NOTIFICATION

On the recommendations of Academic Council made in its 21st (2/2024) meeting held on 07.06.2024, the Syndicate in its 67th (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 (5th 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 (5th 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 (5th Semester Intake)	(Annex-'I')

(WAQAR AHMAD)
Additional Registrar (General)

No. SU/Acad/24/747

Dated: 26.09.2024

Distribution:

- Chairman, Department of Computer Science
- Chairman, Department of Information Technology
- Chairman, Department of Software Engineering
- Controller of Examinations
- Director Academics

C.C:

- Dean, Faculty of Computing & Information Technology
- Director, QEC
- Deputy Registrar (Affiliation)
- Deputy Registrar (Registration)
- Secretary to the Vice-Chancellor
- PA to Registrar
- Notification File

Revised
Curriculum
of
BS Information Technology
for
Main Campus, and Affiliated Colleges

Department of Information Technology

University of Sargodha

(Applicable from Fall 2024)

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Social Science Electives

URCA-5101 Introduction to Management	
Credit Hours:	2 (2-0)
Contact Hours:	2
Pre-requisites:	None

Course Introduction:

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.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
-	-	

Course Outline:

Introduction to Managers and Management: What as 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 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; 7th 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

URCA-5102 Foreign Language (French, German, Arabic, Chinese etc.)	
Credit Hours:	2 (2-0)
Contact Hours:	2
Pre-requisites:	None

Course Introduction:

This course is designed to open doors to diverse cultures and enhance communication skills beyond borders. Explore the richness of global languages, fostering cross-cultural understanding and personal growth. This will help students delve into the art of language acquisition, broadening their horizons and connecting them with the world.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
-	--	

Course Outline:

Follow UOS's Relevant Department's Syllabus

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

Guidelines for Affiliated Colleges
- BSIT program shall be offered under Term System observing University of Sargodha's Affiliation Rules & Regulation.
- There shall be two terms in a calendar academic year.
- The affiliated college(s)/institutions shall follow the prescribed curriculum and course matrix. Necessary modification/changes shall be communicated to the affiliated Colleges/Institutions, if any.
- For domain elective courses, the affiliated institution(s)/college(s) shall follow "Regular Track". However, the administration of any affiliated institution must get prior permission from the competent authority to offer any specialization tracks/courses approved by the BOS. For this purpose, the institution's administration needs to show/demonstrate the availability of appropriate human resource along with necessary educational provisions before the start of the term in which specialization track/course shall be offered. The recommendations of the Convener BOS shall be solicited to allow the Institution to offer the requested specialization track/course already approved by the BOS.

The Discipline of Information Technology

The evolution of information technology (IT) has been marked by rapid and transformative changes, starting from the mechanical calculators of the 19th century to the sophisticated digital systems of the 21st century. Initially, IT was primarily focused on data processing and number crunching, but over time, it has expanded to include a wide range of functionalities, such as communication, data storage, and security. The advent of personal computing in the 1980s and the internet in the 1990s revolutionized the field, making technology more accessible and integral to daily life. This evolution continued with the development of mobile computing, cloud computing, and artificial intelligence, significantly impacting how individuals and organizations interact with technology and process information.

Information technology (IT) refers to the use of computers, networking devices, and software to process, store, retrieve, and send information. It encompasses a variety of activities, including computer programming, data management, networking, system administration, and hardware development. IT is fundamental to the operations of modern organizations, enabling them to manage their information resources efficiently, enhance communication, implement automation, and improve decision-making processes. Through IT, businesses and other entities can leverage technological advancements to optimize their operations, innovate services and products, and maintain competitiveness in the digital age.

The motivation to offer a Bachelor of Science (BS) in Information Technology stems from the critical role that IT plays in the contemporary world. As businesses and societies become increasingly reliant on technology, there is a growing demand for skilled professionals who can develop, implement, and manage IT systems. A BS in Information Technology equips students with the necessary knowledge and skills to address complex technological challenges, meet the evolving needs of the digital economy, and contribute to the advancement of various sectors. This degree program is designed to provide a comprehensive understanding of fundamental and advanced IT concepts, preparing graduates for a range of careers in the tech industry, from systems analysis and network administration to cybersecurity and software development.

Information Technology Programs' Rationale

The digital revolution not only reshaped the way scientists conduct their research but also expedite the pace of inventions. Consequently, the latest advancements in technologies for communication, computation, and delivery of information brought a paradigm shift in the business world - from data processing to information processing - converting computer technology into information technology (IT) and industrial society into an "information society". While this paradigm shift improves productivity, it also created new work place challenges regarding the development, operation, maintenance, and up-gradation of organizational IT infrastructure. Inventions like the Internet, the World Wide Web, email, bulletin board systems, virtual communities, E-business and other online technologies forced organizations to find IT based solutions to all kinds of business challenges. For this, organizations need appropriate systems that work properly and professionals who make these systems secured, upgraded, and maintained. In parallel, employees require support from these professionals to make technology effective for enhancing organizational productivity. This has created a huge demand of IT professionals both locally and globally. Meeting this demand is the key rationale behind the IT programs. In this regard, the IT programs offer a curriculum structure that can produce graduates who can meet above discussed challenges of the 21st century's knowledge driven complex work places. The curriculum structure will create,

expand, disseminate and teach the information technology body of knowledge through academics, applications and research which positively impact society (locally, nationally, and internationally). It will also provide an integration of all components that allow accessing all of the new knowledge and technologies for meeting the above discussed challenges.

