



**UNIVERSITY OF SARGODHA  
OFFICE OF THE REGISTRAR  
(ACAD BRANCH)**

**NOTIFICATION**

On the recommendations of Academic Council made in its 21<sup>st</sup> (2/2024) meeting held on 07.06.2024, the Syndicate in its 67<sup>th</sup> (3/2024) meeting held on 12.07.2024 approved the following for implementation w.e.f. Fall 2024 at Main Campus and Affiliated Colleges:

- |  |             |
|--|-------------|
| i. Curriculum of Associate Degree in Computer Science                                    | (Annex-‘A’) |
| ii. Revised curriculum of BS in Computer Science   | (Annex-‘B’) |
| iii. Curriculum of BS in Computer Science (5 <sup>th</sup> Semester Intake)              | (Annex-‘C’) |
| iv. Revised curriculum of Associate Degree in Information Technology                     | (Annex-‘D’) |
| v. Revised curriculum of BS in Information Technology                                    | (Annex-‘E’) |
| vi. Revised curriculum of BS in Information Technology (5 <sup>th</sup> Semester Intake) | (Annex-‘F’) |
| vii. Curriculum of Associate Degree in Software Engineering                              | (Annex-‘G’) |
| viii. Revised curriculum of BS in Software Engineering                                   | (Annex-‘H’) |
| ix. Curriculum of BS in Software Engineering (5 <sup>th</sup> Semester Intake)           | (Annex-‘I’) |

  
(WAQAR AHMAD)  
Additional Registrar (General)

No. SU/Acad/24/747

Dated: 26.09.2024

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- Chairman, Department of Information Technology
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Curriculum  
of  
BS Computer Science 5th Semester Intake  
for  
Main Campus and Affiliated Colleges



Department of Computer Science

University of Sargodha

(Applicable from Fall 2024)

H. Farid  
Chairman  
Department of Computer Science  
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## **Underlying Principles of Computer Science Degree Programs**

Computing (a nucleus of all activities including technical, academic, professional and development practices relating to computers) provides a wide range of choices on how an individual might focus his or her professional life. This document provides an overview of the different kinds of degree programs in Computing that are currently available and for which curriculum standards are now available. It is believed that this report may be an essential source for university faculty, administrators, students, parents and professionals who need to be aware of Computing as a broad based discipline that crosses the boundaries between science, engineering, and professional practice. In reality, computing consists of several disciplines. Various questions are naturally critical including: what are the different kinds of Computing degree programs or how are they similar and how are they different? The variety of degree programs in Computing presents prospective students, educators, and administrators with important choices where they may focus their efforts.

The following sections of the report also provide a complete detail of the proposed curricula pertaining to the Computer Science BS program. All details regarding the scheme of study, course content with CLOs, and overall structure of the degree programs are presented in this document. Computing is a dynamic field and accordingly a good care has been taken to design a flexible structure that will maintain currency with the latest scientific and technological advancements in the field. Moreover, it seems that Computing is a discipline that incorporates scientific, engineering, and creative features. A reasonable emphasis has been given to formal scientific and engineering areas to enhance the level of formalization in the degree programs. Technology can play an important role in the implementation of Computing programs. As a result, all programs are structured on essential dimensions including scientific knowledge, technology, and design skills.

## **Curriculum for BS Computer Science 5th Semester Intake**

### **BS COMPUTER SCIENCE 5TH SEMESTER INTAKE Program's Rationale**

Computer Science is the systematic study of the feasibility, structure, expression, and mechanization of the methodical processes (or algorithms) that underlie the acquisition, representation, processing, storage, communication of, and access to information, whether such information is encoded in bits and bytes in a computer memory or transcribed in genes and protein structures in a human cell.

Computer Science spans a wide range, from its theoretical and algorithmic foundations to cutting-edge developments in robotics, computer vision, intelligent systems, bioinformatics, image processing, computational biology, computational lenses, and other exciting areas. Computer scientists develop new programming approaches for software development, devise new ways to use computers and develop effective ways to solve computing problems. While

other disciplines produce graduates with more immediately relevant job-related skills, computer science offers a comprehensive foundation for research and innovation.

Recent developments in computer hardware, software and communication technologies have offered new exciting opportunities and challenges for creation of innovative learning environments for Computer Science and its curricula design. The challenge of getting all newly emerging technologies incorporated into the curriculum is becoming pivotal for the effectiveness of curricula. There is a need for curricula structures that are really able to meet the challenges of 21<sup>st</sup> century knowledge driven complex work places. The key rationale behind the BS Computer Science 5th Semester Intake Computer Science program is to prepare a curriculum that provide integration of all components and the foundations that allow accessing all of the new knowledge and technology to fulfill the vision of future.

## Objectives

BS COMPUTER SCIENCE 5TH SEMESTER INTAKE Program is committed to create, expand, disseminate and teach the computer science body of knowledge through academics, applications and research which positively impact society locally, nationally, and internationally.

BS COMPUTER SCIENCE 5TH SEMESTER INTAKE program aims to develop students' critical professional thinking and intuition. The program's curriculum provides a balanced mixture of learning experiences to make the graduates capable of sound professional decisions. As a result, the successful graduates will be able to assume responsible positions in business, government, and education at the research, development, and planning levels. The program also provides an excellent foundation for further formal learning and training. The program is also expected to provide environments to put into practice, the principles and techniques learnt during the course of implementation of the program's curriculum. Some of the key objectives of the program are listed below:

- The program should provide a broad understanding of the field through introducing concepts, theory, techniques, and through intensive education/training in focused areas of Computer Science.
- The program should encourage students to develop and use abstract models in addition to apply respective technology in practical situations.
- The program should promote students' special communication skills both orally and in writing. They must be able to produce well-organized reports/presentations/projects, which clearly delineate objectives, methods of solution, results, and conclusions for a complex task.
- The program should provide formal foundations for higher learning and education.
- The program should be dynamic and flexible enough to maintain its body of knowledge in line with the latest scientific and technological developments in the field.
- The program should provide professional orientation to prepare students for industry.

*[Handwritten signature]*  
 Director of Quality Assurance  
 University of Sargodha

## Curricula Consideration

During the revision of the Computing Curricula two major guidelines have been considered (ACM and Seoul Accord). However, in some cases the main focus of these guidelines is mostly traditional Computer Science programs.

### Association of Computing Machinery (ACM) - Guidelines

Association of Computing Machinery (ACM), USA is the largest body in the world for computer scientists. Its membership is spread over the entire globe. It has a pool of highly reputed professionals which meet after a few years to assess the directions being taken by the computing discipline. In view of its assessment, it identifies knowledge areas and also their relative importance in the years to come. Thus, ACM shows the path to follow to the computing academia and professionals all over the world. Computing curricula are designed keeping in view following identified knowledge areas of ACM [ref # ACM 2013 curriculum report]. It has been tried to reasonably cover all knowledge areas without compromising the flexibility needed for a national model curriculum. The mapping of these key knowledge areas with the courses are given in the table below.

- AL - Algorithms and Complexity
- AR - Architecture and Organization
- CN - Computational Science
- DS - Discrete Structures
- GV - Graphics and Visual Computing
- HCI - Human-Computer Interaction
- IAS - Information Assurance and Security
- IM - Information Management
- IS - Intelligent Systems
- NC - Networking and Communications
- OS - Operating Systems
- PBD - Platform-based Development
- PD - Parallel and Distributed Computing
- PL - Programming Languages
- SDF - Software Development Fundamentals
- SE - Software Engineering
- SF - Systems Fundamentals
- SP - Social Issues and Professional Issues

The following knowledge areas have been addressed with the major computing courses.



### Knowledge Areas in ACM CS 2013 Curriculum

|    | Knowledge Area                         | CS 2013 |        | ACM 2013 Subjects Taught in Various Universities  | NCEAC Revised 2023 Subjects in Core                          |
|----|--|---------|--------|---|--|
|    |  | Tier-1  | Tier-2 |   |  |
| 1  | AL-Algorithms and Complexity           | 19      | 9      | Algorithms; Algorithms and Data Structures; Algorithm Design and Analysis                                       | Data structures, Analysis of Algorithms, Theory of Automata  |
| 2  | AR-Architecture and Organization       | 0       | 16     | Intro to Computer Architecture; DLD; Computer Engineering   | DLD, Computer Org & Assembly Language, Computer Architecture |
| 3  | CN-Computational Science               | 1       | 0      | eScience; Modeling and Simulation; Computer Graphics  | HCI & Computer Graphics; (Elective: Numerical Analysis)      |
| 4  | DS-Discrete Structures                 | 37      | 4      | Discrete Mathematics; Mathematical Foundations of CS; Probability for CS; Discrete Structures 1; Discrete Str 2 | Discrete Structures, Probability & Statistics                |
| 5  | GV-Graphics and Visualization          | 2       | 1      | Computer Graphics; Computer Graphics  | HCI & Computer Graphics; (Elective: Computer Graphics)       |
| 6  | HCI-Human-Computer Interaction         | 4       | 4      | Human Computer Interaction  | HCI & Computer Graphics                                      |
| 7  | IAS-Information Assurance and Security | 3       | 6      | Computer Systems Security   | Information Security; (Elective: Cyber Security)             |
| 8  | IM-Information Management              | 1       | 9      | Database Systems  | Database Systems; Adv Database Management Sys                |
| 9  | IS-Intelligent Systems                 | 0       | 10     | Artificial Intelligence Programming; Artificial Intelligence  | Artificial Intelligence                                      |
| 10 | NC-Networking and Communication        | 3       | 7      | Introduction to Computer Networking; Computer Networks  | Computer Networks  |

## 1.2 Outcome Based Education (OBE) System and Seoul Accord:

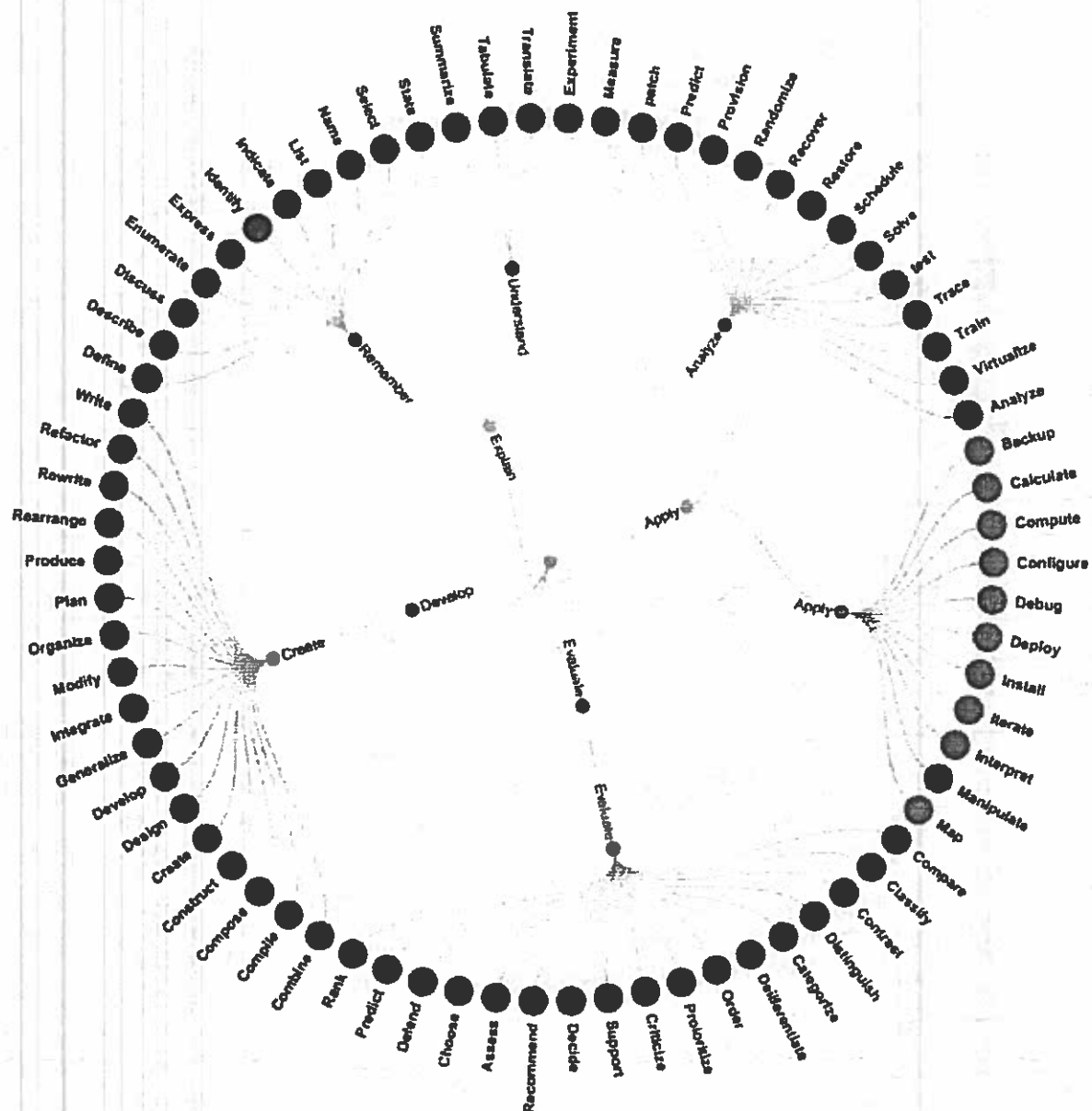
Keeping in view the latest transformation from knowledge-based education philosophy to Outcome based education (OBE) system, the OBE model based on Seoul Accord has also been considered. Computing programs prepare students to attain educational objectives by ensuring that students demonstrate achievement of the following outcomes (derived from Graduate Attributes define by Seoul Accord [www.seoulaccord.org](http://www.seoulaccord.org) ).

| S# | Program Learning Outcomes (PLOs)         | Computing Professional Graduate  |
|----|--|--|
| 1  | Academic Education                       | To prepare graduates as computing professionals  |
| 2  | Knowledge for Solving Computing Problems | Apply knowledge of computing fundamentals, knowledge of a computing specialization, and mathematics, science, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements. |
| 3  | Problem Analysis                         | Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.  |
| 4  | Design/ Development of Solutions         | Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.                 |
| 5  | Modern Tool Usage                        | Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.   |
| 6  | Individual and Team Work                 | Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings.   |
| 7  | Communication                            | Communicate effectively with the computing community and with society at large about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.           |

|    |                                       |   |
|----|---------------------------------------|---|
| 8  | Computing Professionalism and Society | Understand and assess societal, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice |
| 9  | Ethics                                | Understand and commit to professional ethics, responsibilities, and norms of professional computing practice  |
| 10 | Life-long Learning                    | Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional   |

**Bloom's Taxonomy**

| Revised Bloom's Taxonomy | Skill level with applicable verbs  |
|--------------------------|--|
| Remember                 | <b>Explain:</b> define, describe, discuss, enumerate, express, identify, indicate, list, name, select, state, summarize, tabulate, translate   |
| Understand               |  |
| Apply                    | <b>Apply:</b> backup, calculate, compute, configure, debug, deploy, experiment, install, iterate, interpret, manipulate, map, measure, patch, predict, provision, randomize, recover, restore, schedule, solve, test, trace, train, virtualize |
| Analyze                  | <b>Evaluate:</b> analyze, compare, classify, contrast, distinguish, categorize, differentiate, discriminate, order, prioritize, criticize, support, decide, recommend, assess, choose, defend, predict, rank                                   |
| Evaluate                 |  |
| Create                   | <b>Develop:</b> combine, compile, compose, construct, create, design, develop, generalize, integrate, modify, organize, plan, produce, rearrange, rewrite, refactor, write   |



## Program's Outcome

The program will produce Computer Scientists of great character, competence, vision and drive equipped with up-to-date knowledge, marketable skills, valuable competencies, unique expertise, globally compatible dispositions and culturally and professionally acceptable values to take on appropriate professional roles in computer science domain or proceed to further or higher education or training.

