issues, Client Server Model in Distributed Computing System, Cooperation between clients and servers, Extensions to the Client Server Model, Service Discovery, Client Server Interoperability	8 Hrs.
Unit 3	Communication Paradigm: Message and message passing mechanisms, Remote Procedure Calls, Remote Method Invocation, Distributed Shared Memory, its design and implementation and consistency models	6 Hrs.
Unit 4	Internetworking: Communication Protocol Architectures, TCP/IP Protocol Suite, IPv6	5 Hrs.
Unit 5	Interprocess communication using message passing: Developing distributed applications using message passing, sockets and system calls	5 Hrs.
Unit 6	Reliability and Replication Techniques: Fault Tolerance, Reliability, Availability, Failure Classification, Techniques to achieve reliability, Reliability Modelling, Fault Tolerant Distributed Algorithms, Replication and reliability, Replication schemes and consistency	7 Hrs.
Unit 7	Security: Secure Networks, Security Mechanisms on Internet, DDoS Attacks, Active and Passive Defense against DDoS attack	6 Hrs.
Unit 8	Current Developments in Distributed Network System: Introduction and characteristics of Cluster Computing, Grid Computing, P2P Computing, Pervasive Computing	4 Hrs.

Laboratory Works:
Laboratory exercise should consist of tasks related configuration of distributed system, client server applications, message passing, remote method invocation, remote procedure calls, socket and system calls, and reliability and replication techniques.

Text Book:

1. Weijia Jia, Wanlei Zhou, Distributed Network Systems from Concept to Implementation, Springer

Reference Books:

1. Hagit Attiya, Jennifer Welch, Distributed Computing: Fundamentals, Simulations and Advanced Topics, 2nd Edition, March 2004
2. Distributed Systems: Principles and Paradigms – Andrew Tanenbaum and Maarten van Steen, Prentice Hall, 2007

Prerequisite: Networking and Communication Fundamentals

Game Technology

Course Title: Game Technology
Course No: CSC465
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course is a practical and conceptual introduction to game design and development including basic ideas of game design, learn to design a game, and working as a game designer. This course will provide ample opportunities to try out concepts and theories to design, develop and test 2D and 3D games. The main platform will be Unity, a cross-platform game editor and engine widely in use by many companies in the game industry.

Course Objectives:
After completion of the course, students will learn

- basics of game development
- to design games
- to work as a game designer
- to use Unity game editor and engine to develop games

Course Contents:

Unit 1: Game Design Basics (12 Hrs.)
Role of the Game Designer: An Advocate for the Player, Passions and Skills, A Playcentric Design Process, Designing for Innovation; Structure of Games: Engaging the Player, The Sum of the Parts, Defining Games, Beyond Definitions; Working with Formal Elements: Players, Objectives, Procedures, Rules, Resources, Conflict, Boundaries, Outcome; Working with Dramatic Elements: Challenge, Play, Premise, Character, Story, World Building, The Dramatic Arc; Working with System Dynamics: Games as Systems, System Dynamics, Interacting with Systems, Tuning Game Systems

Unit 2: Designing a Game (25 Hrs.)
Conceptualization: Where Do Ideas Come From, Alternative Methods, Editing and Refining, Turning Ideas into a Game, Ideas vs. Designs; Prototyping: Methods of Prototyping, Prototyping Your Original Game Idea, Making the Physical Prototype Better, Beyond the Physical Prototype; Digital Prototyping: Types, Designing Control Schemes, Selecting Viewpoints, Effective Interface Design, Prototyping Tools; Playtesting: Playtesting and Iterative Design, Recruiting Playtesters, Conducting a Playtesting Session, Methods of Playtesting, The Play Matrix, Taking Notes, Basic Usability Techniques, Data Gathering, Test Control Situations, Playtesting Practice; Functionality, Completeness, and Balance: What Are You Testing For? Is Your Game Functional? Is Your Game Internally Complete? Is Your Game Balanced? Techniques for Balancing Your Game; Fun and Accessibility: Is Your Game Fun? Improving Player Choices, Fun Killers, Beyond Fun, Is Your Game Accessible?

Unit 3: Working as a Game Designer (8 Hrs.)

Team Structures: Team Structure, Developer's Team, Publisher's Team, Team Profile, All Contribute to the Design, Team Communication; Stages and Methods of Development: Stages, Using Agile Development; Communication your Designs: Visualization, Flowcharts, Tables and Spreadsheets, Concept Art, Description, Formats, Contents, Design Macros; Understanding the New Game Industry: Size, Platform for Distribution, Genres of Gameplay, Publishers, Developers, The Business of Game Publishing; Selling Yourself and Your Ideas to the Game Industry: Getting a Job at a Publisher or Developer, Pitching Your Original Ideas, Independent Production

Laboratory Works:

The Laboratory work includes designing and developing games using Unity game editor and engine.