Underlying Principles of Information Technology Programs

Curriculum plays an important role within education as it outlines the planned and structured learning experiences that an academic program provides. For an effective academic program the curriculum must meet the needs of the stakeholders and face the emerging challenges. The Department of CS & IT (UOS) realizes the rapidly changing needs of today's knowledge intensive technology driven complex work places and the changing patterns of 21st century universities' education which have removed the identity of place, the identity of time, the identity of the scholarly community, and the identity of the student community. To meet these challenges, the Department has revised the existing curriculum. The revised curriculum is based on following underlying principles:
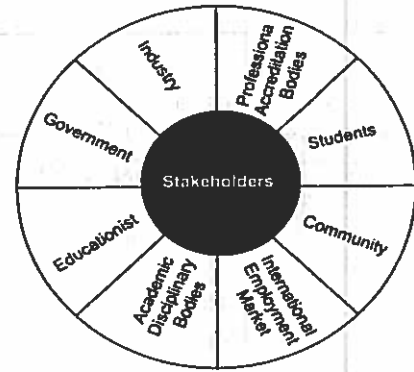
i. The curriculum should be a broad based and provides students with the flexibility to work across many disciplines & professions.
ii. The curriculum should prepare graduates to succeed in a rapidly changing field.
iii. The curriculum should provide guidance for the expected level of mastery of topics by graduates.
iv. Should provide realistic, adoptable recommendations that provide guidance and flexibility, allowing curricular designs that are innovative and track recent developments in the field.
v. The curriculum contents should be relevant and compatible with a variety of institutions.
vi. The size of the essential knowledge must be managed.
vii. The curriculum should identify the fundamental skills and knowledge that all graduates should possess.
viii. The curriculum should provide the greatest flexibility in organizing topics into courses and curricula.

In the light of these principles, the curriculum of the program has adopted a balanced and multidisciplinary approach and presents a blend of study areas which spread across the boundaries of fundamental knowledge of traditional disciplines to advanced knowledge of the emerging disciplines. Body of knowledge (BOK) of the program covers knowledge areas which are required for the program's accreditation from the Accreditation Council and knowledge area which are required for professional certification and professional development.

It is universally accepted that each profession needs both a specific skill set and an appropriate mindset. Developing an appropriate mindset of the prospective computing graduates requires a body of knowledge which enriches students' experiences, thoughts, beliefs, assumptions, and attitudes about the special characteristics of that specific domain. Therefore, the course contents and related practical experiences are designed to meet the professional requirements of the respective domain. To achieve the curricula have focused on

following six (6) key areas:

i. Knowledge: Theoretical learning of concepts and principles regarding a particular subject(s).
ii. Skills: Capability of using learnt knowledge and applying it according to the context
iii. Competencies: The ability to do things satisfactory- not necessarily outstandingly or even well, but rather to a minimum level of acceptable performance.
iv. Expertise: Level of proficiency and innovative ways of applying learnt knowledge. (Competitive edge)
v. Dispositions: Habits of mind or tendencies to respond to certain situations in certain ways. The role of dispositions in computing education is very important. For example, having the disposition to be a programmer is much better that just having programming skills.
vi. Values: Moral, ethical and professional practices.

To strengthen the curriculum further, specialization tracks/courses have also been integrated within the curriculum's BOK. These specialization tracks/courses are designed according to what the industry is looking for in an employee and the learning interests of students. Furthermore, life skills including desired dispositions, soft skills, public speaking, critical thinking & reasoning, 21st Century literacies, personal attributes, entrepreneurship, attitude towards lifelong learning, professional practices and other social skills have not considered discrete items, rather threaded into the entire fabric of the curriculum.

Vision Statement of University of Sargodha

Our vision is to contribute to society through the pursuit of quality education, creative learning and productive research

Mission Statement of University of Sargodha

- To provide students with a healthy learning experience based on critical thinking, innovation and leadership skills
- To ensure a collaborative work environment for faculty and staff to achieve professional excellence and institutional growth
- To contribute to knowledge economy and social transformation through advanced studies and research

Vision Statement of Department of Information Technology

Department of Information Technology aspires to societal betterment through a commitment to quality education, technical skills, fostering creativity via analytical learning, and conducting impactful research in the ever-dynamic field of Information Technology.

Mission Statement of Department of Information Technology

Our mission includes:
- Imparting students with an enriching learning experience in the field of Information Technology centered on in-depth knowledge, critical thinking, innovation, and technical proficiency.
- Cultivating a professional and collaborative work environment for faculty and staff of the department, fostering the attainment of professional excellence

Contributing to knowledge economy, drive social transformation and deliver community services through advanced studies and research in the field of Information Technology.

Curriculum
for
BS Information Technology Program

Details of BS Information Technology

Program Educational Objectives

The aim of the BS (IT) program is to produce entrepreneurs of great character, competence, vision and drive equip 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 information technology domain or proceed to further or higher education or training. One of the key objectives of the program is to equip students with skills and knowledge that enable them to take on appropriate professional positions in IT and grow into leading roles. The following are the PEOs for all BS degree programs being offered in the Department of Information Technology:

PEO-1: Provide in-depth knowledge, analytical skills, and creativity in the domain of Information Technology.

PEO-2: Attain the ability to adapt in an evolving technological environments, assimilate new information with a strong focus on application to solve real-world problems.

PEO-3: Instill moral and ethical values, along with the ability to communicate effectively.

PEO-4: Train graduates to contribute towards knowledge economy and socio-economic growth of the country.

Program's Outcome

BSIT program will produce entrepreneurs of great character, competence, vision and drive equip 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 information technology domain or proceed to further or higher education or training.

Program's Structure

The structure of BSIT program is very 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:

Specialization Tracks
Following specialization tracks are being offered:
1. Regular Track [Public-Private campuses and affiliated colleges will follow track]

2. General Track [Main and public sub campuses]

Degree Requirement

To become eligible for award of BS degree, a student must satisfy the following requirements:
   a) Must have studied and passed the prescribed courses, totaling at least 133 credit hours.
   b) Must have earned CGPA (Cumulative Grade Point Average) of at least 2.0 on a scale of 4.0.