## Program's Structure

- The structure of BS Computer Science 5th Semester Intake program meets the needs of students with formal computing experience and relevant skills. The students are expected to learn theoretical and practical understanding of the entire field of Computer Science. The program structure is dynamic and provides basis for various options

including Breadth-Based, Depth-Based, and Integrated Breadth & Depth-Based specializations. Student may choose a particular option, which is the most appropriate to their planned future career. Followings are the program's details:

### **Degree Requirement**

Minimum credit hours shall be 62 for the BS Computer Science 5th Semester Intake. Deficiency courses may be offered to the students by the department.

### **Duration**

The program shall comprise of minimum four semesters/terms spread over two calendar years with two semesters/terms a year as per the rules of the University.

### **Eligibility Criteria**

1. Maximum age limit 26 years at the time of admission.
2. ADP/ ADS Specialization in (Computer Science or Computing relevant) of two years (Semester system) with minimum CGPA of 2.5. Minimum credit hours should not be less than 72.
3. ADP/B.Sc of two years (Annual System) minimum marks obtained should not be less than 45%. ADP/B.Sc with (Computer Studies out of 200 + Mathematics out of 200) Minimum.
4. In addition to the above mentioned eligibilities, the applicant must have one of the following combination in his/her Intermediate (HSSC) examination along with at least 50% passing marks.
  - i. Pre-Engineering
  - ii. Pre-Medical
  - iii. General Science
    - a. Mathematics, Statistics, Physics
    - b. Mathematics, Statistics, Economics
    - c. Mathematics, Statistics, Computer
    - d. Mathematics, Physics, Computer
    - e. Mathematics, Economics, Computer
  - iv. A-Levels (with equivalence of mentioned above by IBCC).

### **Assessment & Evaluation**

University's semester and examination rules & regulations shall be followed for assessment & evaluation.

### **Distribution of Courses**

The distribution of total credit hours for BS COMPUTER SCIENCE 5<sup>th</sup> Semester Intake is given as follows:



| <b>BS Computer Science 5<sup>th</sup> Semester Intake</b> |                               |                     |                |
|---|-------------------------------|---------------------|----------------|
| <b>Category</b>   | <b>Major Areas</b>            | <b>Credit Hours</b> | <b>Courses</b> |
| General education   | General Education Requirement | 08                  | 04             |
| Major courses   | Computing core                | 15                  | 05             |
|   | Domain core                   | 15                  | 05             |
|   | Domain elective               | 18                  | 06             |
| Interdisciplinary courses                                 | Mathematics & supporting      | 03                  | 01             |
|   | Elective supporting           | 03                  | 01             |
|   |                               | <b>62</b>           | <b>22</b>      |

### **Mapping of BS Computer Science 5th Semester Intake Program on the Generic Structure**

| <b>Computing Core Courses – 15 Credit Hours (05 Courses)</b> |             |                |   |                     |
|--|-------------|----------------|---|---------------------|
| <b>Sr #</b>  | <b>Code</b> | <b>Pre-Req</b> | <b>Course Title</b>                       | <b>CH (Cont Hr)</b> |
| 1  | CMPC-5206   |                | Information Security                      | 3 (2-3)             |
| 2  | CMPC-5209   | CMPC-5204      | Computer Organization & Assembly Language | 3 (2-3)             |
| 3  | CMPC-6101   | CMPC-5205      | Analysis of Algorithms                    | 3 (3-0)             |
| 4  | CMPC-6702   |                | Final Year Project - I                    | 2 (0-6)             |
| 5  | CMPC-6703   | CMPC-6702      | Final Year Project - II                   | 4 (0-12)            |

| <b>Domain Core – 15 Credit Hours (5 Courses)</b> |             |                |                                      |                     |
|--|-------------|----------------|--------------------------------------|---------------------|
| <b>Sr #</b>                                      | <b>Code</b> | <b>Pre-Req</b> | <b>Course Title</b>                  | <b>CH (Cont Hr)</b> |
| 1  | CSDC-5102   | CMPC-5203      | Advanced Database Management Systems | 3 (2-3)             |
| 2  | CSDC-6201   |                | HCI & Computer Graphics              | 3 (2-3)             |
| 3  | CSDC-6202   | CMPC-5204      | Computer Architecture                | 3 (2-3)             |
| 4  | CSDC-6203   | CSDC-5101      | Compiler Construction                | 3 (2-3)             |
| 5  | ITDC-6204   |                | Parallel & Distributed Computing     | 3 (2-3)             |

| <b>Domain Elective – 18 Credit Hours (6 Courses)</b> |             |                |  |                     |
|--|-------------|----------------|--|---------------------|
| <b>Sr #</b>  | <b>Code</b> | <b>Pre-Req</b> | <b>Course Title</b>                      | <b>CH (Cont Hr)</b> |
| 1  | ITDC-5202   | CMPC-5206      | Cyber Security                           | 3 (2-3)             |
| 2  | CSDE-6505   |                | Introduction to Large Language Models    | 3 (2-3)             |
| 3  | CSDE-6209   |                | Semantic Web                             | 3 (2-3)             |
| 4  | SEDC-6202   |                | Software Project Management              | 3 (2-3)             |
| 5  | DSDC-5201   |                | Introduction to Data Science             | 3 (2-3)             |
| 6  | DSDC-6203   |                | Data Warehousing & Business Intelligence | 3 (2-3)             |
| 7  | DSDE-6201   |                | Big Data Analytics                       | 3 (2-3)             |
| 8  | AIDC-6101   |                | Computer Vision                          | 3 (2-3)             |
| 9  | CSDE-6501   | ITDC-5201      | MERN Stack Development                   | 3 (2-3)             |
| 10   | CSDE-6502   | ITDC-5201      | Django Web Framework                     | 3 (2-3)             |
| 11   | CSDE-6503   |                | Introduction to DevOps                   | 3 (2-3)             |
| 12   | CSDE-6504   | CMPC-5101      | Software Testing & Quality Assurance     | 3 (2-3)             |

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| <b>Mathematics &amp; Supporting Courses – 03 Credit Hours (1 Course)</b> |             |                |                              |                     |
|--|-------------|----------------|------------------------------|---------------------|
| <b>Sr #</b>  | <b>Code</b> | <b>Pre-Req</b> | <b>Course Title</b>          | <b>CH (Cont Hr)</b> |
| 1  | ENGL-6101   | URCE-5118      | Technical & Business Writing | 3 (3-0)             |

| <b>Elective Supporting Courses (Social Science) – 3 Credit Hours (1 Course)</b> |             |                |                           |                     |
|---|-------------|----------------|---------------------------|---------------------|
| <b>Sr #</b>   | <b>Code</b> | <b>Pre-Req</b> | <b>Course Title</b>       | <b>CH (Cont Hr)</b> |
| 1   | BUSB-6101   |                | Introduction to Marketing | 3 (3-0)             |
| 2   | BUSB-6102   |                | Human Resource Management | 3 (3-0)             |

| <b>General Education Requirement – 08 Credit Hours (06 Courses)</b> |             |                |                                       |                     |
|---|-------------|----------------|---------------------------------------|---------------------|
| <b>Sr #</b>   | <b>Code</b> | <b>Pre-Req</b> | <b>Course Title</b>                   | <b>CH (Cont Hr)</b> |
| 1   | URCI-5122   |                | Ideology and Constitution of Pakistan | 2 (2-0)             |
| 2   | URCA-5101   |                | Introduction to Management            | 2 (2-0)             |
| 3   | URCS-6101   |                | Professional Practices                | 2 (2-0)             |
| 4   | URCC-5125   |                | Civics and Community Engagement       | 2 (2-0)             |
| 5   | URCQ-5111   |                | Translation of Holy Quran-III         | 0 (1-0)             |
| 6   | URCQ-5111   |                | Translation of Holy Quran-IV          | 0 (1-0)             |



## Course Coding Scheme

| Level | Course Type                           |
|-------|---------------------------------------|
| 5     | Foundation, Core Level 1 Courses      |
| 5     | Foundation, Core Level 1 Courses      |
| 6     | Core Level 2 + Specialization Level 1 |
| 6     | Specialization Level 2                |

| Code | Discipline                              |
|------|---|
| CMPC | Computing Core                          |
| CSDC | Computer Science Domain Core            |
| CSDE | Computer Science Domain Elective        |
| ITDC | Information Technology Domain Core      |
| ITDE | Information Technology Domain Elective  |
| SEDC | Software Engineering Domain Core        |
| SEDE | Software Engineering Domain Elective    |
| AIDC | Artificial Intelligence Domain Core     |
| AIDE | Artificial Intelligence Domain Elective |
| DSDC | Data Science Domain Core                |
| DSDE | Data Science Domain Elective            |
| URCP | Pakistan Studies                        |
| URCI | General Science                         |
| MATH |   |
| ENGL |   |
| URCC |   |

|      |
|------|
| URCQ |
| URCS |
| URCE |
| URCA |
| URCF |
| URCW |
| URCT |

## Scheme of Studies for BS Computer Science 5th Semester Intake

(62 Credit Hours)

### Semester V

| S#                        | Code      | Pre-requisite  | Course Title                              | Domain          | CH (Cont Hrs)     |
|---------------------------|-----------|----------------|---|-----------------|-------------------|
| 1                         | CMPC-5206 | ?              | Information Security                      | Computing Core  | 3 (2-3)           |
| 2                         | CMPC-5209 | ?<br>CMPC-5204 | Computer Organization & Assembly Language | Computing Core  | 3 (2-3)           |
| 3                         | CMPC-6101 | ?<br>CMPC-5205 | Analysis of Algorithms                    | Computing Core  | 3 (3-0)           |
| 4                         | xxxx-yyyy | ✓              | Domain Elective 1                         | Domain Elective | 3 (2-3)           |
| 5                         | xxxx-yyyy | ✓              | Domain Elective 2                         | Domain Elective | 3 (2-3)           |
| 6                         | URCA-5101 | ✓              | Introduction to Management                | GER             | 2 (2-0)           |
| <b>Total Credit Hours</b> |           |                |   |                 | <b>17 (13-12)</b> |

## Semester VI

| S#                        | Code      | Pre-requisite | Course Title                     | Domain          | CH (Cont Hrs)     |
|---------------------------|-----------|---------------|----------------------------------|-----------------|-------------------|
| 1                         | CSDC-6203 | CSDC-5101     | Compiler Construction            | Domain Core     | 3 (2-3)           |
| 2                         | ITDC-6204 |               | Parallel & Distributed Computing | Domain Core     | 3 (2-3)           |
| 3                         | xxxx-yyyy |               | Domain Elective 3                | Domain Elective | 3 (2-3)           |
| 4                         | xxxx-yyyy |               | Domain Elective 4                | Domain Elective | 3 (2-3)           |
| 5                         | xxxx-yyyy |               | Domain Elective 5                | Domain Elective | 3 (2-3)           |
| 6                         | URCQ-5111 |               | Translation of Holy Quran-III    | GER             | 0 (1-0)           |
| <b>Total Credit Hours</b> |           |               |                                  |                 | <b>15 (11-15)</b> |

## Semester VII

| S#                        | Code                 | Pre-requisite | Course Title                         | Domain              | CH (Cont Hrs)     |
|---------------------------|----------------------|---------------|--------------------------------------|---------------------|-------------------|
| 1                         | CMPC-6702            |               | Final Year Project - I               | Core                | 2 (0-6)           |
| 2                         | <del>CSDC-5102</del> | CMPC-5203     | Advanced Database Management Systems | Domain Core         | 3 (2-3)           |
| 3                         | CSDC-6201            |               | HCI & Computer Graphics              | Domain Core         | 3 (2-3)           |
| 4                         | CSDC-6202            | CMPC-5204     | Computer Architecture                | Domain Core         | 3 (2-3)           |
| 5                         | ENGL-6101            | URCE-5118     | Technical & Business Writing         | EN                  | 3 (3-0)           |
| 6                         | BUSB-6102            |               | Human Resource Management            | Elective Supporting | 3 (3-0)           |
| <b>Total Credit Hours</b> |                      |               |                                      |                     | <b>17 (12-15)</b> |

## Semester VIII

| S#                        | Code      | Pre-requisite    | Course Title                          | Domain          | CH (Cont Hrs)    |
|---------------------------|-----------|------------------|---------------------------------------|-----------------|------------------|
| 1                         | CMPC-6703 | CMPC-6702        | Final Year Project - II               | Core            | 4 (0-12)         |
| 2                         | URCI-5122 | <i>Diato</i>     | Ideology and Constitution of Pakistan | GER             | 2 (2-0)          |
| 3                         | URCS-6101 | <i>6</i>         | Professional Practices                | GER             | 2 (2-0)          |
| 4                         | URCC-5125 | <i>6</i>         | Civics and Community Engagement       | GER             | 2 (2-0)          |
| 5                         | URCQ-5111 |                  | Translation of Holy Quran-IV          | GER             | 0 (1-0)          |
| 6                         | xxxx-yyyy | <i>Neurology</i> | Domain Elective 6                     | Domain Elective | 3 (2-3)          |
| <b>Total Credit Hours</b> |           |                  |                                       |                 | <b>13 (7-15)</b> |