Recommended Books:

1. Tracy Fullerton, Game Design Workshop: A Playcentric Approach to Creating Innovative Games, Fourth Edition, CRC Press, 2019.
2. The Digital Gaming Handbook, Edited by Roberto Dillon, CRC Press, 2021.

Distributed and Object Oriented Database

Course Title: Distributed and Object Oriented Database
Course No: CSC466
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course aims to discuss concepts of distributed and object oriented database management systems. Main focus is given to basic concepts of DDBMS, distributed database design, distributed query processing, distributed concurrency control, concepts of OODBMS, and language and design of object oriented database.

Course Objectives:

- Discuss basic concepts related to distribute DBMS.
- Exemplify design of distributed database.
- Describe distributed query processing and concurrency control.
- Discuss basic concepts of OODBMS.
- Demonstrate language and design for distributed database.

Course Contents:

Unit 1: Introduction to Distributed Database (4 Hrs.)
Distributed Data Processing, Distributed Database Systems, Promises of DDBS, Complicating Factors, Design Issues of DDBMS, and Distributed DBMS Architectures: Autonomy, Distribution, Heterogeneity DDBMS Architecture – Client/Server, Peer to peer, MDBS.

Unit 2: Distributed Database Design and Access Control (4 Hrs.)
Top-Down Design Process, Distribution Design Issues, Fragmentation, Allocation, Data Directory, View Management, Data Security, Semantic Integrity Control.

Unit 3: Query Processing, Decomposition, and Localization (6 Hrs.)
Query Processing Problem, Objectives of Query processing, Complexity of RA Operations, Characterization of Query Processors, Layers of Query Processing, Query Decomposition, Localization of Distributed Data.

Unit 4: Distributed Concurrency Control (8 Hrs.)
Serializability Theory, Taxonomy of Concurrency Control Mechanisms, Lock Based Concurrency Control Algorithms, Time-Stamp Based Concurrency Control Algorithms, Optimistic Concurrency Control Algorithms, Deadlock management.

Unit 5: Object Oriented Database Concepts (6 Hrs.)
Overview of Object-Oriented Concepts, Object Identity, Object Structure, and Type Constructors, Encapsulation of Operations, Methods, and Persistence, Type Hierarchies and Inheritance, Complex Objects, Other Objected-Oriented Concepts

Unit 6: OODBMS Languages and Design (6 Hrs.)
Object Model, Object Definition Language, Object Query Language, Object Database Conceptual Design, Examples of ODBMSs.

Laboratory Works:
Students should implement all the concepts of object oriented and distributed databases mentioned in the course.

Text Books:

1. M. Tamer Özsu and Patrick Valduriez, Principles of Distributed Database Systems, Fourth Edition, Springer, 2019.
2. Elmasri Ramez and Navathe Shamkant, Fundamentals of Database System, Seventh Edition, Pearson Education, 2017.

Introduction to Cloud Computing

Course Title: Introduction to Cloud Computing
Course No: CSC467
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course covers different concepts of cloud computing including introduction, architectures, cloud virtualization, programming models, security, and platforms and applications of cloud computing.

Course Objectives:
The main objective of this course is to provide theoretical as well as practical knowledge of cloud computing including designing, implementing and managing the cloud computing.

Course Contents:

Unit 1: Introduction to Cloud Computing (6 Hrs.)
Evolution of Cloud Computing, Characteristics of Cloud Computing, Types of cloud and its Cloud services, Benefits and challenges of cloud computing, Applications cloud computing, Cloud Storage, Cloud services requirements, cloud and dynamic infrastructure, Cloud adoption

Unit 2: Cloud Computing Architecture (6 Hrs.)
Platform as service, Software as a service, Infrastructure as service, Public clouds, Private clouds, Community cloud, Hybrid clouds, Cloud design and implementation using SOA, security, trust and privacy

Unit 3: Cloud Virtualization technology (10 Hrs.)
Introduction to Virtualization, different types of Virtualization, Implementation Levels of Virtualization Structures, Benefits of virtualization, server virtualization, virtualization software, Types of Hypervisor, and Load balancing, Infrastructure requirement for virtualization

Unit 4: Cloud Programming Models (12 Hrs.)
Thread programming, Task programming, Map-reduce programming, Parallel efficiency of Map-Reduce, Enterprise batch processing using Map-Reduce, Comparisons between Thread, Task and Map reduce

Unit 5: Cloud security (6 Hrs.)
Cloud Security issues, challenges and Risks, Software-as-a-Service Security, Security Monitoring, Security Architecture Design, Data and application Security, Virtual Machine Security, Legal issues and Aspects, Multi-tenancy issues

Unit 6: Cloud Platforms and Applications (12 Hrs.)
Web services, AppEngine, Azures Platform, Aneka, Open challenges, Scientific applications, Business and Consumer applications

Laboratory Works:
The practical work consists of all features of cloud computing.