Duration

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

Eligibility Criteria

HSSC (Part-I) with least 50% Marks with one of the following combinations:
   I.   Pre-Engineering
   II.   Pre-Medical (Admitted candidates has to pass 6-credit hours courses of mathematics in first two semester.)

Merit: Basic criteria+20 marks of Hafiz-e-Quran (if applicable)

   1) General Science
      a) Math, Stat, Phy
      b) Math, Stat, Eco
      c) Math, Stat, Comp
      d) Math, Phy, Comp
      e) Math, Eco, Comp

   2) At least 60% marks in DAE (1st & 2nd Year) in a relevant discipline [for BS-IT Only and Maximum Five Seats]

   3) A-Level (with equivalence of mentioned above by IBCC) with at least 50% obtained marks.

Assessment & Evaluation

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

Distribution of Courses

BSIT			
Taxonomy of Courses	**Major Areas**	**Credit Hours**	**Courses**
Major Courses	Computing Core	46	14
	Domain Core	18	06

	Domain Elective	21	07	
Interdisciplinary	Mathematics & Supporting	12	04	
	Elective Supporting	03	01	
General Education	General Education	30	12	
	Total	**130**	**44**	

Major Area Courses

#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
Computing Core Courses – 46 Credit Hours - 14 Courses				
1	CMPC-5201	-	Programming Fundamentals	4 (3-3)
2	CMPC-5202	CMPC-5201	Object Oriented Programming	4 (3-3)
3	CMPC-5203	-	Database Systems	4 (3-3)
4	CMPC-5204	-	Digital Logic Design	3 (2-3)
5	CMPC-5205	CMPC-5202	Data Structures	4 (3-3)
6	CMPC-5206	-	Information Security	3 (2-3)
7	CMPC-5207	-	Artificial Intelligence	3 (2-3)
8	CMPC-5208	-	Computer Networks	3 (2-3)
9	CMPC-5101	-	Software Engineering	3 (3-0)
10	CMPC-5209	CMPC-5204	Computer Organization & Assembly Language	3 (2-3)
11	CMPC-6201	-	Operating Systems	3 (2-3)
12	CMPC-6101	CMPC-5205	Analysis of Algorithms	3 (3-0)
13	CMPC-6702	-	Final Year Project – I	2 (0-6)
14	CMPC-6703	CMPC-6702	Final Year Project – II	4 (0-12)

#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
Domain Core – 18 Credit Hours - 06 Courses				
1	ITDC-5201	-	Web Technologies	3 (2-3)
2	ITDC-5202	-	Cyber Security	3 (2-3)
3	ITDC-6201	-	Database Administration & Management	3 (2-3)
4	ITDC-6202	-	System & Network Administration	3 (2-3)
5	ITDC-6203	-	Information Technology Infrastructure	3 (2-3)
6	ITDC-6204		Parallel & Distributed Computing	3 (2-3)

#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
Domain Elective – 21 Credit Hours - 07 Courses				
1	ITDE-6201	-	Cloud Computing	3 (2-3)
2	ITDE-6202	-	Internet of Everything	3 (2-3)
3	ITDE-6203	-	IoT Data Analytics	3 (2-3)

#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
4	ITDE-6204	-	Virtual Systems and Services	3 (2-3)
5	ITDE-6205	-	Ubiquitous, Pervasive, and Autonomic Computing	3 (2-3)
6	ITDE-6206	-	Fog Computing, Edge Computing, and Mobile Fog Computing	3 (2-3)
7	ITDE-6207	-	Machine Learning in Fog/Edge	3 (2-3)
8	ITDE-6208	-	Application Development Using Microservices & Serverless	3 (2-3)
9	ITDE-6209	-	Semantic Web	3 (2-3)
10	ITDE-6210	-	Digital Marketing and Ecommerce	3 (2-3)
11	ITDE-6211	-	E-Commerce Application Development	3 (2-3)
12	ITDE-6212	-	Enterprise Systems	3 (2-3)
13	ITDE-6213	CMPC-5208	Mobile and Wireless Networks	3 (2-3)
14	ITDE-6214	-	Network Design and Management	3 (2-3)
15	ITDE-6215	-	Web3 and Blockchain Fundamentals	3 (2-3)
16	ITDE-6216	-	Network Security	3 (2-3)
17	ITDE-6217		Digital Forensics	3 (2-3)
18	ITDE-6218	-	UI / UX Designing	3 (2-3)
19	CSDC-6202	CMPC-5209	Computer Architecture	3 (2-3)
20	CSDC-5101	-	Theory of Automata	3 (3-0)
21	CSDC-6201	-	HCI & Computer Graphics	3 (2-3)
22	CSDE-6202	-	Mobile Application Development I	3 (2-3)
23	CSDE-6205		Web Engineering	3 (2-3)
24	SEDC-6202	-	Software Project Management	3 (2-3)
25	SEDC-6204	-	Software Requirement Engineering	3 (2-3)
26	DSDC-5201		Introduction to Data Science	3 (2-3)
27	DSDC-6201		Data Mining	3 (2-3)
28	DSDC-6203		Data Warehousing & Business Intelligence	3 (2-3)
29	DSDE-6201		Big Data Analytics	3 (2-3)
30	DSDE-6202	CMPC-5203	Advanced Database Management	3 (2-3)
31	AIDC-5201	-	Programming for Artificial Intelligence	3 (2-3)
32	AIDC-5202		Machine Learning	3 (2-3)
33	AIDC-6201		Computer Vision	3 (2-3)
34	AIDC-5203		Artificial Neural Networks & Deep Learning	3 (2-3)
35	AIDE-6202	MATH-5103	Advance Statistics	3 (2-3)
36	AIDE-5201		Natural Language Processing	3 (2-3)
37	AIDE-6203	-	Reinforcement Learning	3 (2-3)