## Computing Core Courses

| CMPC-5206 Information Security   |   |                |
|--|---|----------------|
| <b>Credit Hours:</b>   | 3 (2-1)   |                |
| <b>Contact Hours:</b>  | 2-3   |                |
| <b>Pre-requisites:</b>   | None  |                |
| <b>Course Introduction:</b>  |   |                |
| <p>This course provides a broad overview of the threats to the security of information systems, the responsibilities and basic tools for information security, and the levels of training and expertise needed in organizations to reach and maintain a state of acceptable security. It covers concepts and applications of system and data security. Areas of particular focus include secure network design, implementation and transition issues, and techniques for responding to security breaches.</p>                  |   |                |
| CLO No.  | Course Learning Outcomes  | Bloom Taxonomy |
| CLO-1  | Explain key concepts of information security such as design principles, cryptography, risk management, and ethics | C2 (Explain)   |
| CLO-2  | Discuss legal, ethical, and professional issues in information security   | A2 (Discuss)   |
| CLO-3  | Apply various security and risk management tools for achieving information security and privacy                   | C3 (Apply)     |
| CLO-4  | Identify appropriate techniques to tackle and solve problems in the discipline of information security            | C4 (Identify)  |
| <b>Course Outline:</b>   |   |                |
| <p>Information security foundations, security design principles; security mechanisms, symmetric and asymmetric cryptography, encryption, hash functions, digital signatures, key management, authentication and access control; software security, vulnerabilities and protections, malware, database security; network security, firewalls, intrusion detection; security policies, policy formation and enforcement, risk assessment, cybercrime, law and ethics in information security, privacy and anonymity of data.</p> |   |                |
| <b>Reference Materials (or use any other standard and latest books):</b>   |   |                |
| <ol style="list-style-type: none"> <li>1. Computer Security: Principles and Practice, 3rd edition by William Stallings</li> <li>2. Principles of Information Security, 6th edition by M. Whitman and H. Mattord</li> <li>3. Computer Security, 3rd edition by Dieter Gollmann</li> <li>4. Computer Security Fundamentals, 3rd edition by William Easttom</li> <li>5. <u>CISSP</u>, 7th edition, Shon Harris</li> </ol>   |   |                |

| <b>CMPC-5209 Computer Organization &amp; Assembly Language</b>  |   |                       |
|---|---|-----------------------|
| <b>Credit Hours:</b>  | 3 (2-1)   |                       |
| <b>Contact Hours:</b>   | 2-3   |                       |
| <b>Pre-requisites:</b>  | Digital Logic Design  |                       |
| <b>Course Introduction:</b>   |   |                       |
| <p>This course helps students understanding the architecture and design principles of modern computing systems. They will explore the essentials of assembly language programming, understanding how low-level instructions contribute to the functioning of CPUs. They will also gain a profound understanding of hardware-software interactions, setting the foundation for advanced studies in computer science and programming.</p>   |   |                       |
| <b>CLO No.</b>  | <b>Course Learning Outcomes</b>   | <b>Bloom Taxonomy</b> |
| CLO-1   | Understanding the basics of computer organization with emphasis on the lower level abstraction of a computer system | C1 (Memorize)         |
| CLO-2   | Understand the digital logic, instruction set   | C2 (Understand)       |
| CLO-3   | Familiarity with assembly language programming.   | C2 (Understand)       |
| <b>Course Outline:</b>  |   |                       |
| <p>Introduction to Microprocessor Architecture: Microprocessor Bus Structure -Addressing, Data and Control, Registers and Flags. Addressing Modes. Introduction to Assembly Language, 80x86 families; program layout. Data Definitions, Basic Instructions. Unsigned Arithmetic; Logic and Bit Operations. Modules; Separate Assembly; Argument Passing Libraries; Combining Assembly and C Code. String Instructions; Arrays. Macros; Structures. Floating Point Instruction. Bit MS-DOS. BIOS Disk Accessing. BIOS Keyboard/Video/Graphics. Interrupts; TSR Programs. Accessing I/O Ports; 8253 Timer</p>   |   |                       |
| <b>Reference Materials (or use any other standard and latest books):</b>  |   |                       |
| <ol style="list-style-type: none"> <li>1. Introduction to Computer Organization: An Under the Hood Look at Hardware and x86-64 Assembly, 1st Edition, 2022</li> <li>2. Assembly Language for x86 Processors by Kip R. Irvine, Prentice Hall; 6th Edition (March 7, 2010). ISBN-10: 013602212X</li> <li>3. The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications by Walter A. Triebel &amp; Avtar Singh, Prentice Hall; 4th Edition (September 8, 2002). ISBN-10: 0130930814.</li> <li>4. Lab Manual to Accompany - The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications by Walter A. Triebel &amp; Avtar Singh, Pearson; 4th Edition (2003). ASIN: B000Q652KQ</li> <li>5. Principles of Computer Organization and Assembly Language by Patrick Juola, Prentice Hall; 1st Edition (January 11, 2011). ASIN: B009TGB11Q</li> <li>6. The Art of Assembly Language by Randall Hyde, No Starch Press; 2nd Edition (March 22, 2010). ISBN-10: 1593272073.</li> </ol> |   |                       |

## CMPC-6101 Analysis of Algorithms

**Credit Hours:** 3 (3-0)  
**Contact Hours:** 3-0  
**Pre-requisites:** Data Structures

### Course Introduction:

Detailed study of the basic notions of the design of algorithms and the underlying data structures. Several measures of complexity are introduced. Emphasis on the structure, complexity, and efficiency of algorithms.

| CLO No. | Course Learning Outcomes  | Bloom Taxonomy  |
|---------|---|-----------------|
| CLO-1   | Explain what is meant by "best", "expected", and "worst" case behavior of an algorithm  | C2 (Understand) |
| CLO-2   | Identify the characteristics of data and/or other conditions or assumptions that lead to different behaviors.                                 | C3 (Apply)      |
| CLO-3   | Determine informally the time and space complexity of simple algorithms   | C3 (Solve)      |
| CLO-4   | List and contrast standard complexity classes   | C4 (Examine)    |
| CLO-5   | Use big O, Omega, Theta notation formally to give asymptotic upper bounds on time and space complexity of algorithms                          |                 |
| CLO-6   | Use of the strategies(brute-force, greedy, divide-andconquer, and dynamic programming) to solve an appropriate problem                        |                 |
| CLO-7   | Solve problems using graph algorithms, including single source and all-pairs shortest paths, and at least one minimum spanning tree algorithm |                 |
| CLO-8   | Trace and/or implement a string-matching algorithm  |                 |

### Course Outline:

Introduction; role of algorithms in computing, Analysis on nature of input and size of input Asymptotic notations; Big-O, Big  $\Omega$ , Big  $\Theta$ , little-o, little- $\omega$ , Sorting Algorithm analysis, loop invariants, Recursion and recurrence relations; Algorithm Design Techniques, Brute Force Approach, Divide-and-conquer approach; Merge, Quick Sort, Greedy approach; Dynamic programming; Elements of Dynamic Programming, Search trees; Heaps; Hashing; Graph algorithms, shortest paths, sparse graphs, String matching; Introduction to complexity classes.

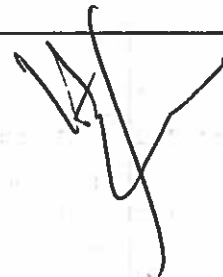
### Reference Materials (or use any other standard and latest books):

7. Introduction to Algorithms (3rd edition) by Thomas H. Corman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein
8. Algorithm Design, (1st edition, 2013/2014), Jon Kleinberg, Eva Tardos,
9. Algorithms, (4th edition, 2011), Robert Sedgewick, Kevin Wayne

| <b>CMPC-6702 Final Year Project-I</b>  |   |                       |
|--|---|-----------------------|
| <b>Credit Hours:</b>   | 2 (0-6)   |                       |
| <b>Contact Hours:</b>  | 0-6   |                       |
| <b>Pre-requisites:</b>   | None  |                       |
| <b>Course Introduction:</b>  |   |                       |
| This course marks a crucial phase in the undergraduate program, providing students with a unique opportunity for hands-on research and/or project development.   |   |                       |
| <b>CLO No.</b>   | <b>Course Learning Outcomes</b>   | <b>Bloom Taxonomy</b> |
| CLO-1  | Undertake problem identification, formulation and solution.   | C2 (Understand)       |
| CLO-2  | Define project scope and set milestones.  | C3 (Apply)            |
| CLO-3  | Attain proficiency in creating comprehensive project documentation.   | C3 (Apply)            |
| CLO-4  | Cultivate effective teamwork and collaboration skills, fostering ability to work with team members towards shared objectives. | -                     |
| <b>Course Outline:</b>   |   |                       |
| <ol style="list-style-type: none"> <li>1. Project Proposal</li> <li>2. Introduction Software Requirement Specification</li> <li>3. Software Function Specification</li> <li>4. Design Documentation</li> </ol> |   |                       |



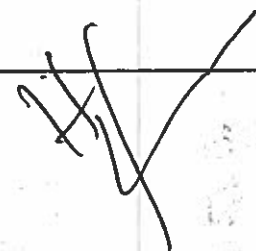
|   |  |                       |
|---|--|-----------------------|
| <b>CMPC-6703 Final Year Project-II</b>  |  |                       |
| <b>Credit Hours:</b>  | 4 (0-12)   |                       |
| <b>Contact Hours:</b>   | 0-12   |                       |
| <b>Pre-requisites:</b>  | Final Year Project-I   |                       |
| <b>Course Introduction:</b>   |  |                       |
| Final Year Project-II represents the culmination of the undergraduate program, where students bring their projects to completion. Students engage in refining their projects, addressing challenges, and contributing to the existing body of knowledge in their chosen fields. |  |                       |
| <b>CLO No.</b>  | <b>Course Learning Outcomes</b>                                | <b>Bloom Taxonomy</b> |
| CLO-1   | Develop, implement, and test solutions to real world problems. | C3 (Apply)            |
| <b>Course Outline:</b>  |  |                       |
| <ol style="list-style-type: none"> <li>1. Database Design</li> <li>2. Interface Design</li> <li>3. Initial Prototype</li> <li>4. Implementation</li> <li>5. Testing</li> </ol>  |  |                       |



## Domain Core Courses

| DSDE-5102 Advanced Database Management System  |   |                 |
|--|---|-----------------|
| <b>Credit Hours:</b>   | 3 (2-1)   |                 |
| <b>Contact Hours:</b>  | 2-3   |                 |
| <b>Pre-requisites:</b>   | Database Systems  |                 |
| <b>Course Introduction:</b>  |   |                 |
| <p>Advanced Database Management Systems is an extension to "Database Systems" course. The aim of the course is to enhance the previous knowledge of database systems by deepening the understanding of the theoretical and practical aspects of the database technologies, and showing the need for distributed database technology to tackle deficiencies of the centralized database systems. Moreover, it focuses to introduce the basic principles and implementation techniques of distributed database systems, and expose emerging research issues in database systems and application development.</p>   |   |                 |
| CLO No.  | Course Learning Outcomes  | Bloom Taxonomy  |
| CLO-1  | Understanding advance data models, technologies and approaches for building distributed database systems.                   | C2 (Understand) |
| CLO-2  | Applying the models and approaches in order to become enabled to select and apply appropriate methods for a particular case | C3 (Apply)      |
| CLO-3  | To develop a database solution for a given scenario/ challenging problem in the domain of distributed database systems.     | C3 (Apply)      |
| <b>Course Outline:</b>   |   |                 |
| <p>Introduction to advance data models such as object relational, object oriented. File organizations concepts, Transactional processing and Concurrency control techniques, Recovery techniques, Query processing and optimization, Database Programming (PL/SQL, T-SQL or similar technology), Integrity and security, Database Administration (Role management, managing database access, views), Physical database design and tuning, Distributed database systems, Emerging research trends in database systems, MONGO DB, NO SQL (or similar technologies)</p>   |   |                 |
| <b>Reference Materials (or use any other standard and latest books):</b>   |   |                 |
| <ol style="list-style-type: none"> <li>10. MongoDB: The Definitive Guide: Powerful and Scalable Data Storage 3rd Edition</li> <li>11. by Shannon Bradshaw, 2019</li> <li>12. Fundamentals of Database Management Systems, Mark L. Gillenson, 3rd Edition, 2023</li> <li>13. Database Systems: A Practical Approach to Design, Implementation, and Management, 6th Edition by Thomas Connolly and Carolyn Begg, 2019</li> <li>14. Database Systems: The Complete Book, 2nd Edition by Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom, 2013</li> <li>15. Database System Concepts, 6th Edition by Avi Silberschatz, Henry F. Korth and S. Sudarshan, 2019</li> <li>16. Database Management Systems, 3rd Edition by Raghu Ramakrishnan, Johannes Gehrke, 2002</li> </ol> |   |                 |

| DSDE-5102 Database Administration and Management  |   |                 |
|---|---|-----------------|
| <b>Credit Hours:</b>  | 04 (3-1)  |                 |
| <b>Contact Hours:</b>   | 3-3   |                 |
| <b>Pre-requisites:</b>  | Database Systems  |                 |
| <b>Course Introduction:</b>   |   |                 |
| <p>The course will focus on the complexities of managing Oracle databases, gaining the expertise needed to administer intricate database systems effectively. From mastering Oracle Database Architecture fundamentals to advanced tasks like managing database instances, administering user access, and implementing multi tenancy.</p>   |   |                 |
| CLO No.   | Course Learning Outcomes  | Bloom Taxonomy  |
| CLO-1   | Understand the fundamental concepts of Oracle Database Administration, including Oracle Database Architecture, physical database files, memory structures, background processes, and Oracle Net Services configuration..  | C2 (Understand) |
| CLO-2   | Manage Oracle Database instances proficiently, including tasks such as starting and shutting down the database, working with initialization parameters, diagnosing problems, and utilizing the Data Dictionary for database administration tasks.               | C3 (Apply)      |
| CLO-3   | Administer user access effectively by configuring user privileges, roles, and resource limitations. Understand multitenancy concepts in Oracle databases, including creating and managing pluggable databases (PDBs), data encryption, and managing tablespaces | C3 (Apply)      |
| <b>Course Outline:</b>  |   |                 |
| <p>Oracle Database Administration, Oracle Database Architecture, Physical files of the DB, Memory Structures, Memory Management, Background Processes, How to install Oracle Database Software on the server without GUI ,How to access Oracle Database via sqlplus, sqlcl and SQL Developer, Managing Database Instance: Starting and Shutting down DB, working with initialization parameters, Diagnosing problems, working with Data Dictionary Oracle Net Services, Administering User Access, Privileges &amp; Roles, Resource Limitation Multitenancy: Creating PDBs from SEED, Clonning PDBs, creating Refreshable Clones, Unplug/Plug PDBs, Transparent Data Encryption (TDE), Creating and Managing Tablespaces Managing UNDO Data, Practicing different Backup and Recovery scenarious via RMAN, Moving Data: Data Pump, SQL Loader, Data Guard configuration, Applying the latest Database Patch, Database Upgrade from 19c to 21c</p> |   |                 |
| <b>Reference Materials (or use any other standard and latest books):</b>  |   |                 |
| <ol style="list-style-type: none"> <li>1. DBA Essentials for 21c: Installing Oracle Database 21c on OCI Compute (English Edition), by Divit Gupta, 1st Edition, 2023</li> <li>2. Oracle Database 19c DBA By Examples: Installation and Administration by Ravinder Gupta 1st Edition, 2021</li> <li>3. <a href="https://docs.oracle.com/en/database/oracle/oracle-database/21/admin/index.html">https://docs.oracle.com/en/database/oracle/oracle-database/21/admin/index.html</a></li> <li>4. <a href="https://www.udemy.com/course/oracle-database-course/">https://www.udemy.com/course/oracle-database-course/</a></li> </ol>  |   |                 |