Text Books:
1. Dr. Kumar Saurabh, Cloud Computing
2. Raj Kumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing

Reference Books:
1. David S. Linthicum, Cloud Computing and SOA Convergence in your enterprise
2. Barrie Sosinsky, Cloud Computing Bible
3. Saurabh, K. (2011). Cloud Computing – Insights into New -Era Infrastructure, Wiley India.

Geographical Information System

Course Title: Geographical Information System
Course No: CSC468
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course covers about spatial data structure, modeling and database design, different techniques for capturing the real world, spatial data manipulation, analysis and visualization, spatial data infrastructure and data standardization, overview of open GIS and open source GIS data.

Course Objectives:
The main objective of this course is to provide both theoretical and practical knowledge of Geographical Information System.

Course Contents:

Unit 1: Introduction to Geographic Information System (GIS) (5 Hrs.)

1.1 Overview, concepts of GIS, components of GIS
1.2 Origin of GIS, History of *GIS* and geospatial technology
1.3 Functions and benefits of GIS
1.4 Scope and application areas of GIS
1.5 Data base management system (DBMS) and concept of spatial and attribute data

Unit2: Digital Mapping Concepts and Visualization (5 Hrs.)

2.1 Database and mapping concept: geographic features and attributes, thematic maps, map layers, map scales, resolution and representation
2.2 Map outputs and elements, map design and layout
2.3 Map projection: coordinate systems, projection systems, common map projections in GIS, conversion among coordinate systems

Unit 3: Spatial Data Structure and Database Design (6 Hrs.)

3.1 concepts of geographic phenomena and data modeling, geographic objects and fields
3.2 vector data and raster data model
3.3 spatial relationships and topology
3.4 GIS data formats and data conversion
3.5 Spatial database design with the concepts of geo-database

Unit 4: Data Acquisition, Data Quality and Management (9 Hrs.)

4.1 different methods of data capture
4.2 geo-referencing and digitization
4.3 data preparation, conversion and integration
4.4 spatial data quality and accuracy
4.5 introduction to global navigation and satellite systems (GNSS)
4.6 Basics of remote sensing (RS) technology
4.7 integration of RS and GNSS data into GIS

Unit 5: Spatial Analysis (10 Hrs.)

5.1 vector data analysis: geo-processing, overlay analysis, buffering, network analysis
5.2 raster analysis: local operations, focal operations, zonal operations, re-sampling, mosaic and clip, distance measurement
5.2 spatial interpolation techniques, geo-statistics, GIS modeling
5.3 GIS programming and customization: Opening and exploring Model Builder, Python script tools, Customizing QGIS with Python

Unit 6: Introduction to Spatial Data Infrastructure (3 Hrs.)

6.1 SDI concepts, components of SDI and trends
6.2 The concept of metadata and clearing house
6.3 System Architecture for SDI Interoperability, Client Server Architecture, SDI technologies
6.4 legal aspects of SDI

Unit 7: Open GIS (7 Hrs.)

7.1 Introduction of open concept in GIS
7.2 Open source software for spatial data analysis
7.3 Web Based GIS system
7.4 Open source GIS data
7.5 GIS application case studies

Laboratory work:

The lab should cover at least the concepts given in each chapter.

Recommended Books:

1. Chang, K. T. *Introduction to geographic information systems*. Ninth edition, Boston: McGraw-Hill.
2. Principles of geographic information systems: An introductory textbook, international institute for Geo-information science and Earth observation, the Netherlands- By rolf De By, Richard A. knippers, yuxian sun
3. ESRI guide to GIS analysis Andy Mitchell, ESRI press, Red lands
4. GIS Cook BOOK

Decision Support System and Expert System

Course Title: Decision Support System and Expert System
Course No: CSC469
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60+ 20+20
Pass Marks: 24+8+8
Credit Hrs: 3

Course Description:

This course is a study uses of artificial intelligence in business decision making. Emphasis will be given in business decision making process, design and development of decision support systems and expert systems.

Course Objectives:

- Introduce intelligent business decision making
- Discuss design, development and evaluation of DSS Systems
- Discuss various models of building DSS systems
- Explain Concept behind expert systems

Course Contents:

Unit 1: Business Decision Making (10 Hrs.)