Mathematics & Supporting Courses – 12 Credit Hours - 04 Courses			
#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
1	MATH-5101	URCQ-5102	Multivariable Calculus	3 (3-0)

2	MATH-5102	URCQ-5102	Linear Algebra	3 (3-0)
3	MATH-5103	-	Probability & Statistics	3 (3-0)
4	ENGL-6101	URCF-5118	Technical and Business Writing	3 (3-0)

Supporting Electives – 3 Credit Hours - 1 Course				
#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
1	BUSB-6101	-	Introduction to Marketing	3 (3-0)
2	BUSB-6102	-	Human Resource Management	3 (3-0)
3	BUSB-6103	-	Financial Accounting	3 (3-0)
4	BUSB-6104	-	Business Economics	3 (3-0)

General Education – 30 Credit Hours - 12 Courses				
#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
1	URCF-5118	-	Functional English	3 (3-0)
2	URCE-5119	URCF-5118	Expository Writing	3 (3-0)
3	URCQ-5101	-	Quantitative Reasoning I (Discrete Structures)	3 (3-0)
4	URCI-5105	-	Islamic Studies	2 (2-0)
5	URCE-5126		Ethics (for non-Muslims)	2 (2-0)
6	URCI-5122	-	Ideology and Constitution of Pakistan	2 (2-0)
7	URCS-5123	-	Applications of Information & Communication Technologies	3 (2-3)
8	URCS-6101	-	Professional Practices	2 (2-0)
9	URCQ-5102	-	Calculus & Analytical Geometry*	3 (3-0)
10	URCA-xxxx	-	Social Science Elective	2 (2-0)
11	URCW-5201	-	Applied Physics	3 (2-3)
12	URCC-5125	-	Civics and Community Engagement	2 (2-0)
13	URCE-5124	-	Entrepreneurship	2 (2-0)
14	URCQ-5111	-	Translation of Holy Quran-I	NC
15	URCQ-5111	-	Translation of Holy Quran-II	NC
16	URCQ-5111	-	Translation of Holy Quran-III	NC
17	URCQ-5111	-	Translation of Holy Quran-IV	NC

*A pre-medical student can only study Calculus & Analytical Geometry after passing 6-credit hours courses of mathematics.

Social Science Electives – 2 Credit Hours - 1 Course				
#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
1	URCA-5101	-	Introduction to Management	2 (2-0)
2	URCA-5102	-	Foreign Language (French, German, etc)	2 (2-0)

Course Coding Scheme

Discipline Code	Course Level	Course Type	Course Number
4 Letters	1 Digit	1 Digit	2 Digits
Xxxx	5-6	1-2	01-99

Discipline Code

Code	Discipline
CMPC	Computing Core
ITDC	Information Technology Domain Core
ITDE	Information Technology Domain Elective
CSDC	Computer Science Domain Core
CSDE	Computer Science 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
MATH	Mathematics
ENGL	English
URCI	General Science
URCC	
URCQ	
URCS	
URCE	
URCA	
URCF	
URCW	
URCT	

Course Level

Level	Course Type
5	Semester 1-4
6	Semester 5-8

Course Type

Level	Course Type
1	Non-lab Course
2	Lab Course

Scheme of Studies for BSIT

For Main Campus

4-Year Program (8 Regular Semesters)

Semester – I

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-5201	-	Programming Fundamentals	Core	4 (3-3)
2	URCS-5123	-	Application of Information & Communication Technologies	GER	3 (2-3)
3	URCQ-5101	-	Discrete Structures	GER	3 (3-0)
4	URCQ-5102	-	Calculus and Analytic Geometry	GER	3 (3-0)
5	URCF-5118	-	Functional English	GER	3 (3-0)
6	BUSB-61xx	-	Elective Supporting Course	SS	3 (3-0)
				Total Credit Hours	19 (17-6)

Semester - II

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-5202	CMPC-5201	Object Oriented Programming	Core	4 (3-3)
2	CMPC-5203	-	Database Systems	Core	4 (3-3)
3	CMPC-5204	-	Digital Logic Design	Core	3 (2-3)
4	MATH-5101	URCQ-5102	Multivariable Calculus	MATH	3 (3-0)
5	MATH-5102	URCQ-5102	Linear Algebra	MATH	3 (3-0)
6	URCQ-5111	-	Translation of Holy Quran-I	GER	0 (0-0)
				Total Credit Hours	17 (14-9)

Semester – III

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-5205	CMPC-5202	Data Structures	Core	4 (3-3)
2	CMPC-5206	-	Information Security	Core	3 (2-3)
3	CMPC-5207	-	Artificial Intelligence	Core	3 (2-3)
4	CMPC-5208	-	Computer Networks	Core	3 (2-3)
5	CMPC-5101	-	Software Engineering	Core	3 (3-0)
6	MATH-5103	-	Probability & Statistics	MATH	3 (3-0)
				Total Credit Hours	19 (15-12)

Semester – IV

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-5209	CMPC-5204	Computer Organization & Assembly Language	Core	3 (2-3)
2	ITDC-5201	-	Web Technologies	Domain Core	3 (2-3)

3	ITDC-5202	-	Cyber Security	Domain Core	3 (2-3)
4	URCI-5105	-	Islamic Studies/ Ethics	GER	2 (2-0)
5	URCW-5201	-	Applied Physics	GER	3 (2-3)
6	URCE-5119	URCF-5118	Expository Writing	GER	3 (3-0)
7	URCQ-5111	-	Translation of Holy Quran-II	GER	0 (0-0)
				Total Credit Hours	**17 (13-12)**