## CSDC-6201 HCI & Computer Graphics

**Credit Hours:** 3 (2-1)  
**Contact Hours:** 2-3  
**Pre-requisites:** N/A

### Course Introduction:

The course concerns interaction between humans (the users) and computers. The course is used in UI design, rendering, geometric objects, animation, and many more.

| CLO No. | Course Learning Outcomes                                      | Bloom Taxonomy  |
|---------|---|-----------------|
| CLO-1   | Explain context of HCI and different measures for evaluation. | C2 (Understand) |
| CLO-2   | Apply the principles of good design                           | C3 (Apply)      |
| CLO-3   | Perspective of age and disabilities.                          | C4 (Analyze)    |

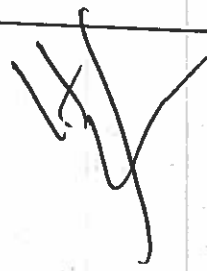
### Course Outline:

The human: Input-output channels, Human memory, Thinking, Emotion, Individual differences, Psychology and the design of interactive systems. The computer: Text entry devices, Positioning, pointing and drawing, display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Paper: printing and scanning, Memory, Processing and networks. The interaction: Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interface, Interactivity, The context of the interaction, Experience, engagement and fun. Interaction design basics: What is design? The process of design, User focus, Scenarios, Navigation design, Screen design and layout, Iteration and prototyping. HCI in the software process: The software life cycle, Usability engineering, Iterative design and prototyping, Design rationale. Design rules: Principles to support usability, Standards, Guidelines, Golden rules and heuristics, HCI patterns. Implementation support: Elements of windowing systems, Programming the application. Using toolkits, User interface management systems. Evaluation techniques: What is evaluation? Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, choosing an evaluation method. Universal design: Universal design principles, Multi-modal interaction, Designing for diversity. User support: Requirements of user support, Approaches to user support, Adaptive help systems, designing user support systems. Task analysis: Differences between task analysis and other techniques, Task decomposition, Knowledge-based analysis, Entity-relationship-based techniques, Sources of information and data collection, Uses of task analysis. Dialog notations and design: What is dialog? Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design. Models of the system: Standard formalisms, Interaction models, Continuous behavior. Modeling rich interaction: Introduction, Status-event analysis, Rich contexts, Low intention and sensor-based interaction. Groupware: Groupware systems, Computer-mediated communication, Meeting and decision support

systems, Shared applications and artifacts, Frameworks for groupware, implementing synchronous groupware. Ubiquitous computing and augmented realities: Ubiquitous computing applications research, Virtual and augmented reality, Information and data visualization. Hypertext, multimedia and the World Wide Web: Understanding hypertext, Finding things, Web technology and issues, Static web content, Dynamic web content.

**Reference Materials (or use any other standard and latest books):**

1. Kunigk, J., Buss, I., Wilkinson, P., & George, L. (2018). *Architecting modern data platforms: a guide to enterprise hadoop at scale*. O'Reilly Media.
2. Marcus, A. (2015). HCI and user-experience design. *Human-Computer Interaction Series*, 265-269.
3. Grudin, J. (2006). The GUI shock: computer graphics and human-computer interaction. *Interactions*, 13(2), 46-ff.
4. Jacko, J. A. (Ed.). (2012). *Human computer interaction handbook: Fundamentals, evolving technologies, and emerging applications*.



## CSDC-6202 Computer Architecture

|                        |                      |
|------------------------|----------------------|
| <b>Credit Hours:</b>   | 3 (2-1)              |
| <b>Contact Hours:</b>  | 2-3                  |
| <b>Pre-requisites:</b> | Digital Logic Design |

### Course Introduction:

This course in computer architecture will take you from an understanding of digital design using combinational logic and synchronous sequential building blocks to building your own single-cycle multicycle, and pipelined microprocessors.

| CLO No. | Course Learning Outcomes   | Bloom Taxonomy  |
|---------|--|-----------------|
| CLO-1   | Understand structure and behavior of the various functional modules of the computer    | C2 (Understand) |
| CLO-2   | How these structure and behavior interact to provide the processing needs of the user. | C3 (Apply)      |

### Course Outline:

Introduction to a Simple Computer: CPU Basics and Organization, The Bus, Clock, The Input/Output Subsystem, Memory Organization and Addressing, Interrupts, MARIE, Instruction Processing, Hardware vs Micro-programmed Control, Real-World Examples of Computer. Architectures: Intel & MIPS Architecture. Instruction Set Architecture: Instruction Format, Instruction Types, Addressing, Instruction Pipelining, ISAs – Intel, MIPS, Java Virtual Machine. Micro-architecture: Single-Cycle Processor, Multicycle Processor, Pipeline Processors, DDL Representation, Exceptions. Advanced Micro-architecture: Deep Pipelines, Branch Prediction, Superscalar Processor, Out-of-Order Processor, Register Renaming, Single Instruction Multiple Data, Multithreading, Homogeneous Multiprocessing, Heterogeneous Multiprocessor. Memory: Types of Memory, The Memory Hierarchy, Cache Memory, Virtual Memory, Memory Management. Input/Output and Storage System: I/O and Performance, Amdahl's Law, I/O architectures, Data Transmission Modes, Magnetic Disk Technology, Optical Disk Technology, Magnetic Tape, RAID, Future of Data Storage. Alternative Architectures: RISC Machines, Flynn's Taxonomy, Parallel and Multiprocessor Architecture, Alternative Parallel Processing Approaches, Quantum Computing. Embedded Systems: Embedded Hardware & Embedded Software.

### Reference Materials (or use any other standard and latest books):

1. Harris, S., & Harris, D. (2015). Digital design and computer architecture. Morgan Kaufmann.
2. Null, L. (2023). Essentials of Computer Organization and Architecture. Jones & Bartlett Learning.
3. Hennessy, J. L., & Patterson, D. A. (2011). *Computer architecture: a quantitative approach*. Elsevier.
4. Harris, D., & Harris, S. (2010). *Digital design and computer architecture*. Morgan Kaufmann.

| CSDC-6203 Compiler Construction  |   |                 |
|--|---|-----------------|
| <b>Credit Hours:</b>   | 3 (2-1)   |                 |
| <b>Contact Hours:</b>  | 2-3   |                 |
| <b>Pre-requisites:</b>   | Theory of Automata  |                 |
| <b>Course Introduction:</b>  |   |                 |
| This course introduces students to the essential elements of building a compiler: parsing, context-sensitive property checking, code linearization, register allocation, etc.  |   |                 |
| CLO No.  | Course Learning Outcomes  | Bloom Taxonomy  |
| CLO-1  | Understand the basic techniques used in compiler construction such as lexical analysis, top-down, bottom-up parsing, context-sensitive analysis, and intermediate code generation | C2 (Understand) |
| CLO-2  | Understand the basic data structures used in compiler construction such as abstract syntax trees, symbol tables, three-address code, and stack machines                           | C2 (Understand) |
| CLO-3  | Design and implement a compiler using a software engineering approach   | C2 (Understand) |
| <b>Course Outline:</b>   |   |                 |
| <p>Overview of Compilation: Principles of Compilation, Compiler Structure, High-Level View of Translation, Desirable Properties of a Compiler. Scanners: Recognizing Words, Regular Expressions, Implementing Scanners. Parsers: Expressing Syntax, Top-Down Parsing, Bottom-Up Parsing. Context-Sensitive Analysis: Type Systems, Attribute-Grammar Framework, Ad Hoc Syntax-Directed Translation. Intermediate Representations: Graphical IRs, Linear IRs, Mapping Values to Names, Symbol Tables. The Procedure Abstraction: Procedure Calls, Name Spaces, Communicating Values Between Procedures, Standardized Linkages. Code Shape: Assigning Storage Locations, Arithmetic Operators, Boolean and Relational Operators, Storing and Accessing Arrays, Character Strings, Structure References, Control-Flow Constructs, Procedure Calls. Code Optimization: Scope of Optimization, Local Optimization, Regional Optimization, Global Optimization, Interprocedural Optimization. Data-Flow Analysis: Iterative Data-Flow Analysis, Static Single-Assignment Form, Inter-procedural Analysis. Scalar Optimizations: Taxonomy for Transformations, Example Optimizations. Instruction Selection: Code Generation, Extending the Simple Tree-Walk Scheme, Instruction Selection via Tree-Pattern Matching, Instruction Selection via Peephole Optimization. Instruction Scheduling: The Instruction-Scheduling Problem, Local List Scheduling, Regional Scheduling. Register Allocation: Background Issues, Local Register Allocation and Assignment, Moving Beyond Single Blocks, Global Register Allocation and Assignment. Implementation of a prototype compiler (Class Assignment for the Semester)</p> |   |                 |
| <b>Reference Materials (or use any other standard and latest books):</b>   |   |                 |
| <ol style="list-style-type: none"> <li>1. Engineering a Compiler, Second Edition by Keith Cooper and Linda Torczon, Morgan Kaufmann; 2nd Edition (February 21, 2017). ISBN-10: 012088478X</li> <li>2. Compilers: Principles, Techniques, and Tools, A. V. Aho, R. Sethi and J. D. Ullman, Addison-Wesley, 2nd ed., 2007</li> <li>3. Modern Compiler Design, D. Grune, H. E. Bal, C. J. H. Jacobs, K. G. Langendoen, John Wiley, 2012.</li> <li>4. Modern Compiler Implementation in C, A. W. Appel, M. Ginsburg, Cambridge University Press, 2004.</li> </ol>  |   |                 |

## ITDC-6204 Parallel and Distributed Computing

**Credit Hours:** 3 (2-1)  
**Contact Hours:** 2-3  
**Pre-requisites:** None

**Course Introduction:**

The Parallel and Distributed Computing course explores advanced computing paradigms, covering parallel processing and distributed systems. Participants gain expertise in designing and optimizing algorithms for parallel execution, addressing challenges in distributed computing environments.

| CLO No. | Course Learning Outcomes  | Bloom Taxonomy  |
|---------|---|-----------------|
| CLO-1   | Learn about parallel and distributed computers.   | C2 (Understand) |
| CLO-2   | Write portable programs for parallel or distributed architectures using Message-Passing Interface (MPI) library | C3 (Apply)      |
| CLO-3   | Analyze complex problems with shared memory programming with openMP.  | C4 (Analyze)    |

**Course Outline:**

Asynchronous/synchronous computation/communication, concurrency control, fault tolerance, GPU architecture and programming, heterogeneity, interconnection topologies, load balancing, memory consistency model, memory hierarchies, Message passing interface (MPI), MIMD/SIMD, multithreaded programming, parallel algorithms & architectures, parallel I/O, performance analysis and tuning, power, programming models (data parallel, task parallel, process-centric, shared/distributed memory), scalability and performance studies, scheduling, storage systems, synchronization, and tools (Cuda, Swift, Globus, Condor, Amazon AWS, OpenStack, Cilk, gdb, threads, MPICH, OpenMP, Hadoop, FUSE).

**Reference Materials (or use any other standard and latest books):**

1. An Introduction to Parallel Programming, P. S. Pacheco and M. Malensek, Morgan Kaufmann, 2nd Edition, 2021
2. Parallel And Distributed Computing, Ajit Singh, Kindle Edition, 2021
3. Distributed Systems: Principles and Paradigms, A. S. Tanenbaum and M. V. Steen, Prentice Hall, 4th Edition, 2008



## Domain Elective Courses

|   |   |                       |
|---|---|-----------------------|
| ITDC-5202 Cyber Security  |   |                       |
| <b>Credit Hours:</b>  | 3 (2-1)   |                       |
| <b>Contact Hours:</b>   | 2-3   |                       |
| <b>Pre-requisites:</b>  | Information Security  |                       |
| <b>Course Introduction:</b>   |   |                       |
| The Cyber Security course focuses on safeguarding digital systems and data, covering threat detection, encryption, and risk management strategies, preparing participants to defend against cyber threats and secure information assets.  |   |                       |
| <b>CLO No.</b>  | <b>Course Learning Outcomes</b>   | <b>Bloom Taxonomy</b> |
| CLO-1   | To be able to identify computer system threats  | C2 (Understand)       |
| CLO-2   | To be able to identify Malware attacks, and understand the stages of attack and payloads. | C2 (Understand)       |
| CLO-3   | Implement various cryptographic techniques and simulate attack scenarios                  | C3 (Apply)            |
| <b>Course Outline:</b>  |   |                       |
| Introduction to Cyber security; Networks and the Internet; cyber threat landscape; understanding security; information security Principles (Confidentiality, Integrity, Availability); Information Security Terminology; Who are the attackers; Advanced Persistent Threat (APT); Malware, types of malware; Attacks using malware; Malware Attack Lifecycle: Stages of Attack; Social engineering attacks; types of payload; Industrial Espionage in Cyberspace; Basic cryptography; Web application attacks; Database security; Cyber kill chain; Privacy and anonymity; Network security; Wireless Security; Software security; Mobile device security; Mobile app security; Cyber Terrorism and Information Warfare; Introduction to Digital Forensics; Digital Forensics Categories. |   |                       |
| <b>Reference Materials (or use any other standard and latest books):</b>  |   |                       |
| <ol style="list-style-type: none"> <li>1. Computer Security Fundamentals by Chuck Easttom, 4th edition or latest</li> <li>2. Security+ Guide to Network Security Fundamentals, by Mark Ciampa, 5th Edition</li> <li>3. Security in Computing by C.P. Pfleeger, Prentice-Hall, 4th Edition or Latest</li> </ol>  |   |                       |

## CSDE-6505 Introduction to Large Language Models

**Credit Hours:** 3 (2-1)  
**Contact Hours:** 2-3  
**Pre-requisites:** None

### Course Introduction:

The student will journey through the world of Large Language Models (LLMs) and discover how they are reshaping the AI landscape. You'll explore the factors fueling the LLM boom, such as the deep learning revolution, data availability, and computing power. This conceptual course will dig into LLMs and how they revolutionize businesses and everyday life with real-world examples, from finance to content creation.

| CLO No. | Course Learning Outcomes  | Bloom Taxonomy  |
|---------|---|-----------------|
| CLO-1   | Deepens your understanding of the end-to-end AI system architecture needed to design and deploy large language models | C2 (Understand) |
| CLO-2   | Acquire the tools, skills, and strategies to successfully deploy LLMs   | C3 (Apply)      |
| CLO-3   | Implement an LLM application of your own during a hands-on group project  | C3 (Apply)      |

### Course Outline:

Overview of LLMs, Lifecycle of LLMs (pre-training, fine-tuning, and inference), LLM Hallucination & causes, LLM downstream tasks (Text classification, text similarity, search, question-answering, summarization, translation, and named entity recognition), Prompt engineering & optimization overview, Zero-shot and few-shot in-context learning, Fine-tune and evaluate models, Tradeoffs between various in-context learning approaches, Various types of embedding and their applications, Synthetic data generation, knowledge graph creation using LLM, Comparison of LLM models (GPT Turbo 3.5, GPT 4, Llama 2, Claude, BERT, Cohere, Lamda, Orca, Palm), HuggingFace Models, Integration Framework (LangChain), Data Framework (LlamaIndex).