1.1. Supporting Business Decision Making: Introduction, History, Conceptual Perspective, Decision Support vs. Transaction Processing System, Categories of DSS Applications and Products, DSS Framework, Building Decision Support Systems
1.2. Gaining Competitive Advantage with Decision Support Systems: Introduction, Technology Trends, Gaining Competitive Advantage, Examples of Strategic DSS, Opportunities and IS Planning, DSS Benefits, Limitations, and Risks, Resistances to Using DSS
1.3. Business Decision Making Process: Introduction, Managerial Decisions, Decision Making Context, Decision Making Process, Good Decision Making, Redesigning Decision Making Process

Unit 2: Designing, Developing, and Evaluating DSS Systems (10 Hrs.)

2.1. Designing and Evaluating DSS Systems: Introduction, Design and Development Issues, Decision Oriented Diagnosis, Prepare a Feasibility Study, Choose a Development Approach, DSS Project Management and Participants.
2.2. Designing and Evaluating DSS User Interfaces: Introduction, Overview of User Interface, User Interface Styles, ROMC Design Approach, Building DSS User Interface, Comments on Design Elements, Guidelines of Dialog and UI Design, Factors of UI Design Success.
2.3. DSS Architecture, Networking, and Security Issues: Introduction, DSS Architecture and IT Infrastructure, Networking Issues, Improving Security for Decision Support Systems.

Unit 3: Building DSS Systems (10 Hrs.)

3.1. Implementing Communication-Driven and Group Decision Support Systems, Building Data and Document Driven Decision Support Systems, Building Knowledge Driven Decision Support Systems, Building Model Driven Decision Support Systems, Building Web Based and Interorganizational Decision Support Systems, Evaluating DSS Projects

Unit 4: Expert Systems (8 Hrs.)

4.1. Definition and Features of Expert Systems, Architecture and Components of Expert Systems, Persons Who Interact with Expert Systems, Advantages and Disadvantages of Expert Systems, Expert Systems Development Life Cycle, Error Sources on Expert System Development

Unit 5: Fuzzy Expert Systems (7 Hrs.)

5.1. Fuzzy Rule, Fuzzy Reasoning, Need of Fuzzy Expert Systems, Operations on Fuzzy Expert Systems, Fuzzy Inference Systems, Fuzzy Inference Process, Types of Fuzzy Expert Systems, Fuzzy Controller.

Laboratory Work: Student should study some widely used decision support systems and expert systems. Besides, student need to develop decision support systems or expert systems as a mini-project.

Text Books:

1. Daniel J. Power, Decision Support Systems: Concepts and Resources for Managers, Illustrated Edition, Praeger.
2. I. Gupta and G. Nagpal, Artificial Intelligence and Expert Systems, Mercury Learning & Information, 2020

Mobile Application Development

Course Title: Mobile Application Development
Course No: CSC470
Nature of the course: Theory + Lab
Semester: VIII

Full Marks: 60+20+20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
This course introduces mobile application development frameworks, architectures, design and engineering issues, techniques, methodologies for mobile application development.

Course Objective:
The main objective of this course is to provide knowledge of understanding characterization and architecture with designing and developing of mobile applications.

Course Contents:

Unit 1: Introduction to Mobile Computing (5 Hrs.)
Introduction to Mobile Computing, 3-tier architecture of mobile computing, History of mobile, the evolution of devices (Brick era, Candy bar era, Feature phone era, Smartphone era, Touch era), Introduction to mobile application development frameworks (Swiftic, React Native, Xamarin, Ionic, Sencha, Adobe PhoneGap), Mobile ecosystem, Mobile application development environments, Factors in Developing Mobile Applications (Mobile Software Engineering, Framework and tools, User interface), Adding dimensions of mobile computing

Unit 2: Architecture, Design and Mobile Development Frameworks (10 Hrs.)
Mobile computing architectures, Fully centralized and client server architectures, N-tier architecture, Mobile information architecture, Mobile design, The mobile design tent-pole, Elements of mobile design, Designing for right device and different size screen, Fully centralized framework, N-tier client server framework, Mobile operating system and Virtual machine, Hardware specific tools and frameworks, BREW (Binary Runtime Environment for Wireless), BREW SDK, Building and deploying BREW application, WAP Architecture, WAP UI, WAP proxies and gateways, Multimedia messaging services, WAP push, security, Publishing frameworks (cocoon architecture)