Semester – V

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-6201	-	Operating Systems	Core	3 (2-3)
2	ITDC-6201	-	DB Administration & Management	Domain Core	3 (2-3)
3	ITDC-6202	CMPC-5209	System & Network Administration	Domain Core	3 (2-3)
4	ITDE-6xxx	-	Domain Elective 1	Domain Elective	3 (2-3)
5	ITDE-6xxx	-	Domain Elective 2	Domain Elective	3 (2-3)
6	URCA-xxxx	-	Social Science Elective	GER	2 (2-0)
				Total Credit Hours	**17 (12-15)**

Semester – VI

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	ITDC-6203	-	Information Technology Infrastructure	Domain Core	3 (2-3)
2	ITDC-6204		Parallel & Distributed Computing	Domain Core	3 (2-3)
3	ITDE-6xxx	-	Domain Elective 3	Domain Elective	3 (2-3)
4	ITDE-6xxx	-	Domain Elective 4	Domain Elective	3 (2-3)
5	ITDE-6xxx	-	Domain Elective 5	Domain Elective	3 (2-3)
6	ITDE-6xxx	-	Domain Elective 6	Domain Elective	3 (2-3)
7	URCQ-5111	-	Translation of Holy Quran-III	GER	0 (0-0)
				Total Credit Hours	**18 (12-18)**

Semester – VII

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-6702	-	Final Year Project – I	Core	2 (0-6)
2	CMPC-6101	CMPC-5205	Analysis of Algorithms	Core	3 (3-0)
3	ITDE-6xxx	-	Domain Elective 7	Domain Elective	3 (2-3)
4	ENGL-6101	URCF-5118	Technical & Business Writing	EN	3 (3-0)
5	URCE-5124	-	Entrepreneurship	GER	2 (2-0)

			Total Credit Hours		13 (10-9)

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	-	Ideology and Constitution of Pakistan	GER	2 (2-0)
3	URCS-6101	-	Professional Practices	GER	2 (2-0)
4	URCC-5125	-	Civics and Community Engagement	GER	2 (2-0)
5	URCQ-5111	-	Translation of Holy Quran-IV	GER	0 (0-0)
			Total Credit Hours		10 (6-12)

Scheme of Studies for BSIT

For Affiliated Colleges

4-Year Program (8 Regular Semesters)

Semester – I

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-5201	-	Programming Fundamentals	Core	4 (3-3)
2	URCS-5123	-	Application of Information & Communication Technologies	GER	3 (2-3)
3	URCQ-5101	-	Discrete Structures	GER	3 (3-0)
4	URCQ-5102	-	Calculus and Analytic Geometry	GER	3 (3-0)
5	URCF-5118	-	Functional English	GER	3 (3-0)
6	BUSB-6101	-	Introduction to Marketing	SS	3 (3-0)
			Total Credit Hours		19 (17-6)

Semester - II

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-5202	CMPC-5201	Object Oriented Programming	Core	4 (3-3)
2	CMPC-5203	-	Database Systems	Core	4 (3-3)
3	CMPC-5204	-	Digital Logic Design	Core	3 (2-3)
4	MATH-5101	URCQ-5102	Multivariable Calculus	MATH	3 (3-0)
5	MATH-5102	URCQ-5102	Linear Algebra	MATH	3 (3-0)
6	URCQ-5111	-	Translation of Holy Quran-I	GER	0 (0-0)
			Total Credit Hours		17 (14-9)

Semester – III

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)

#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-5205	CMPC-5202	Data Structures	Core	4 (3-3)
2	CMPC-5206	-	Information Security	Core	3 (2-3)
3	CMPC-5207	-	Artificial Intelligence	Core	3 (2-3)
4	CMPC-5208	-	Computer Networks	Core	3 (2-3)
5	CMPC-5101	-	Software Engineering	Core	3 (3-0)
6	MATH-5103	-	Probability & Statistics	MATH	3 (3-0)
				Total Credit Hours	**19 (15-12)**

Semester – IV

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-5209	CMPC-5204	Computer Organization & Assembly Language	Core	3 (2-3)
2	ITDC-5201	-	Web Technologies	Domain Core	3 (2-3)
3	ITDC-5202	-	Cyber Security	Domain Core	3 (2-3)
4	URCI-5105	-	Islamic Studies/ Ethics	GER	2 (2-0)
5	URCW-5201	-	Applied Physics	GER	3 (2-3)
6	URCE-5119	URCF-5118	Expository Writing	GER	3 (3-0)
7	URCQ-5111	-	Translation of Holy Quran-II	GER	0 (0-0)
				Total Credit Hours	**17 (13-12)**

Semester – V

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-6201	-	Operating Systems	Core	3 (2-3)
2	ITDC-6201	-	DB Administration & Management	Domain Core	3 (2-3)
3	ITDC-6202	CMPC-5209	System & Network Administration	Domain Core	3 (2-3)
4	ITDE-6201	-	Cloud Computing	Domain Elective	3 (2-3)
5	ITDE-6211	-	E-Commerce Application Development	Domain Elective	3 (2-3)
6	URCA-5101	-	Introduction to Management	GER	2 (2-0)
				Total Credit Hours	**17 (12-15)**

Semester – VI

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	ITDC-6203	-	Information Technology Infrastructure	Domain Core	3 (2-3)
2	ITDC-6204	-	Parallel & Distributed Computing	Domain Core	3 (2-3)
3	ITDE-6202	-	Internet of Everything	Domain Elective	3 (2-3)
4	CSDE-6202	-	Mobile Application Development I	Domain Elective	3 (2-3)

5	ITDE-6212	-	Enterprise Systems	Domain Elective	3 (2-3)
6	ITDE-6214	-	Network Design and Management	Domain Elective	3 (2-3)
7	URCQ-5111	-	Translation of Holy Quran-III	GER	0 (0-0)
				Total Credit Hours	**18 (12-18)**