### Reference Materials (or use any other standard and latest books):

1. Quick Start Guide to Large Language Models: Strategies and Best Practices for Using ChatGPT and Other LLMs by Ozdemir, Sinan. Addison-Wesley Professional.
2. Natural language understanding with Python: combine natural language technology, deep learning, and large language models to create human-like language comprehension in computer systems by Dahl, Deborah Anna.
3. Modern Generative AI with ChatGPT and OpenAI models: leverage the capabilities of OpenAI's LLM for productivity and innovation with GPT3 and GPT4 by Alto, Valentina.

| CSDE-6209 Semantic Web   |  |                 |
|--|--|-----------------|
| <b>Credit Hours:</b>   | 3 (2-1)  |                 |
| <b>Contact Hours:</b>  | 2-3  |                 |
| <b>Pre-requisites:</b>   | None   |                 |
| <b>Course Introduction:</b>  |  |                 |
| This course provides an overview of Semantic Web technologies, including RDF, OWL, and SPARQL. Students will learn to model, represent, and query semantic data, enabling them to build intelligent and interoperable web applications.  |  |                 |
| CLO No.  | Course Learning Outcomes   | Bloom Taxonomy  |
| CLO-1  | Understand the foundational principles and components of the Semantic Web, including RDF, OWL, and SPARQL.   | C2 (Understand) |
| CLO-2  | Apply Semantic Web technologies to model information using RDF, create ontologies with OWL, and execute complex queries using SPARQL with hands-on projects and real-world applications. | C3 (Apply)      |
| CLO-3  | Analyze and evaluate semantic data models, ontologies, and SPARQL queries.   | C4 (Analyze)    |
| <b>Course Outline:</b>   |  |                 |
| Semantic Web – Introduction and Vision , Structured Web Documents, XML, RDF, RDF-S, Web Ontology Language, WL, Ontology Engineering (Protégé) ,Discovering Information, Querying (SPARQL) Semantic Web Applications (E-learning, Web services), Description Logic Reasoning (Fact++); Rules (SWRL) Building Semantic Web Applications (Apache Jena Framework), Building Semantic Web Applications, State-of-the-art in Semantic Web community (Linked data and applications) |  |                 |
| <b>Reference Materials (or use any other standard and latest books):</b>   |  |                 |
| <ol style="list-style-type: none"> <li>1. A Semantic Web Primer third edition Grigoris Antoniou, Paul Groth, Frank van Harmelen, Rinke Hoekstra ISBN:0262018284 9780262018289</li> <li>2. The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management by Michael C. Daconta Leo J. Obrst and Kevin T. Smith</li> <li>3. Explorer's Guide to the Semantic Web by Thomas B. Passin</li> </ol>   |  |                 |

| SEDC-6202 Software Project Management  |   |                 |
|--|---|-----------------|
| <b>Credit Hours:</b>   | 3 (2-1)   |                 |
| <b>Contact Hours:</b>  | 2-3   |                 |
| <b>Pre-requisites:</b>   | None  |                 |
| <b>Course Introduction:</b>  |   |                 |
| <p>In Software Project Management course students will navigate the intricate landscape of planning, execution, and control in software development projects. This course will equip them with essential skills to lead teams, manage resources, and ensure the successful delivery of software projects on time and within budget. The students will comprehensively explore project management principles tailored for the dynamic realm of software development.</p>  |   |                 |
| CLO No.  | Course Learning Outcomes  | Bloom Taxonomy  |
| CLO-1  | Explain principles of the project lifecycle and how to identify opportunities to work with learners on relevant and appropriate project scenarios to share this understanding.  | C2 (Understand) |
| CLO-2  | Critically evaluate and discuss the issues around project management and its application in the real world with course participants and learners  | C3 (Apply)      |
| CLO-3  | Choose project management techniques for IT projects to initiate, plan, execute and evaluate a project and work in teams to create a project plan for a project scenario that includes key tasks, critical path, dependencies and a realistic timeline. | C3 (Apply)      |
| CLO-4  | Present strategies for gaining confidence in managing projects through simple project planning examples.  | C3 (Apply)      |
| <b>Course Outline:</b>   |   |                 |
| <p>Introduction: Software Project Versus Other Type of Projects Dimensions of a Software Project, Activities in SPM, Setting Goals &amp; Objectives, Business Case, Significance of Processes, Project Vs. Program Management. Introduction of PM Tools, PMI's Knowledge Areas, Technical Fundamentals in SPM, Lifecycle Relationships, Classic Mistakes Product-Process-Peoples-Technology Mistakes PMI Framework, PMI Process Groups: Process Initiating Process Group, Planning Process Group, Executing Process, Process Monitoring and controlling, Closing Process Group, Project Charter, Statement of Work. Understanding Organizations, Organizational Structures, Functional -Project -Matrix, Organizational Impact on Projects, Identifying stakeholders: Define Responsibilities, Authority Relationships, Position Qualifications. Project Planning: Project Selection, Project Scope, Project Infrastructure, Analyze Project Characteristics, Identify Project &amp; Product Activities, Work Break Down Structure. Project Evaluation: Strategic Assessment, Technical Assessment, Economic Assessment, Project Portfolio Management, Cost-Benefit Analysis, Cash Flow Forecasting,</p> |   |                 |

Cost-Benefit Evaluation Techniques, Procurement Management, Procurement Tools & Techniques, Types of Contracts. Selection of an Appropriate Approach in Project: Choosing Technologies, Technical Plan, Waterfall Model, V-Model, Spiral Model, Software Prototyping, Incremental Delivery, Agile Process Model: Dynamic Systems Development Method, Extreme Programming, Selection of Most Appropriate Process Model. Software Effort Estimation: Work Breakdown Structure (WBS) and Its Types, Estimation Problems, Software Estimation Techniques: Expert Judgment, Estimating By Analogy, LOC, Function Point Estimation, and COCOMO. Activity Planning: Project and Activities, Sequencings and Scheduling Activities, Network Planning Models, Formulation of Network Model, Adding the Time Dimensions, The Forward Pass, The Backward Pass, Identifying the Critical Path, Identifying the Critical Activities Project, AOA, GanttChart, (Installation & Configuration of Software Tools like MS-Project). Risk Management: Categories of Risks, A Framework for Dealing with Risks, Evaluating the Risks to the Schedule: PERT, Importance of Risk, Types Of Risk, Risk Identification Techniques, Project Risk and Change Management. Risk Control, RMMM, Configuration Management & Maintenance, Environment for Configuration Control, Configuration Control vs. Version Control. Resource Allocation: Nature of Resources, Identifying Resource Requirements, Scheduling Resources, Resource Scheduling Techniques. Monitoring & Control: Creating Framework, Collecting Data, Visualizing Progress, Cost Monitoring, Earned Value, Change Control. Review and Evaluation: Determining Satisfaction of Requirements, Reviewing And Evaluating Performance, Project Closure: Project Documentation, Cutover/Migration, Quality Standards, Project Closing. Challenges of Outsourcing in Project Management, Presentations

**Reference Materials (or use any other standard and latest books):**

1. Software Project Management by Bob Hughes and Mike Cotterell, McGraw-Hill Education; 5th Edition. ISBN-10: 0077122798
2. Information Technology Project Management with MindTap by Kathy Schwalbe, 9E ISBN: 9789355736130, Edition: 9th, Year : 2019
3. A Guide to the Project Management Body of Knowledge, Seventh Edition (PMBOK Guide) (2021)
4. Applied Software Project Management by Andrew Stellman and Jennifer Greene, O'Reilly Media; 1st Edition (2005). ISBN-10: 0596009488
5. Mastering Software Project Management: Best Practices, Tools and Techniques by Murali K. Chemuturi and Thomas M. Cagley Jr., J. Ross Publishing (2010). ISBN-10: 1604270349
6. Effective Project Management: Traditional, Agile, Extreme by Robert K. Wysocki, Wiley; (2019). ISBN:9781119562801
7. The Software Project Manager's Handbook - Principles that work at work by Dwayne Phillips, 2nd Edition, IEEE Computer Society Press and Wiley Inter-science, . ISBN 0-471-67420-6

## DSDC-5201 Introduction to Data Science

|                        |         |
|------------------------|---------|
| <b>Credit Hours:</b>   | 3 (2-1) |
| <b>Contact Hours:</b>  | 2-3     |
| <b>Pre-requisites:</b> | None    |

### Course Introduction:

Data Science is the study of the generalizable extraction of knowledge from data. Being a data scientist requires an integrated skill set spanning mathematics, statistics, machine learning, databases and other branches of computer science along with a good understanding of the craft of problem formulation to engineer effective solutions. The aim of this course is to: Introduce students to this rapidly growing field and equip them with some of its basic principles and tools as well as its general mindset. Explain the significance of exploratory data analysis in data science. Identify common approaches used for Feature Generation as well as Feature Selection, and finally discuss the Ethical and Privacy issues. Programming language Python has been proposed for the practical work of this course.

| CLO No. | Course Learning Outcomes   | Bloom Taxonomy  |
|---------|--|-----------------|
| CLO-1   | Describe what Data Science is and the skill sets needed to be a data scientist.              | C2 (Understand) |
| CLO-2   | Apply EDA and the Data Science process in a case study.                                      | C3 (Apply)      |
| CLO-3   | Comprehend the fundamental constructs of Python programming language.                        | C2 (Understand) |
| CLO-4   | Apply basic machine learning algorithms to solve real world problems of moderate complexity. | C3 (Apply)      |

### Course Outline:

Introduction: What is Data Science? Big Data and Data Science hype, Datafication, Current landscape of perspectives, Skill sets needed; Statistical Inference: Populations and samples, Statistical modeling, probability distributions, fitting a model, Intro to Python; Exploratory Data Analysis and the Data Science Process; Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbors (k-NN), k-means, Naive Bayes; Feature Generation and Feature Selection; Dimensionality Reduction: Singular Value Decomposition, Principal Component Analysis; Mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighborhood properties in graphs; Data Visualization: Basic principles, ideas and tools for data visualization; Data Science and Ethical Issues: Discussions on privacy, security, ethics, Next-generation data scientists.

### Reference Materials (or use any other standard and latest books):

1. Foundations of data science, Blum, A., Hopcroft, J., & Kannan, R., Vorabversion eines Lehrbuchs, 2016.
2. An Introduction to Data Science, Jeffrey S. Saltz, Jeffrey M. Stanton, SAGE Publications, 2017.
3. Python for everybody: Exploring data using Python 3, Severance, C.R., CreateSpace Independent Pub Platform. 2016.
4. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil and Rachel Schutt, O'Reilly. 2014.
5. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education Services, John Wiley & Sons, 2015.

## DSDC- 6203 Data Warehousing & Business Intelligence

|                        |         |
|------------------------|---------|
| <b>Credit Hours:</b>   | 3 (2-1) |
| <b>Contact Hours:</b>  | 2-3     |
| <b>Pre-requisites:</b> | None    |

### Course Introduction:

Gives an overview about importance & significance of Data Warehousing (DWH) and Business Intelligence (BI). Discusses the main concepts and solutions for DWH and BI. The key concepts underpinning the logical design, physical design and implementation of data warehouses are appraised. Data collection, data extraction, cleansing, transformation and loading methods are considered along with query optimization techniques. Differentiation between OLAP & OLTP. Data Warehousing supports information processing by providing a solid platform of integrated, historical, and consistent data for performing enterprise- wide data analysis.

| CLO No. | Course Learning Outcomes   | Bloom Taxonomy  |
|---------|--|-----------------|
| CLO-1   | Demonstrate an appreciation of the role that Data Warehouses and Business Intelligence play in enhancing the decision-making process.                            | C2 (Understand) |
| CLO-2   | Demonstrate an understanding of the fundamental concepts of the Star and the Snowflake Schema; learn how to design the schema of a DW based on these two models. | C2 (Understand) |
| CLO-3   | Understand the architecture of DW Systems and be able to specify the advantages and potential problem areas  | C3 (Apply)      |
| CLO-4   | Use Analytic SQL to aggregate, analyze and report, and model data.   | C3 (Apply)      |

### Course Outline:

Introduction to Data Warehouse and Business Intelligence; Necessities and essentials of Business Intelligence; DW Life Cycle and Basic Architecture; DW Architecture in SQL Server; Logical Model; Indexes; Physical Model; Optimizations; OLAP Operations, Queries and Query Optimization; Building the DW; Data visualization and reporting based on Data warehouse using SSAS and Tableau; Data visualization and reporting based on Cube; Reports and Dashboard management on PowerBI; Dashboard Enrichment; Business Intelligence Tools.