Unit 3: User Interfaces (10 Hrs.)
Generic UI development, Human factors, Elements of the user interfaces (channels, interaction, prompts, response, commands, menus, forms, natural language), Resource files, Using UI widgets, Event driven programming, Context, (Taxonomy of context by domain, Extrinsic and Intrinsic context), User interface components, XForms, Developing mobile GUI, MVC, PAC, VUIs and mobile apps, Qualities of speech, Voice transcription, Voice recognition (Speech Grammar), Text to speech technologies, Speech synthesis, Multichannel and Multimodal UIs

Unit 4: Testing and Publishing Apps (5 Hrs.)
Mobile application build and delivery, Testing mobile applications, Automated versus Manual testing, Testing the mobile infrastructure, Coding standards, Unit testing, Black box testing, White box testing, Regression testing, App distribution through App stores, Monetizing Apps

Unit 5: Mobile Agent and Peer-to-Peer Architectures for Mobile Applications (3 Hrs.)
Basics of Agent technologies, Mobile agents for mobile computing, Peer to peer applications for mobile computing, JXTA

Unit 6: Wireless Connectivity and Mobile Applications (3 Hrs.)
Modulation and Transmission techniques, Short range and long range wireless communication, Security in wireless network, Bluetooth security, Security in long range wireless networking technologies, Mobile IP, SMS

Unit 7: Synchronization and Replication of Mobile Data (3 Hrs.)
Taxonomy of synchronization and replication, Scalability issues, Solving the mobile synchronization, Bluetooth synchronization, Working with the content provider

Unit 8: Location and Sensing (4 Hrs.)
Mobility and location based service, Data acquisition of location information, GPS based solution, Non GPS solution, Using GIS for mobile applications, Location information modeling, Location based service, Architecture for offering location services, Security and privacy of location information

Unit 9: Active Transactions (2 Hrs.)
Active computing and wireless infrastructure, WAP Push, Mobile IP and Push, Session initiation protocol

Laboratory Works: The laboratory should contain all the features mentioned in a course, which should include

- Language overview (Java, Object oriented concept)
- Basic Concept of Android application architecture
    - source, resource folder concept
    - Terminology for android
- Concept of android Layouts
    - Concept of Linear layout, Relative layout, toolbar
    - Concepts of list view, recycler view, grid view, scroll view, view pager, tab Layout
    - Create form and form validation
    - Alert Dialogs, Toast
    - Popup
- Shared Preference
- Menu
    - Option menu, context menu
- Introduction to Activity, Fragment
    - Simple activity information
    - Working with intents
- Theme and Style
- Database
    - Simple overview to database (simple query)
    - SQLite overview
- API Implementation

    - Working with volley
    - Working with Retrofit
- Advanced
    - Thread
    - JSON Parsing
    - Google Play Service (Maps, GPS)
    - FCM (Firebase Cloud Messaging)

Text Books:

1. Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML, Reza B'Far, Cambridge University Press, 2005
2. Mobile Design and Development, Brian Fling, O'Reilly, 2009

Real Time Systems

Course Title: Real Time Systems
Course No: CSC471
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60+20+20
Pass Marks: 24+8 + 8
Credit Hrs: 3

Course Description:
This course familiarizes students with different concepts of real time systems mainly focusing on scheduling, access control, memory management, optimization, and real time communications.

Course Objective:
The main objective of this course is to provide core knowledge of different concepts of real time system which will enhance the student capacity in building real time systems.

Course Contents:

Unit 1: Introduction (4 Hrs.)
Definition, Hard, Soft and Firm Real Time System, Real Time Vs. Embedded System, Timing Constraints, Application of Real Time System, Brief Survey of Real Time Programming: Ada 95, C, C++, C#, Fortran, Java, Occam 2, Special Real-Time Languages

Unit 2: Reference Model of Real Time System (4 Hrs.)
Processor and Resources, Temporal Parameters of Real-Time Workload, Periodic and Aperiodic Task Model, Precedence Constraints and Data Dependency, Other Dependencies, Functional Parameters, Resource Parameters of Jobs and Parameters of Resources

Unit 3: Periodic Task Scheduling (7 Hrs.)
Clock Driven Scheduling – Definition, Notations and Assumption, Scheduler Concepts, General Scheduling Structure, Cyclic Executives. Priority Driven Scheduling - Notations and Assumption, Fixed Priority Verses Dynamic Priority, Fixed Priority Scheduling Algorithms (RM and DM) and their Schedulability Analysis, Concept of Schedulability Tests – Inexact and Exact Schedulability Tests for RM and DM, Optimality of the RM and DM Algorithms, Practical Factors.