Semester – VII

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-6702	-	Final Year Project - I	Core	2 (0-6)
2	CMPC-6101	CMPC-5205	Analysis of Algorithms	Core	3 (3-0)
3	ITDE-6204		Virtual Systems and Services	Domain Elective	3 (2-3)
4	ENGL-6101	URCF-5118	Technical & Business Writing	EN	3 (3-0)
5	URCE-5124	-	Entrepreneurship	GER	2 (2-0)
				Total Credit Hours	**13 (10-9)**

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	-	Ideology and Constitution of Pakistan	GER	2 (2-0)
3	URCS-6101	-	Professional Practices	GER	2 (2-0)
4	URCC-5125	-	Civics and Community Engagement	GER	2 (2-0)
5	URCQ-5111	-	Translation of Holy Quran-IV	GER	0 (0-0)
				Total Credit Hours	**10 (6-12)**

Contents of Computing Core Courses

CMPC-5201 Programming Fundamentals	
Credit Hours:	4 (3-3)
Contact Hours:	3-3
Pre-requisites:	None

Course Introduction:

This course provides fundamental concepts of programming to freshmen. The courses is prerequisite
to many other courses, therefore, students are strongly advised to cover all contents and try to achieve CLOs to the maximum possible level. The course may be taught as language independent. Further, it is up to the university to choose any language for the practical/Lab purpose but that must be latest and market oriented.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand basic problem solving steps and logic constructs	C2 (Understand)
CLO-2	Apply basic programing concepts	C3 (Apply)
CLO-3	Design and implement algorithms to solve real world problems	C3 (Solve)

Course Outline:

Introduction to problem solving, a brief review of Von-Neumann architecture, Introduction to programming, role of compiler and linker, introduction to algorithms, basic data types and variables, input/output constructs, arithmetic, comparison and logical operators, conditional statements and execution flow for conditional statements, repetitive statements and execution flow for repetitive statements, lists and their memory organization, multidimensional lists, introduction to modular programming, function definition and calling, stack rolling and unrolling, string and string operations, pointers/references, static and dynamic memory allocation, File I/O operations.

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

1. Starting out with Programming Logic & Degins, 4th Edition, Tony Gaddis,
2. The C Programming Language, 2nd Edition by Brian W. Kernighan, Dennis M. Ritchie
3. Object Oriented Programming in C++ by Robert Lafore
4. C How to Program, 7th Edition by Paul Deitel & Harvey Deitel
5. Problem Solving and Program Design in C++, 7th Edition by Jeri R. Hanly & Elliot B. Koffman

CMPC-5202 Object Oriented Programming	
Credit Hours:	4 (3-3)
Contact Hours:	3-3
Pre-requisites:	Programming Fundamentals

Course Introduction:

The course aims to focus on object-oriented concepts, analysis and software development. The basic concept of OOP is covered in this course.

CLO	Course Learning Outcomes	Bloom

No.		Taxonomy
CLO-1	Understand principles of object-oriented paradigm.	C2 (Understand)
CLO-2	Identify the objects & their relationships to build object-oriented solution	C3 (Apply)
CLO-3	Model a solution for a given problem using object-oriented principles	C3 (Solve)
CLO-4	Examine an object-oriented solution	C4 (Examine)

Course Outline:

Introduction to object oriented design, history and advantages of object oriented design, introduction to object oriented programming concepts, classes, objects, data encapsulation, constructors, destructors, access modifiers, const vs non-const functions, static data members & functions, function overloading, operator overloading, identification of classes and their relationships, composition, aggregation, inheritance, multiple inheritance, polymorphism, abstract classes and interfaces, generic programming concepts, function & class templates, standard template library, object streams, data and object serialization using object streams, exception handling.

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

1. Java: How to Program, 9th Edition by Paul Deitel
2. Beginning Java 2, 7th Edition by Ivor Horton
3. An Introduction to Object Oriented Programming with Java, 5th Edition by C. Thomas Wu
4. Starting Out with C++ from Control Structures to Objects, 9th Edition, Tony Gaddis
5. C++ How to Program, 10th Edition, Deitel & Deitel.
6. Object Oriented Programming in C++, 3rd Edition by Robert Lafore

CMPC-5203 Database Systems	
Credit Hours:	4 (3-3)
Contact Hours:	3-3
Pre-requisites:	None

Course Introduction:

The course aims to introduce basic database concepts, different data models, data storage and retrieval techniques and database design techniques. The course primarily focuses on relational data model and DBMS concepts.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Explain fundamental database concepts.	C2 (Explain)
CLO-2	Design conceptual, logical and physical database schemas using different data models.	C5 (Design)
CLO-3	Identify functional dependencies and resolve database anomalies by normalizing database tables.	C2 (Identify)
CLO-4	Use Structured Query Language (SQL) for database definition and manipulation in any DBMS	C4 (Use)

Course Outline:

Basic database concepts, Database approach vs. file based system, database architecture, three

level schema architecture, data independence, relational data model, attributes, schemas, tuples, domains, relation instances, keys of relations, integrity constraints, relational algebra, selection, projection, Cartesian product, types of joins, normalization, functional dependencies, normal forms, entity relationship model, entity sets, attributes, relationship, entity-relationship diagrams, Structured Query Language (SQL), Joins and subqueries in SQL, Grouping and aggregation in SQL, concurrency control, database backup and recovery, indexes, NoSQL systems.