### Reference Materials (or use any other standard and latest books):

1. W. H. Inmon, "Building the Data Warehouse, Latest Edition", Wiley-India Edition.
2. Ralph Kimball, "The Data Warehouse Toolkit, Latest Edition – Practical Techniques for Building Dimensional Data Warehouse," John Wiley & Sons, Inc.
3. Matteo Golfarelli, Stefano Rizzi, "Data Warehouse Design, Latest Edition - Modern Principles and Methodologies", McGraw Hill Publisher

| DSDE-6201 Big Data Analytics  |   |                 |
|---|---|-----------------|
| <b>Credit Hours:</b>  | 3 (2-1)   |                 |
| <b>Contact Hours:</b>   | 2-3   |                 |
| <b>Pre-requisites:</b>  | None  |                 |
| <b>Course Introduction:</b>   |   |                 |
| The course objective is to develop understanding about the core concept of Big Data, why Big Data requires a different programming paradigm and mindset, and what are the various programming approaches used, what type of data can be processed.  |   |                 |
| CLO No.   | Course Learning Outcomes  | Bloom Taxonomy  |
| CLO-1   | Understand the fundamental concepts of Big Data and its programming paradigm. | C2 (Understand) |
| CLO-2   | Hadoop/MapReduce Programming, Framework, and Ecosystem                        | C3 (Apply)      |
| CLO-3   | Apache Spark Programming  | C3 (Apply)      |
| <b>Course Outline:</b>  |   |                 |
| Introduction and Overview of Big Data Systems; Platforms for Big Data, Hadoop as a Platform, Hadoop Distributed File Systems (HDFS), MapReduce Framework, Resource Management in the cluster (YARN), Apache Scala Basic, Apache Scala Advances, Resilient Distributed Datasets (RDD), Apache Spark, Apache Spark SQL, Data analytics on Hadoop Spark, Machine learning on Hadoop / Spark, Spark Streaming, Other Components of Hadoop Ecosystem                           |   |                 |
| <b>Reference Materials (or use any other standard and latest books):</b>  |   |                 |
| <ol style="list-style-type: none"> <li>1. White, Tom. "Hadoop: The definitive guide." O'Reilly Media, Inc., 2012.</li> <li>2. Karau, Holden, Andy Konwinski, Patrick Wendell, and Matei Zaharia. "Learning spark: lightning-fast big data analysis." O'Reilly Media, Inc., 2015.</li> <li>3. Miner, Donald, and Adam Shook. "MapReduce design patterns: building effective algorithms and analytics for Hadoop and other systems." O'Reilly Media, Inc., 2012.</li> </ol> |   |                 |



| AIDC-6101 Computer Vision   |  |                 |
|---|--|-----------------|
| <b>Credit Hours:</b>  | 3 (2-1)  |                 |
| <b>Contact Hours:</b>   | 2-3  |                 |
| <b>Pre-requisites:</b>  | None   |                 |
| <b>Course Introduction:</b>   |  |                 |
| <p>With a single glance a human interprets the entire scene. How many objects are present in the scene and where they are located. Which person is present in the scene. What will happen next. However, computers lack this capability. We have seen only face detectors so far working in our mobile phones? What is the challenge in understanding the 3D scene, i.e., the identity, the location and the size of the objects present in the scene. In this course we will introduce the basic concepts related to 3D scene modelling from single view and multiple views.</p>   |  |                 |
| CLO No.   | Course Learning Outcomes                             | Bloom Taxonomy  |
| CLO-1   | Understanding the single view geometry concepts      | C2 (Understand) |
| CLO-2   | Understanding the multiple view geometry concepts    | C2 (Understand) |
| CLO-3   | Apply concepts of CV for solving real world problems | C3 (Apply)      |
| <b>Course Outline:</b>  |  |                 |
| <p>Introduction to Computer Vision (Problems faced, History and Modern Advancements). Image Processing, Image filtering, Image pyramids and Fourier transform, Hough transform. Camera models, Setting up a camera model from parameters, Camera looking at a plane, Relationship of plane and horizon line, Rotation about camera center. Concatenation, Decomposition and Estimation of transformation from point correspondences, Points and planes in 2D/3D, Transformations in 2D/3D, Rotations in 2D/3D. Edge detection, corner detection. Feature descriptors and matching (HoG features, SIFT, SURF). Applications of Computer Vision Traditional Methods: Image Stitching: Making a bigger picture from smaller pictures Single View Geometry: Converting a single image into a 3D model. Applications of CV using Deep Learning: Image Detection (Localization, Historical Techniques, RCNN, FRCNN, YOLO, Retina), Image Segmentation (UNet, SegNet, MaskRCNN), Image Generation (GANN)</p> |  |                 |
| <b>Reference Materials (or use any other standard and latest books):</b>  |  |                 |
| <ol style="list-style-type: none"> <li>1. Szeliski, R. (2022). <i>Computer vision: algorithms and applications</i>. Springer Nature.</li> <li>2. Hartley, R., &amp; Zisserman, A. (2003). <i>Multiple view geometry in computer vision</i>. Cambridge university press.</li> <li>3. Forsyth, D. A., &amp; Ponce, J. (2002). <i>Computer vision: a modern approach</i>. prentice hall professional technical reference.</li> <li>4. Gonzalez, R. C. (2009). <i>Digital image processing</i>. Pearson education India.</li> </ol>   |  |                 |

## CSDE-6501 MERN Stack Development

|                        |                  |
|------------------------|------------------|
| <b>Credit Hours:</b>   | 3 (2-1)          |
| <b>Contact Hours:</b>  | 2-3              |
| <b>Pre-requisites:</b> | Web Technologies |

### Course Introduction:

MERN stack stands out for its versatility, efficiency, and end-to-end JavaScript implementation when building web applications. It allows developers to leverage a single language, JavaScript, across the entire stack, enabling code reuse and streamlining the development process.

| CLO No. | Course Learning Outcomes                | Bloom Taxonomy  |
|---------|---|-----------------|
| CLO-1   | Build full stack development            | C3 (Apply)      |
| CLO-2   | Master authentication and authorization | C2 (Understand) |
| CLO-3   | Master Data Modelling in mongoose       | C2 (Understand) |

### Course Outline:

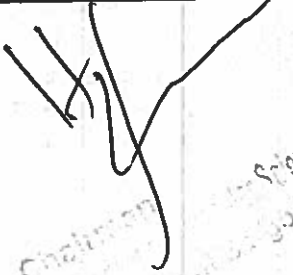
React Project scaffolding, React functional and class components, React parent to child and child to parent communications, React Redux, React Hooks, React Context Api, React Routers, React Material UI, React project with fake JSON server, Nodejs, Npm package registry understanding with package.json, Nodejs HTTP server, Express Introduction, Express server, Creation of rest apis, Validation with YUP or JOI validator, Usage of Lodash, Mail configuration with SMTP nodemail, Job with queues, Schedule Commands with cron jobs, File uploads with Multer, File upload with GridFS, Rest APIs (Modern Technique for Web applications), GraphQL Apis (Modern Technique for Web applications), MongoDB, MongoDB CRUD queries, Lookup queries, aggregation pipeline, MongoDB with reference and embedded relations, MongoDB indexing, MongoDB with Mongoose ORM, MongoDB schema creation with mongoose, Apis Integration with Frontend React project, Api calls with Axios and fetch on frontend, Dotenv on frontend react and backend nodejs express, React store creation with redux persistent, React service Layer for Apis

### Reference Materials (or use any other standard and latest books):

#### Text Book:

1. Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App by Greg Lim
2. MERN Projects for Beginners: Create Five Social Web Apps Using MongoDB, Express.js, React, and Node by Nabendu Biswas

| CSDE-6502 Django Web Framework  |  |                 |
|---|--|-----------------|
| <b>Credit Hours:</b>  | 3 (2-1)                                      |                 |
| <b>Contact Hours:</b>   | 2-3  |                 |
| <b>Pre-requisites:</b>  | Web Technologies                             |                 |
| <b>Course Introduction:</b>   |  |                 |
| Build & deploy rich web applications using Django. Learn the fundamentals of building a full-featured web site using Django.  |  |                 |
| CLO No.   | Course Learning Outcomes                     | Bloom Taxonomy  |
| CLO-1   | Install and deploy a Django application      | C3 (Apply)      |
| CLO-2   | Describe and build a data model in Django    | C2 (Understand) |
| CLO-3   | Apply built-in login functionality in Django | C3 (Apply)      |
| <b>Course Outline:</b>  |  |                 |
| Installing Django, HTML, CSS, SML, SQL, Data Models, Django views, Django generic views, Forms in http and html, Django forms, User authentication, One to many data models, Many to many data models, Javascript, JSON, Ajax, File Uploading, Pagination, Writing URLs, Sending emails, Limiting query results in django, TinyMCE integration, creating blogs, Filters in Django, Pass data from Django views to template. |  |                 |
| <b>Reference Materials (or use any other standard and latest books):</b>  |  |                 |
| <b>Text Book:</b>   |  |                 |
| <ol style="list-style-type: none"> <li>1. Django for beginners, Build websites with Python and Django by William S. Vincent</li> <li>2. Django 4 By Example: Build powerful and reliable Python web applications from scratch 4th Edition by Antonio Melé</li> </ol>  |  |                 |

  
 Chairman  
 Department of Science  
 University of Jammu

| CSDE-6503 Introduction to DevOps  |   |                 |
|---|---|-----------------|
| <b>Credit Hours:</b>  | 3 (2-1)   |                 |
| <b>Contact Hours:</b>   | 2-3   |                 |
| <b>Pre-requisites:</b>  | N/A   |                 |
| <b>Course Introduction:</b>   |   |                 |
| This course covers best practices, tools, and techniques for automating tasks and collaborating with other engineers on projects.   |   |                 |
| CLO No.   | Course Learning Outcomes  | Bloom Taxonomy  |
| CLO-1   | Essential DevOps concepts: software engineering practices, cloud native microservices, automated continuous deployments | C2 (Understand) |
| CLO-2   | impact of DevOps, including breaking down silos, working in cross functional teams, and sharing responsibilities.       | C2 (Understand) |
| <b>Course Outline:</b>  |   |                 |
| DevOps Principles, DevOps Delivery Pipeline, DevOps on Cloud, Cloud & virtualization architecture, Cloud deployment architecture, Why we need DevOps on cloud?, Introduction to AWS, Introduction to version control, Git installation & setup, Git commands, Recording repository changes, Viewing commit history, Undoing things, Working with remotes, Branching & merging in git, Git workflows, Git cheatsheets, Jenkins tool management, Jenkins authentication, Jenkins authorization, Maven overview, Maven plugins, Maven build lifecycle, Maven test project, Introduction to docker, Working with container, Docker networking, Docker swarm, Kubernetes overview, Kubernetes cluster architecture, Design of pods |   |                 |
| <b>Reference Materials (or use any other standard and latest books):</b>  |   |                 |
| <b>Text Book:</b>   |   |                 |
| <ol style="list-style-type: none"> <li>1. Learning DevOps: A Comprehensive Guide to Accelerating DevOps Culture Adoption with Terraform, Azure DevOps, Kubernetes, and Jenkins by Mikael Krief, 2nd ed. Edition (2022).</li> <li>2. Cloud Native DevOps with Kubernetes: Building, Deploying, and Scaling Modern Applications in the Cloud by John Arundel and Justin Domingus, ISBN: 9781098116828, 2nd ed. Edition (2022).</li> </ol>   |   |                 |

| CSDE-6504 Software Testing & Quality Assurance   |  |                 |
|--|--|-----------------|
| <b>Credit Hours:</b>   | 3 (2-1)  |                 |
| <b>Contact Hours:</b>  | 2-3  |                 |
| <b>Pre-requisites:</b>   | Software Engineering   |                 |
| <b>Course Introduction:</b>  |  |                 |
| Software testing is indispensable for developers who want to ship high-quality software. After completing this course, you will have an understanding of the fundamental principles and processes of software testing.   |  |                 |
| CLO No.  | Course Learning Outcomes   | Bloom Taxonomy  |
| CLO-1  | Distinguish between verification and validation describing the key differences between them. | C2 (Understand) |
| CLO-2  | Write automated functional tests for both front-end and back-end code.                       | C2 (Understand) |
| <b>Course Outline:</b>   |  |                 |
| Testing foundations, Testing in software development life cycle, Writing good unit tests, Black box testing, White box testing, Requirements based testing, Black box and white box testing using Cucumber, Introduction to Automated Analysis, Automated test generation, Static analysis, Effective automated verification, Web and mobile testing, Functional web testing, Nonfunctional web testing, Mobile testing, Penetration testing, Test design techniques and validation. |  |                 |
| <b>Reference Materials (or use any other standard and latest books):</b>   |  |                 |
| <b>Text Book:</b>  |  |                 |
| <ol style="list-style-type: none"> <li>1. Effective Software Testing: A Developer's Guide by Maurizio Aniche, 2022, ISBN: 9781633439931</li> <li>2. Automated Software Testing with Cypress by Narayanan Palani, 1st Edition (2021)</li> <li>3. Leading Quality: How Great Leaders Deliver High Quality Software and Accelerate Growth by Ronald Cummings-John &amp; Owais Peer (2019)</li> </ol>  |  |                 |

Handwritten signature: *H. J.*

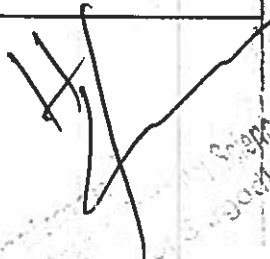
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## Mathematics & Supporting Courses

|   |                                 |                       |
|---|---------------------------------|-----------------------|
| <b>ENGL-6101 Technical &amp; Business Writing</b>   |                                 |                       |
| <b>Credit Hours:</b>  | 3 (3-0)                         |                       |
| <b>Contact Hours:</b>   | 3                               |                       |
| <b>Pre-requisites:</b>  | Functional English              |                       |
| <b>Course Introduction:</b>   |                                 |                       |
| <p>Students in the senior level needs good technical writing skills not only for writing project report but also useful for them to communicate their resume and get place in the market. This is a high level course which provide useful knowledge to the students for writing proposals etc. Further, the course aims at augmenting students' proficiency in technical writing in order to sensitize them to the dynamics, challenges, and needs of the modern world characterized by technologically advanced social, cultural, and corporate settings. It will focus on students' ability to effectively convey and exchange information in cross-cultural, international, and multinational milieu necessitated by the emergence of global society.</p>   |                                 |                       |
| <b>CLO No.</b>  | <b>Course Learning Outcomes</b> | <b>Bloom Taxonomy</b> |
| CLO-1   | -                               | -                     |
| <b>Course Outline:</b>  |                                 |                       |
| <p>Overview of technical reporting, use of library and information gathering, administering questionnaires, reviewing the gathered information; Technical exposition; topical arrangement, exemplification, definition, classification and division, casual analysis, effective exposition, technical narration, description and argumentation, persuasive strategy, Organizing information and generation solution: brainstorming, organizing material, construction of the formal outline, outlining conventions, electronic communication, generation solutions. Polishing style: paragraphs, listening sentence structure, clarity, length and order, pomposity, empty words, pompous vocabulary, document design: document structure, preamble, summaries, abstracts, table of contents, footnotes, glossaries, crossreferencing, plagiarism, citation and bibliography, glossaries, index, appendices, typesetting systems, creating the professional report; elements, mechanical elements and graphical elements. Reports: Proposals, progress reports, Leaflets, brochures, handbooks, magazines articles, research papers, feasibility reports, project reports, technical research reports, manuals and documentation, thesis. Electronic documents, Linear verses hierarchical structure documents.</p> |                                 |                       |
| <b>Reference Materials (or use any other standard and latest books):</b>  |                                 |                       |
| <ol style="list-style-type: none"> <li>1. Technical Report Writing, by Pauley and Riordan, Houghton Mifflin Company, 8<sup>th</sup> Edition.</li> <li>2. Effective Technical Communication by Ashraf Rizvi, Tata McGraw-Hill.</li> </ol>  |                                 |                       |