Unit 4: Aperiodic Task Scheduling (7 Hrs.)
Aperiodic Task Scheduling: Assumption and Approaches, Server Based and Non-Server Based Fixed Priority Scheduling Algorithms: Polling Server, Deferrable Server, Simple Sporadic Server, Priority Exchange, Extended Priority Exchange, Slack Stealing. Introduction to Scheduling of Flexible Computations: Flexible Applications, Imprecise Computation Model and Firm Deadline Model. Introduction to Scheduling of Flexible Computations –Flexible Applications, Imprecise Computation Model and Firm Deadline Model.

Unit 5: Real-Time Memory Management (5 Hrs.)
Process Stack Management, Multiple-Stack Arrangements, Memory Management in the Task-Control-Block Model, Swapping, Overlays, Block or Page Management, Memory Locking, Working Sets, Real-Time Garbage Collection, Contiguous File Systems

Unit 6: Resources and Resource Access Control (5 Hrs.)
Assumptions on Resources and their Usage, Effects of Resources Contention and Resource Access Control, Non Preemptive Critical Sections, Basic Priority-Inheritance Protocol, Basic Priority-Ceiling Protocol, Stack-Based, Priority-Ceiling (Ceiling-Priority) Protocol, Use of Priority-Ceiling Protocol In Dynamic-Priority System, Preemption-Ceiling Protocol, Controlling Accesses to Multiple-Unit Resources, Controlling Concurrent Accesses to Data Objects

Unit 7: Performance Analysis and Optimization of Real-Time Systems (6 Hrs.)
Challenges in Analyzing Real-Time Systems, Performance Analysis: Analysis of Round-Robin Systems, Response-Time Analysis for Fixed-Period Systems, Response-Time Analysis: RMA Example, Analysis of Sporadic and Aperiodic Interrupt Systems, Performance Optimization: Compute at Slowest Cycle, Scaled Numbers, Binary Angular Measure, Optimizing Memory Usage; Analysis of Memory Requirements; Reducing Memory Utilization: Variable Selection, Memory Fragmentation

Unit 8: Real Time Communication (7 Hrs.)
Introduction, Model of Real-Time Communication, Real Time Traffic Model, Real Time Connections and Service Disciplines, Priority – Based Service Disciplines for Switched Network, Weighted Round-Robin Service Disciplines, Medium Access-Control Protocols of Broadcast Networks, Internet and Resource Reservation Protocols, Real-Time Protocol

Laboratory Work / Case Study:
The laboratory work should focus on implementation of concepts related to scheduling, memory management, synchronization and optimization using suitable simulators and programming languages. There should also be a case study in group with at most 4 students focusing on any real time system implemented system.

Text Books:
1. Real-Time Systems, Jane W. S. Liu, Pearson Education Asia, Latest Edition
2. Real-Time Systems, Design Principles for Distributed Embedded Applications Kopetz, Hermann, Springer Latest Edition

Network and System Administration

Course Title: Network and System Administration
Course No: CSC472
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course covers different concepts of network and system administration including subjects ranging from initial installation of OS to day-to-day administrative tasks such as Network and Server Configurations, management of user accounts and disk space, and even imparting the trouble-shooting skills future system administrators will need to cope with unexpected behavior.

Course Objectives:
The main objective of this course is to provide knowledge of different concepts of network and system administration, configuration, and management.

Course Contents:

Unit 1: Networking Overview (4 Hrs.)
1.1 Overview of Reference Model (OSI, TCP/IP)
1.2 Overview of IPv4 and IPv6 addressing
1.3 Windows and Linux Networking Basics
1.4 Switching and Routing basics
1.5 Overview of SDN and OpenFlow

Unit 2: Server Administration Basics (8 Hrs.)
2.1 Open Source Server and Client Installation
2.2 Linux installation, disk partitioning, logical volume manager
2.3 Boot Process and Startup Services: Xinetd/Inetd
2.4 Managing accounts: users, groups and other privileges
2.5 File Systems and Quota Management
2.6 Job Scheduling with cron, crontab, anacron and system log analysis
2.7 Process controlling and management
2.8 Online Server upgrade/update process
2.9 Administering Database, web, and proxy server
2.10 Shell programming fundamentals

Unit 3: Network Configuration Basics (7 Hrs.)
3.1 Network Interface Configuration
3.2 Diagnosing Network startup issues
3.3 Linux and Windows Firewall configuration
3.4 Network troubleshooting commands
3.5 Introduction to network programming with Mininet
3.6 SDN controller and dataplane communication
3.7 Routing configuration in SDN
3.8 Open source networking monitoring (e.g. Nagios)

Unit 4: Dynamic Host Configuration Protocol (DHCP) (3 Hrs.)
4.1 DHCP Principle
4.2 DHCP Options, Scope, Reservation and Relaying
4.3 DHCP Troubleshooting