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

1. Database Systems: A Practical Approach to Design, Implementation, and Management, 6th Edition by Thomas Connolly and Carolyn Begg
2. Database Systems: The Complete Book, 2nd Edition by Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom
3. Database System Concepts, 6th Edition by Avi Silberschatz, Henry F. Korth and S. Sudarshan.
4. Database Management Systems, 3rd Edition by Raghu Ramakrishnan, Johannes Gehrke

CMPC-5204 Digital Logic Design

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

Course Introduction:

The course introduces the concept of digital logic, gates and the digital circuits. Further, it focuses on the design and analysis combinational and sequential circuits. It also serves to familiarize the student with the logic design of basic computer hardware components.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Acquire knowledge related to the concepts, tools and techniques for the design of digital electronic circuits	-
CLO-2	Demonstrate the skills to design and analyze both combinational and sequential circuits using a variety of techniques	-
CLO-3	Apply the acquired knowledge to simulate and implement small-scale digital circuits	-
CLO-4	Understand the relationship between abstract logic characterizations and practical electrical implementations.	-

Course Outline:

Number Systems, Logic Gates, Boolean Algebra, Combination logic circuits and designs, Simplification Methods (K-Map, Quinn Mc-Cluskey method), Flip Flops and Latches, Asynchronous and Synchronous circuits, Counters, Shift Registers, Counters, Triggered devices & its types. Mealy machines and Moore machines. Binary Arithmetic and Arithmetic Circuits, Memory Elements, State Machines. Introduction Programmable Logic Devices (CPLD, FPGA) Lab Assignments using tools such as Verilog HDL/VHDL, MultiSim.

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

1. Digital Fundamentals by Floyd, 11/e.
2. Fundamental of Digital Logic with Verilog Design, Stephen Brown, 2/e

CMPC-5205 Data Structures

Credit Hours: Contact Hours: Pre-requisites:	4 (3-3) 3-3 Programming Fundamentals

Course Introduction:

The course is designed to teach students structures and schemes, which allow them to write programmer to efficiently manipulate, store, and retrieve data. Students are exposed to the concepts of time and space complexity of computer programs.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Implement various data structures and their algorithms and apply them in implementing simple applications	C3 (Apply)
CLO-2	Analyze simple algorithms and determine their complexities.	C5 (Analyze)
CLO-3	Apply the knowledge of data structure to other application domains.	C3 (Apply)
CLO-4	Design new data structures and algorithms to solve problems.	C6 (Design)

Course Outline:

Abstract data types, complexity analysis, Big Oh notation, Stacks (linked lists and array implementations), Recursion and analyzing recursive algorithms, divide and conquer algorithms, Sorting algorithms (selection, insertion, merge, quick, bubble, heap, shell, radix, bucket), queue, dequeuer, priority queues (linked and array implementations of queues), linked list & its various types, sorted linked list, searching an unsorted array, binary search for sorted arrays, hashing and indexing, open addressing and chaining, trees and tree traversals, binary search trees, heaps, M-way tress, balanced trees, graphs, breadth-first and depth-first traversal, topological order, shortest path, adjacency matrix and adjacency list implementations, memory management and garbage collection.

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

1. Data Structures and Algorithm Analysis in Java by Mark A. Weiss
2. Data Structures and Abstractions with Java by Frank M. Carrano & Timothy M. Henry
3. Data Structures and Algorithms in C++ by Adam Drozdek
4. Data Structures and Algorithm Analysis in C++ by Mark Allen Weiss Java Software Structures: Designing and Using Data Structures by John Lewis and Joseph Chase

CMPC-5206 Information Security

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

Course Introduction:

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.

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)

Course Outline:

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.

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

1. Computer Security: Principles and Practice, 3rd edition by William Stallings
2. Principles of Information Security, 6th edition by M. Whitman and H. Mattord
3. Computer Security, 3rd edition by Dieter Gollmann
4. Computer Security Fundamentals, 3rd edition by William Easttom
5. Official (ISC)2 Guide to the CISSP CBK, 3rd edition

CMPC-5207 Artificial Intelligence

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	Object Oriented Programming

Course Introduction:

Artificial Intelligence has emerged as one of the most significant and promising areas of computing. This course focuses on the foundations of AI and its basic techniques like Symbolic manipulations, Pattern Matching, Knowledge Representation, Decision Making and Appreciating the differences between Knowledge, Data and Code. AI programming language Python has been proposed for the practical work of this course.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand the fundamental constructs of Python programming language.	C2 (Understand)
CLO-2	Understand key concepts in the field of artificial intelligence	C2 (Understand)
CLO-3	Implement artificial intelligence techniques and case studies	C3 (Apply)

Course Outline:

An Introduction to Artificial Intelligence and its applications towards Knowledge Based Systems; Introduction to Reasoning and Knowledge Representation, Problem Solving by

Searching (Informed searching, Uninformed searching, Heuristics, Local searching, Minmax algorithm, Alpha beta pruning, Game-playing); Case Studies: General Problem Solver, Eliza, Student, Macsyma; Learning from examples; ANN and Natural Language Processing; Recent trends in AI and applications of AI algorithms. Python programming language will be used to explore and illustrate various issues and techniques in Artificial Intelligence.

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

1. Russell, S. and Norvig, P. "Artificial Intelligence. A Modern Approach", 3rd ed, Prentice Hall, Inc., 2015.
2. Norvig, P., "Paradigms of Artificial Intelligence Programming: Case studies in Common Lisp", Morgan Kaufman Publishers, Inc., 1992.
3. Luger, G.F. and Stubblefield, W.A., "AI algorithms, data structures, and idioms in Prolog, Lisp, and Java", Pearson Addison-Wesley. 2009.
4. Severance, C.R., 2016. "Python for everybody: Exploring data using Python 3." CreateSpace Independent Publ Platform.
5. Miller, B.N., Ranum, D.L. and Anderson, J., 2019. "Python programming in context." Jones & Bartlett Pub.
6. Joshi, P., 2017. "Artificial intelligence with python." Packt Publishing Ltd.