## Elective Supporting Courses

|   |                                 |                       |
|---|---------------------------------|-----------------------|
| <b>BUSB-6101 Introduction to Marketing</b>  |                                 |                       |
| <b>Credit Hours:</b>  | 3 (3-0)                         |                       |
| <b>Contact Hours:</b>   | 3                               |                       |
| <b>Pre-requisites:</b>  | None                            |                       |
| <b>Course Introduction:</b>   |                                 |                       |
|   |                                 |                       |
| <b>CLO No.</b>  | <b>Course Learning Outcomes</b> | <b>Bloom Taxonomy</b> |
| CLO-1   | -                               | -                     |
| <b>Course Outline:</b>  |                                 |                       |
| <p>Defining Marketing and the Marketing Process, Marketing: Creating and Capturing, Customer Value, Company and Marketing Strategy: Partnering to Build Customer Relationships, Analyzing the Marketing Environment, Managing Marketing Information to Gain Customer Insights, Consumer Markets and Consumer Buyer Behavior, Customer-Driven Marketing Strategy: Creating Value for Target Customers, New Product Development and Product Life-Cycle Strategies, New Product Development and Product Life-Cycle Strategies, Pricing: Understanding and Capturing Customer Value, Pricing Strategies, Marketing Channels: Delivering Customer Value, Retailing and Wholesaling, Advertising and Public Relations</p> |                                 |                       |
| <b>Reference Materials (or use any other standard and latest books):</b>  |                                 |                       |
| <ol style="list-style-type: none"> <li>1. Technical Report Writing, by Pauley and Riordan, Houghton Mifflin Company, 8<sup>th</sup> Edition.</li> <li>2. Effective Technical Communication by Ashraf Rizvi, Tata McGraw-Hill.</li> </ol>  |                                 |                       |

  
 Chairperson  
 Marketing  
 University of Sargodha

| <b>BUSB-6102 Human Resource Management</b>   |                                 |                       |
|--|---------------------------------|-----------------------|
| <b>Credit Hours:</b>   | 3 (3-0)                         |                       |
| <b>Contact Hours:</b>  | 3                               |                       |
| <b>Pre-requisites:</b>   | None                            |                       |
| <b>Course Introduction:</b>  |                                 |                       |
|  |                                 |                       |
| <b>CLO No.</b>   | <b>Course Learning Outcomes</b> | <b>Bloom Taxonomy</b> |
| CLO-1  | -                               | -                     |
| <b>Course Outline:</b>   |                                 |                       |
| <p>Managing Human Resources. Understanding the External and Organizational Environments. Ensuring Fair Treatment and Legal Compliance. HR Planning for Alignment and Change. Using Job Analysis and Competency Modeling. Recruiting and Retaining Qualified Employees. Selecting Employees to Fit the Job and the Organization. Training and Developing a Competitive Workforce. Conducting Performance Management. Developing an Approach to Total Compensation. Using Performance-Based Pay to Achieve Strategic Objectives. Providing Benefits and Services for Employees' Well-Being. Risk Management, Employee Relations, and Risk Management, Health, Safety, and Employee Well-Being. Understanding Unionization and Collective Bargaining.</p> |                                 |                       |
| <b>Reference Materials (or use any other standard and latest books):</b>   |                                 |                       |
| <ol style="list-style-type: none"> <li>1. Managing Human Resources by Susan E. Jackson, Randall S. Schuler and Steve Werner, South-Western College Pub; 11th Edition (June 16, 2011).ISBN-10:1111580227 [TB]</li> <li>2. Management of Human Resources by Gary Dessler, CarolinRekar Munro and Nina D. Cole, Pearson Education Canada; 3rd Edition (February 28, 2010). ISBN-10:0321687140</li> </ol>  |                                 |                       |



## General Education Courses

| URCI-5122 Ideology and Constitution of Pakistan   |   |                |
|---|---|----------------|
| <b>Credit Hours:</b>  | 2 (2-0)   |                |
| <b>Contact Hours:</b>   | 2   |                |
| <b>Pre-requisites:</b>  | -   |                |
| <b>Course Introduction:</b>   |   |                |
| <p>Pakistan studies is an important course at this university in which students study about their motherland. The following are the specific objective of the course</p> <ul style="list-style-type: none"> <li>• to develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideological background of Pakistan.</li> <li>• To study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.</li> </ul>   |   |                |
| CLO No.   | Course Learning Outcomes                                | Bloom Taxonomy |
| CLO-1   | To educate students about the history of Pakistan.      |                |
| CLO-2   | To understand the basic concept of Islam and Quran Pak. |                |
| CLO-3   | To educate student Government and politics              |                |
| <b>Course Outline:</b>  |   |                |
| <p>Historical background of Pakistan: Muslim society in Indo-Pakistan, the movement led by the societies, the downfall of Islamic society, the establishment of British Raj- Causes and consequences. Political evolution of Muslims in the twentieth century: Sir Syed Ahmed Khan; Muslim League; Nehru; Allama Iqbal: Independence Movement; Lahore Resolution; Pakistan culture and society, Constitutional and Administrative issues, Pakistan and its geopolitical dimension, Pakistan and International Affairs, Pakistan and the challenges ahead.</p> |   |                |
| <b>Reference Materials (or use any other standard and latest books):</b>  |   |                |
| <ol style="list-style-type: none"> <li>1. The Emergence of Pakistan, Chaudary M., 1967</li> <li>2. The making of Pakistan, Aziz. 1976</li> <li>3. A Short History of Pakistan, I. H. Qureshi, ed., Karachi, 1988</li> </ol>   |   |                |

|  |                                 |                       |
|--|---------------------------------|-----------------------|
| <b>URCA-5101 Introduction to Management</b>  |                                 |                       |
| <b>Credit Hours:</b>   | 2 (2-0)                         |                       |
| <b>Contact Hours:</b>  | 2                               |                       |
| <b>Pre-requisites:</b>   | None                            |                       |
| <b>Course Introduction:</b>  |                                 |                       |
| Introduction to Marketing helps the students in exploring fundamental principles that drive successful business promotion and customer engagement. This course will delve into the core concepts of market research, product positioning, and strategic communication to provide a comprehensive foundation for understanding the ever-evolving world of marketing.  |                                 |                       |
| <b>CLO No.</b>   | <b>Course Learning Outcomes</b> | <b>Bloom Taxonomy</b> |
| -  | -                               |                       |
| <b>Course Outline:</b>   |                                 |                       |
| <p>Introduction to Managers and Management: What is Management and What Do Managers Do? Defining Management, Management Functions, Management Roles, Management Skills, History of Management. Organizational Culture and Environment: The Manager: Omnipotent or Symbolic? The Organization's Culture, The Environment - Defining Environment, The Specific Environment, The General Environment, Influence on Management Practice. Decision Making The Essence of Manager's Job: The Decision Making Process, The Rational Decision Maker, Decision Making Styles, Analyzing Decision Alternatives - Certainty, Risk, Uncertainty. Planning: The Foundations of Planning, The Definition of Planning, Purposes of Planning, Types of Plans, Contingency Factors on Planning, Objectives: The Foundation for Planning, Multiplicity of Objectives, Real Versus Stated Objectives, Traditional Objective Setting, Management by Objectives. Organization Structure and Design: Defining Organization Structure and Design, Building, The Vertical Dimension of Organizations, Building the Horizontal Dimension of Organizations, The Contingency Approach to Organization Design, Application of Organization Design. Motivation: Motivating Employees, What is Motivation? Contemporary Approaches to Motivation, Contemporary Issues in Motivation, From Theory to Practice: Suggestions for Motivating Employees. Leadership: Managers Verses Leaders, Trait Theories, Behavioural Theories, Contingency Theories, Emerging Approaches to Leadership, Contemporary Issues in Leadership. Communication: Communication and Interpersonal Skills, Understanding Communication, Communication Styles of Men And Women, Feedback Skills, Delegation Skills', Conflict Management Skills, Negotiation Skills. Controlling - Foundations of Control: What is Control? The Importance of Control, The Control Process, Types of Control, Qualities of Effective Control, The Dysfunctional Side of Control, Ethical Issues in Control; Controlling Tools and Techniques: Information Controls, Financial Controls, Operations Controls, Behavioral Controls. The Personnel Function: Terminology, Who Does Personnel Work? Staff Role of The Personnel Department Personnel (Human Resource) Functions. Job Design and Analysis: Job Design, Job Information and Personnel Management, Analyzing Jobs- Obtaining Job Information, Functional Job Analysis, Administration of The Job Analysis</p> |                                 |                       |

Program. Human Resource Planning: Reasons for Human Resource Planning, The Planning Process. Recruitment and Selections/Testing and Interview: Labour Market Considerations, Recruitment and Selection Policy Issues, The Employment Process, Sources of People, The Selection Process, The Selection Procedure, Testing: Interview. Miscellaneous: Union and Management, Compensation Administration, Health And Safety.

**Reference Materials (or use any other standard and latest books):**

1. Management by Robbins, S.P. & Coulter, Mary, Prentice Hall; 10th Edition (November 3, 2008). ISBN-10: 0132090716
2. Fundamentals of Management by Robbins, S.P. & DeCenzo, David A, Prentice Hall; 7<sup>th</sup> Edition (January 13, 2010). ISBN-13: 978-0132090711
3. Human Resource Management by David A. DeCenzo and Stephen P. Robbins. Wiley; 7th Edition (October 10, 2001). ISBN-10: 0471397857



|   |                                 |                       |
|---|---------------------------------|-----------------------|
| <b>URCS-6101 Professional Practices</b>   |                                 |                       |
| <b>Credit Hours:</b>  | 2 (2-0)                         |                       |
| <b>Contact Hours:</b>   | 2                               |                       |
| <b>Pre-requisites:</b>  | None                            |                       |
| <b>Course Introduction:</b>   |                                 |                       |
| <p>A Computing graduate as professional has some responsibilities with respect to the society. This course develops student understanding about historical, social, economic, ethical, and professional issues related to the discipline of Computing. It identifies key sources for information and opinion about professionalism and ethics. Students analyze, evaluate, and assess ethical and professional computing case studies.</p>  |                                 |                       |
| <b>CLO No.</b>  | <b>Course Learning Outcomes</b> | <b>Bloom Taxonomy</b> |
| -   | -                               | -                     |
| <b>Course Outline:</b>  |                                 |                       |
| <p>Historical, social, and economic context of Computing (software engineering, Computer Science, Information Technology); Definitions of Computing (software engineering, Computer Science, Information Technology) subject areas and professional activities; professional societies; professional ethics; professional competency and life-long learning; uses, misuses, and risks of software; information security and privacy; business practices and the economics of software; intellectual property and software law (cyber law); social responsibilities, software related contracts, Software house organization. Intellectual Property Rights, The Framework of Employee Relations Law and Changing Management Practices, Human Resource Management and IT, Health and Safety at Work, Software Liability, Liability and Practice, Computer Misuse and the Criminal Law, Regulation and Control of Personal Information. Overview of the British Computer Society Code of Conduct, IEEE Code of Ethics, ACM Code of Ethics and Professional Conduct, ACM/IEEE Software Engineering Code of Ethics and Professional Practice. Accountability and Auditing, Social Application of Ethics.</p> |                                 |                       |
| <b>Reference Materials (or use any other standard and latest books):</b>  |                                 |                       |
| <ol style="list-style-type: none"> <li>1. Boddington, P. (2023). AI ethics: a textbook. Springer Nature.</li> <li>2. Professional Issues in Software Engineering by Frank Bott, Allison Coleman, Jack Eaton and Diane Rowland, CRC Press; 3rd Edition (2000). ISBN-10: 0748409513</li> <li>3. Computer Ethics by Deborah G. Johnson, Pearson; 4th Edition (January 3, 2009). ISBN-10: 0131112414</li> <li>4. A Gift of Fire: Social, Legal, and Ethical Issues for Computing and the Internet (3<sup>rd</sup> Edition) by Sara Baase, Prentice Hall; 3rd Edition (2008). ISBN-10: 0136008488</li> <li>5. Applied Professional Ethics by Gregory R. Beabout, University Press of America (1993).</li> <li>6. Noorman, M., &amp; Johnson, D. G. (2014). Negotiating autonomy and responsibility in military robots. <i>Ethics and Information Technology</i>, 16(1), 51-62.</li> </ol>  |                                 |                       |

| URCC-5125 Civics and Community Engagement  |  |                 |
|--|--|-----------------|
| <b>Credit Hours:</b>   | 2 (2-0)  |                 |
| <b>Contact Hours:</b>  | 2  |                 |
| <b>Pre-requisites:</b>   | None   |                 |
| <b>Course Introduction:</b>  |  |                 |
| This course explores the foundations of civic responsibility, governance structures, and the vital role individuals play in shaping their communities. It provides knowledge and skills needed to actively engage in civic life, fostering a sense of responsibility and participation in building stronger, more inclusive societies.   |  |                 |
| CLO No.  | Course Learning Outcomes   | Bloom Taxonomy  |
| CLO-1  | Understand the importance of civic participation, culture and cultural diversity, basic foundations of citizenship, group identities and the role of individuals in creating positive change within their communities. | C2 (Understand) |
| CLO-2  | Develop students' knowledge, skills and attitudes necessary for active and responsible citizenship   | C2 (Understand) |
| <b>Course Outline:</b>   |  |                 |
| <p>Introduction to Civics &amp; Community Engagement (Overview of the course: Civics &amp; Community Engagement, Definition and importance of civics, Key concepts in civics: citizenship, democracy, governance, and the rule of law, Rights and responsibilities of citizens, Citizenship and Community Engagement, Introduction to Active Citizenship: Overview of the Ideas, Concepts, Philosophy and Skills, Approaches and Methodology for Active Citizenship, Identity, Culture, and Social Harmony, Concept and Development of Identity, Group identities, Components of Culture, Cultural pluralism, Multiculturalism, Cultural Ethnocentrism, Cultural relativism, Understanding cultural diversity, Globalization and Culture, Social Harmony, Religious Diversity (Understanding and affirmation of similarities &amp; differences), Understanding Socio-Political Polarization, Minorities, Social Inclusion, Affirmative actions, Multi-cultural society and inter-cultural dialogue, Inter-cultural dialogue (bridging the differences, promoting harmony), Promoting intergroup contact/ Dialogue, Significance of diversity and its impact, Importance and domains of Inter-cultural dialogue, ctive Citizen: Locally Active, Globally Connected, Importance of active citizenship at national and global level, Understanding community, Identification of resources (human, natural and others), Utilization of resources for development (community participation), Strategic planning, for development (community linkages and mobilization), Human rights, constitutionalism and citizen's responsibilities, Introduction to Human Rights, Human rights in constitution of Pakistan, Public duties and responsibilities, Constitutionalism and democratic process, Social Institutions, Social Groups, Formal Organizations and Bureaucracy, Types of groups, Group identities, Organizations, Bureaucracy, Weber's model of Bureaucracy, Role of political parties, interest groups and non-government organizations, Civic Engagement Strategies, Grassroots organizing and community mobilization, Advocacy and lobbying for policy change, Volunteerism and service-learning opportunity, Social issues/Problems of Pakistan</p> |  |                 |