Unit 5: Name Server and Configuration (7 Hrs.)
5.1 DNS principles and Operations
5.2 Basic Name Server and Client Configuration
5.3 Caching Only name server
5.4 Primary and Slave Name Server
5.5 DNS Zone Transfers
5.6 DNS Dynamic Updates
5.7 DNS Delegation
5.8 DNS Server Security
5.9 Troubleshooting

Unit 6: Web and Proxy Server Configuration (7 Hrs.)
6.1 HTTP Server Configuration Basics
6.2 Virtual Hosting
6.3 HTTP Caching
6.4 Proxy Caching Server Configuration
6.5 Proxy ACL
6.6 Proxy-Authentication Mechanisms
6.7 Troubleshooting

Unit 7: FTP, File, and Print Server (4 Hrs.)
7.1 General Samba Configuration
7.2 CUPS configuration basics
7.3 FTP Principles
7.4 Anonymous FTP Server
7.5 Troubleshooting

Unit 8: Mail Server basics (5 Hrs.)
8.1 SMTP, POP and IMAP principles
8.2 SMTP Relaying Principles
8.3 Mail Domain Administration
8.4 Basic Mail Server Configuration (Sendmail, postfix, qmail, exim..)
8.5 SPAM control and Filtering
8.6 Troubleshooting

Laboratory work:
The laboratory work includes all the features mentioned in the course.

Samples:
1. Server/Client Installation over VMware Environment
2. Packet Analysis by using TCPDUMP and WIRESHARK

3. Network Practice with Packet Tracer
4. System Administration: User/Group management, File System Management ….
5. Network Configuration: Start/Stop network Service, network interface configuration
6. Firewall Configuration
7. DNS and DHCP Configuration and Troubleshooting
8. Web and Proxy Server Configuration and Troubleshooting
9. Basic Mail Server Configuration and Troubleshooting
10. SAMBA, NFS, CUPS and FTP configuration and Troubleshooting
11. SDN controller installation and client network implementation (OpenDaylight)
12. Network topology programming with Mininet and visualization

Recommended Books:

1. The Practice of System and Network Administration, Second Edition
   Thomas A. Limoncelli, Christina J. Hogan, Strata R. Chalup
2. Advanced Linux Networking, Roderick W. Smith, Addison-Wesley Professional (Pearson Education), 2002.
3. Linux Network Administrator's Guide, Tony Bautts, Terry Dawson, Gregor N. Purdy, O'Reilly, Third Edition, 2005

Prerequisite: Computer Networking Course

Embedded Systems Programming

Course Title: Embedded Systems Programming
Course No: CSC473
Nature of the Course: Theory + Lab
Semester: VIII

Full Marks: 60+20+20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description:
The course covers ARM based embedded system overview – assembly level programming, efficient C programming and embedded OS.

Course Objective:
The main objective of this course is to introduce the underlying principle of embedded system programming in assembly language and C language for ARM based embedded processor.

Course Contents:

Unit 1: ARM Embedded System (4 Hrs.)
Introduction to Embedded Systems, Introduction to RISC Design Philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software

Unit 2: ARM Processor Fundamentals (4 Hrs.)
The Acron RISC Machine, The ARM Programmer's Model, ARM Development Tools, Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, Vector Table, ARM Processor Families

Unit 3: Introduction to ARM Instruction Set (8 Hrs.)
Data Processing Instructions, Branch Instructions, Load – Store instructions, Software Interrupt Instructions, Program Status Register Instructions, Loading Constraints, Conditional Execution

Unit 4: Thumb Instruction Set (8 Hrs.)
The Thumb bit in the CPSR, The Thumb Programmer's Model, Thumb Branch Instructions, Thumb Software Interrupt Instructions, Thumb Data Processing Instructions, Thumb Single Register Data Transfer Instructions, Thumb Multiple Register Data Transfer Instructions, Thumb Breakdown Instruction, Thumb Implementation, Thumb Application

Unit 5: Efficient C Programming for ARM (8 Hrs.)
Basic Data Types, Expressions, Conditional Statements, Loops, Function Calls, Procedures, Use of Memory, Pointer Aliasing, Bit Field

Unit 6: Writing and Optimizing ARM Assembly Code (8 Hrs.)
Writing Assembly Code, Profiling and Cycle Counting, Instruction Scheduling, Register Allocation, Conditional Execution, Looping Constructs, Bit Manipulation, Efficient Switches, Handling Unaligned Data

Unit 7: Firmware and Embedded OS (5 Hrs.)