**Reference Materials (or use any other standard and latest books):**

1. Kennedy, J. K., & Brunold, A. (2016). *Regional context and Citizenship education in Asia and Europe*. New Yourk: Routledge, Falmer.
2. Henslin, James M. (2018). *Essentials of Sociology: A Down to Earth Approach* (13<sup>th</sup> ed.) New York: Pearson Education
3. Macionis, J. J., & Gerber, M.L. (2020). *Sociology*. New York: Pearson Education
4. Glencoe McGraw-Hill. (n.d.). *Civics Today: Citizenship, Economics, and Youth*.
5. Magleby, D. B., Light, P. C., & Nemacheck, C. L. (2020). *Government by the People* (16th ed.). Pearson.
6. Sirianni, C., & Friedland, L. (2005). *The Civic Renewal Movement: Community-Building and Democracy in the United States*. Kettering Foundation Press.
7. Bloemraad, I. (2006). *Becoming a Citizen: Incorporating Immigrants and Refugees in the United States and Canada*. University of California Press.
8. Kuyek, J. (2007). *Community Organizing: Theory and Practice*. Fernwood Publishing.
9. DeKieffer, D. E. (2010). *The Citizen's Guide to Lobbying Congress*. TheCapitol.Net.
10. Rybacki, K. C., & Rybacki, D. J. (2021). *Advocacy and Opposition: An Introduction to Argumentation* (8th ed.). Routledge.
11. Kretzmann, J. P., & McKnight, J. L. (1993). *Building Communities from the Inside Out: A Path Towards Finding and Mobilizing a Community's Assets*. ACTA Publications.
12. Patterson, T. E. (2005). *Engaging the Public: How Government and the Media Can Reinvigorate American Democracy*. Oxford University Press.
13. Love, N. S., & Mattern, M. (2005). *Doing Democracy: Activist Art and Cultural Politics*. SUNY Press

| URCQ-5111: Translation of the Holy Quran – III  |  |                |
|---|--|----------------|
| <b>Credit Hours:</b>  | Non-Credit   |                |
| <b>Contact Hours:</b>   | -  |                |
| <b>Pre-requisites:</b>  | None   |                |
| <b>Course Introduction:</b>   |  |                |
| This course is designed to develop the recitation skills in students.   |  |                |
| CLO No.   | Course Learning Outcomes   | Bloom Taxonomy |
| CLO-1   | To introduce ethics and highlight its importance, need and relevance for individual and collective life.                                   | -              |
| CLO-2   | To illuminate the students with the Quranic norms of Morality i.e. truthfulness, patience, gratitude, modesty, forgiving, hospitality etc. | -              |
| CLO-3   | To familiarize the students with immoral values like falsify, arrogance, immodesty, extravagance, backbiting etc.                          | -              |
| CLO-4   | To inculcate ethical and moral values in our youth.  | -              |
| CLO-5   | To develop a balanced dynamic and wholesome personality.   | -              |
| CLO-6   | To introduce the students to Quranic Arabic grammar in practical manner.   | -              |
| <b>Course Outline:</b>  |  |                |
| <p>اخلاق (تعارف، ضرورت و اہمیت ، اقسام، معنویت )<br/> اخلاق حسنہ:<br/> برائی کو نیکی سے مٹانا ، نیکی کے کاموں میں مسابقت ، لوگوں کے درمیان صلح ، عدل و انصاف، سچائی ، ایثار ، سلیم قلب، مہمان نوازی ، لغویات سے اعراض ، عاجزی و انکساری ، نگاہ اور آواز کو پست رکھنا ، چال میں میانہ روی ، شرمگاہوں کی حفاظت ، صبر ، شکر ، امور میں میانہ روی۔<br/> اخلاق سنیہ :<br/> ظلم اور زیادتی ، غرور و تکبر ، نفسانی خواہشات کی پیروی ، بدگمانی ، جھوٹ ، چغلی اور تہمت ، تمسخر اور شیخی خوری ، لہو و لعب ، برے ناموں سے پکارنا ، احسان جتانا اور تکلیف دینا ، فضول خرچی اور حد سے بڑھنا ، حسد اور تنگ دل ، بے پردگی۔</p> |  |                |
| قرآنی عربی گرامر کے اصول اور انکے اطلاقات   |  |                |

## (متن قرآنی پر اطلاق سے توضیحات)

## منتخب آیات مع ترجمہ و تجوید

- البقرہ (۸۷۷، ۴۵۸، ۳۲، ۸۲۷، ۸۱۷، ۸۴۷، ۸۱۷، ۸۱۷، ۸۴، ۳۴۷، ۱۱۷، ۱۴۸، ۸۸۸، ۴۸۷، ۱۸، ۱۱، ۸۲۷، ۲۵۷، ۱۲۷، ۲۱۷، ۵۲۸، ۳۲۸، ۸۲۸، ۸۷۸، ۱۲، ۷۳۸، ۱۷، ۵۳، ۵۸۷، ۲۴۸، ۱۸، ۷۱، ۳۲، ۲۸۸، ۴۲۷، ۲۱)
- آل عمران (۵۴۷، ۵۷، ۵۸، ۴۲۷، ۸۳۷، ۲۵۷، ۵۳۷، ۴۵۷، ۱۷، ۱۱۸، ۴۸۷، ۵۷۷، ۳۳۷، ۵۱۷، ۵۱۷، ۲۸، ۲۱، ۷۵۷، ۱۵۷، ۲۴۷)
- النساء (۴۳۷، ۳۸، ۸۸، ۲۱۷، ۱۱۷، ۴۱۷، ۵۴، ۱۸، ۱۸، ۳۱۷، ۲۳، ۴۸، ۵۸، ۱۴، ۱۵، ۵۸)
- المائدہ (۲۴، ۱۴، ۳۲، ۳۷، ۲، ۷۵، ۲۷)
- النحل (۱۲، ۲۸۷، ۴۱۷، ۳۷۷، ۱۳، ۲۸۷، ۴۸۷)
- الرعد (۴۸، ۱۸، ۵۸، ۸۸، ۲)
- الاعراف (۷۳، ۲۲، ۷۴، ۲۵۷، ۱۵، ۵، ۱۸، ۵۵۷، ۲۲۷، ۴۲، ۷۲)
- القصص (۵۴، ۵۲)
- فصلت (۵۳)
- الانعام (۸۳، ۱۱، ۱۱، ۱۳۷، ۱۳۷، ۴۴۷، ۱۲۷)
- النمل (۱۲، ۲۵)
- الحج (۱۳، ۲۴، ۱۲، ۲۲، ۱۱)
- الحجرات (۲، ۷۷، ۲، ۷۷، ۳، ۸۷، ۴۷، ۱۷)
- الاحزاب (۳۸، ۱۴، ۲۴، ۲۴، ۸۴، ۴۴، ۲۴، ۴۳، ۵۸، ۴۳)
- الحشر (۲)
- طہ (۸۱)
- الانعام (۵۲۷، ۷۵۷، ۲۷۷، ۷۴۷، ۳۲، ۱۸۷)
- ق (۵۳)
- الانفال (۱۸، ۲۵، ۷۲)
- الفتح (۴۷)
- یونس (۱۷، ۲۷، ۸۷، ۲۲، ۸۸، ۸۸)
- الفرقان (۳۲، ۷۸، ۱۲، ۳۲)
- النور (۳۸، ۲، ۵، ۱۳، ۷۳، ۳۳، ۳۳، ۷۲، ۷۲، ۷۳، ۸۸)
- لقمان (۲، ۳۳، ۲۷، ۸۳، ۲۷)
- الاسراء (۱۳، ۴، ۱۷۷، ۱۳)
- المزمل (۲۷)
- المدثر (۲، ۵)
- المدثر (۵۱)
- فاطر (۸۳)
- الفتح (۲۸)
- البلد (۱۷)
- الزمر (۳، ۱۷)
- الحجر (۴۲)
- النجم (۷۳)
- الرحمن (۱۲)



- ہود (۲، ۸۱۷، ۳)
- الکہف (۸، ۲۴)
- الشوری (۱۳)
- غافر (۲۸، ۱۸)
- الحديد (۱۸، ۱۸)
- مریم (۲۴)
- النازعات (۷۵)
- التوبہ (۴۲، ۵۲، ۱۱)
- الہمزہ (۷)

### URCQ-5111: Translation of the Holy Quran – IV

|                        |            |
|------------------------|------------|
| <b>Credit Hours:</b>   | Non-Credit |
| <b>Contact Hours:</b>  | -          |
| <b>Pre-requisites:</b> | None       |

#### Course Introduction:

This course is designed to develop the recitation skills in students.

| CLO No. | Course Learning Outcomes  | Bloom Taxonomy |
|---------|---|----------------|
| CLO-1   | To familiarize the students with commandments of trade and inheritance mentioned in the Quranic text (with the help of Urdu translation).   | -              |
| CLO-2   | To introduce the students to scientific facts and miracles of the Holy Quran and Quranic stress on deep study of Allah's explored universe. | -              |
| CLO-3   | To motivate the students for reading and exploring the last Holy Book revealed by Almighty Allah.   | -              |
| CLO-4   | Through memorization students will develop their relation with last revelation.   | -              |

#### Course Outline:

تجارت اور وراثت:  
 مال کی تقسیم، نادان کا مال، عوام الناس کا مال، عورتوں کا مال، یتیموں کا مال، کفار کا مال، جائز مال، معاہدے، ربن، قرض  
 سائنسی حقائق:  
 تخلیق کائنات، اجرام فلکی، شجر و حجر، زمین و آسمان کے اسرار، ہوائیں اور طوفان، بہائم اور مویشی، حشرات الارض، پہاڑ اور سمندر

قرآنی عربی گرامر کے اصول اور انکے اطلاقات  
(متن قرآنی پر اطلاق سے توضیحات)

منتخب آیات مع ترجمہ و تجرید

- البقرہ (۷۲۸، ۴۷۸۸، ۴۲۸، ۲۷۸، ۵۲۸، ۴۱۸، ۲۷، ۴۲۸، ۱۱۷، ۴۲۸، ۲۷، ۴۲۸، ۲۷، ۳۸۸، ۴۱۸، ۸۲۸، ۸۲۸، ۵۱۸، ۷۱۸، ۳۲، ۱۱۷، ۴۷۸، ۲۱۸، ۲۱۸، ۲۷، ۱۸، ۳۸۸، ۲۸، ۴۴۸، ۵۲۷، ۲۲۸، ۵۲۷، ۵۲۷، ۱۴، ۱۴، ۱۲، ۵۲۷، ۱۴، ۱۴، ۲۸، ۲۷، ۱۷۸، ۷۱، ۸۲، ۳۲)
- آل عمران (۱۷۷، ۵۳۷، ۱۳۷، ۱۲۷، ۱۸، ۲۴)
- النساء (۲۸، ۸، ۲۸، ۷۲۷)
- المائدہ (۲۲، ۴۲، ۴۱، ۲۲، ۱۲)
- التوبہ (۲۲، ۵۸، ۲۲، ۵۸، ۵۸، ۱۲، ۵)
- الاعراف (۸۱۷، ۴۲۷، ۱۴، ۱۴، ۳۲۷، ۳۲۷، ۱۵، ۱۲۷، ۳۳۷، ۲۱۷، ۲۲۷)
- الرعد (۱۷، ۵)
- الطور (۵۵)
- الانعام (۲۴، ۳۲، ۷۵۷، ۲۵۷، ۲۳)
- الانفال (۲۸، ۲۳، ۷۵)
- الکہف (۷۴، ۲۱۷، ۱۵، ۸۳، ۴۵، ۱۷، ۴۵)
- الجاثیہ (۴)
- فاطر (۱۸، ۸۷، ۳۷)
- العنکبوت (۱۸، ۳۲، ۷۵)
- الروم (۱۴)
- الاسراء (۱۱، ۲۲)
- الرعد (۸)
- السبأ (۱۷، ۳، ۸۸)
- یونس (۲۲، ۷۱۷، ۵۸، ۵۸، ۴، ۸۸)
- یوسف (۵۲، ۵۷)
- الفرقان (۸۲، ۳۴)
- لقمان (۲۸، ۲۷)
- طہ (۵۷۷، ۳۴)
- النحل (۴۱، ۷۷، ۷۲، ۲۵، ۲۱، ۲۲، ۲۲، ۴۷۷، ۲، ۲)
- النمل (۵۲، ۵۲، ۲۲، ۱۲، ۸۲، ۲۷، ۱۷، ۲۷)
- السجدہ (۱۸)
- الحديد (۲)
- ہود (۳۵، ۲)
- یسین (۱۳، ۷۵)
- الروم (۲۳، ۲۳، ۱۴، ۲۷، ۵۸، ۲۵)
- فصلت (۲۳، ۲۳)
- الحج (۷۲، ۴۲، ۸۸، ۳۱)
- الحجر (۲۷، ۸۸)
- الانبیاء (۷۳، ۱۳، ۱۵)
- الزاریات (۱۵)

- الزلزله (٧)
- القصص (٨٢، ٧٢، ١٢، ٢١، ٢١)
- النور (٣٥، ٤٥، ١٥، ٨٨، ٨٨، ١٣)
- الجمعه (٤، ٧٧، ١٧، ٨٢، ٧٧)
- القمر (١)
- الواقعه (٢٢)
- الفاطر (٣٧، ١٨)
- الملك (٢٧)
- الصف (١٧)
- الجن (٣٧)
- الشور 'ى (٢٨)
- الزخرف (٧٧)
- الفيل (٧)

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