Firmware and Bootloader, Fundamental Components of Embedded OS, Embedded Linux, Android OS

Laboratory Works:
Programming in C and Assembly (KEIL and PROTEUS), GPIO Programming (LED, LCD, Keypad, Buzzer)

Text Book:
1. Andrew N. Sloss, Dominic Symes, Chris Wright "ARM System Developer's Guide: Designing and Optimizing System Software", Latest Edition, Morgan Kaufmann Publisher, An imprint of Elsevier

Reference Books:
1. Steve Furber "ARM System – on – Chip Architecture", Second Edition, Pearson Education Limited
2. Warwick A. Smith "C Programming for Embedded Micricontrollers"

International Business Management

Course Title: International Business Management
Course No: MGT474
Nature of the Course: Theory
Semester: VIII

Full Marks: 80 + 20
Pass Marks: 32 + 8
Credit Hrs: 3

Course Description:
This course contains globalization and international business, global economy and regional, international trade and investment theories and practices, national difference in political, economic and socio-cultural environment, strategies for international business and international financial environment to provide the basic knowledge to students.

Course Objectives:
The objective of this course is to familiarize students with the environment and challenges of doing business abroad. The course presents students with the opportunities to explore a number of issues and concerns relating to international business.

Course Contents:

Unit 1: Globalization and International Business (8 Hrs.)
Concept of domestic, international and global business. Opportunities and challenges of IB. Globalization: Concept and drivers, Types of globalization: economic, cultural, political, environmental, production, market. International Business Environment: Economic, demographic, cultural and political-legal environment; Globalization debate: positive and negative impact.

Unit 2: Global Economy and Regional Economy (6 Hrs.)
Global economy: concept, features and structures; changing demographics of global business. MNCs: Concept, types, structures, strategies, and problems. Global economic integration: WTO (Origin, goals, structure, and functions). Regional economic integration levels: preferential trading, free trade areas, customs union, common market, economic union, and political union; International Economic Organizations: WTO, UNCTAD, World Bank, IMF EU, NAFTA, SAFTA, BIMSTEC (Origin, goals and structure).

Unit 3: National Differences in Socio-cultural Environment (3 Hrs.)
Socio-cultural implication on IB. Cultural differences: Determinants of culture: Awareness, values, norms, communication, language and religion. Dealing with cultural differences.

Unit 4: National Differences in Political Environment (3 Hrs.)
Political systems: Democracy & totalitarian spectrum. Business-government relations. Political risk: concept and types. Impact of political environment on international business. Implications of legal systems in business. Intellectual property rights.

Unit 5: National Differences in Economic Environment (3 Hrs.)
Economic system: market, command, mixed. Determinants of economic development: Inflation, Income (GDP, per capita income nominal & PPP, HDI). Level of economic development: developed, developing, and emerging economies (World Bank's Criteria).

Unit 6: International Financial Environment (8 Hrs.)

Foreign exchange markets, Spot market, spot rate quotations, bid-ask spreads, trading in spot markets, cross exchange rates, forward markets, forward rate, long and short forward positions, forwards premium and discount; Arbitrage, Hedging and Speculation; Types of exchange rate systems: fixed and floating, soft peg, crawling peg, free float, managed float; Factors affecting exchange rate- relative inflation rates, interest rates, relative interest rates, relative income levels, government controls, expectations; Mode of payment in international trade.

Unit 7: Strategies for IB (6 Hrs.)

International strategic management: Concept and importance; Modes of entry into a foreign market: Export and import; strategic alliances: equity based (wholly owned subsidiaries, acquisition, greenfield venture, equity alliances, joint venture) and contractual based (licensing, franchising, turnkey operations, BOT, management contract). FDI & portfolio investment: benefits and drawbacks.

Unit 8: Functional Management and Operation of IB (8 Hrs.)

Polycentric, ethnocentric, regiocentric and geocentric approach in functional management of IB. Global marketing strategies: Product strategy, distribution strategy, promotion strategy, pricing strategy. Global production strategies: location, outsourcing, managing global supply chain. Global finance strategies: sources of fund, tax practices, tax haven. Global human resource management strategies: Staffing policy, expatriate management, compensation, cultivating global mindsets.

Recommended Books:

1. Cavusgil S.T., Knight G. and Riesenberger J. (2017). *International Business.* Fourth Edition. England: Pearson Education Limited.
2. Hill, Charles and Hult, Tomas. (2019). *International Business.* Twelfth Edition. New York: McGraw Hill Education.
3. Daniel J.D., Radebaugh L.H., Sullivan D.P. (2015). *International business.* Fifteenth Edition. England: Pearson Education Limited.
4. Rugman A.M. and Collinson, S. (2012). *International business.* Sixth Edution. England: Pearson Education Limited.