CMPC-5208 Computer Networks

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

Course Introduction:

This course introduces the basic concept of computer network to the students. Network layers, Network models (OSI, TCP/IP) and protocol standards are part of the course.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Describe the key terminologies and technologies of computer networks	C2 (Describe)
CLO-2	Explain the services and functions provided by each layer in the Internet protocol stack.	C2 (Explain)
CLO-3	Identify various internetworking devices and protocols and their functions in a networking	C4 (Identify)
CLO-4	Analyze working and performance of key technologies, algorithms and protocols	C4 (Analyze)
CLO-5	Build Computer Network on various Topologies	P3 (Build)

Course Outline:

Introduction and protocols architecture, basic concepts of networking, network topologies, layered architecture, physical layer functionality, data link layer functionality, multiple access techniques, circuit switching and packet switching, LAN technologies, wireless networks, MAC addressing, networking devices, network layer protocols, IPv4 and IPv6, IP addressing, sub netting, CIDR, routing protocols, transport layer protocols, ports and sockets, connection establishment, flow and congestion control, application layer protocols, latest trends in computer networks.

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

1. Computer Networking: A Top-Down Approach Featuring the Internet, 6th edition by James

F. Kurose and Keith W. Ross
2. Computer Networks, 5th Edition by Andrew S. Tanenbaum
3. Data and Computer Communications, 10th Edition by William Stallings
4. Data Communication and Computer Networks, 5th Edition by Behrouz A. Forouzan

CMPC-5101 Software Engineering	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

Course Introduction:

This course provides students with a foundational understanding of the principles, methodologies, and practices essential for designing, developing, and maintaining software systems. Emphasis is placed on the entire software development life cycle, covering requirements analysis, system design, quality assurance and testing.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Describe various software engineering processes and activates	C1 (Describe)
CLO-2	Apply the system modeling techniques to model a medium size software systems	C3 (Apply)
CLO-3	Apply software quality assurance and testing principles to medium size software systems	C4 (Apply)
CLO-4	Discuss key principles and common methods for software project management such as scheduling, size estimation, cost estimation and risk analysis	C2 (Discuss)

Course Outline:

Nature of Software, Overview of Software Engineering, Professional software development, Software engineering practice, Software process structure, Software process models, Agile software Development, Agile process models, Agile development techniques, Requirements engineering process, Functional and non-functional requirements, Context models, Interaction models, Structural models, behavioral models, model driven engineering, Architectural design, Design and implementation, UML diagrams, Design patterns, Software testing and quality assurance, Software evolution, Project management and project planning, configuration management, Software Process improvement

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

1. Software Engineering, Sommerville I., 10th Edition, Pearson Inc., 2014
2. Software Engineering, A Practitioner's Approach, Pressman R. S.& Maxim B. R., 8th Edition, McGraw-Hill, 2015.

CMPC-5209 Computer Organization & Assembly Language	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	Digital Logic Design

Course Introduction:

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.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
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)

Course Outline:

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

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

1. Assembly Language for x86 Processors by Kip R. Irvine, Prentice Hall; 6thEdition (March 7, 2010). ISBN-10: 013602212X
2. The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications by Walter A. Triebel & Avtar Singh, Prentice Hall; 4thEdition (September 8, 2002). ISBN-10: 0130930814.
3. Lab Manual to Accompany - The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications by Walter A. Triebel & Avtar Singh, Pearson; 4thEdition (2003). ASIN: B000Q652KQ
4. Principles of Computer Organization and Assembly Language by Patrick Juola, Prentice Hall; 1stEdition (January 11, 2011). ASIN: B009TGBI1Q
5. The Art of Assembly Language by Randall Hyde, No Starch Press; 2ndEdition (March 22, 2010). ISBN-10: 1593272073.

CMPC-6201 Operating Systems	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	Data Structures

Course Introduction:

To help students gain a general understanding of the principles and concepts governing the functions of operating systems and acquaint students with the layered approach that makes design, implementation and operation of the complex OS possible.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand the characteristics of different structures of the Operating Systems and identify the core functions of the	C2 (Understand)

	Operating Systems	
CLO-2	Analyze and evaluate the algorithms of the core functions of the Operating Systems and explain the major performance issues with regard to the core functions	C5 (Evaluate)
CLO-3	Demonstrate the knowledge in applying system software and tools available in modern operating systems.	C3 (Demonstrate)

Course Outline:

Operating systems basics, system calls, process concept and scheduling, inter-process communication, multithreaded programming, multithreading models, threading issues, process scheduling algorithms, thread scheduling, multiple-processor scheduling, synchronization, critical section, synchronization hardware, synchronization problems, deadlocks, detecting and recovering from deadlocks, memory management, swapping, contiguous memory allocation, segmentation & paging, virtual memory management, demand paging, thrashing, memory-mapped files, file systems, file concept, directory and
disk structure, directory implementation, free space management, disk structure and scheduling, swap space management, system protection, virtual machines, operating system security

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

1. Operating Systems Concepts, 9th edition by Abraham Silberschatz
2. Modern Operating Systems, 4th edition by Andrew S. Tanenbaum
3. Operating Systems, Internals and Design Principles, 9th edition by William StallingsWu

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	
CLO-2	Identify the characteristics of data and/or other conditions or assumptions that lead to different behaviors.	
CLO-3	Determine informally the time and space complexity of simple algorithms	
CLO-4	List and contrast standard complexity classes	
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 Ω, Big Θ, little-o, little-ω, 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):

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

CMPC-6702 Final Year Project-I	
Credit Hours:	2 (0-6)
Contact Hours:	0-6
Pre-requisites:	None

Course Introduction:

This course marks a crucial phase in the undergraduate program, providing students with a unique opportunity for hands-on research and/or project development.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
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.	-

Course Outline:

1. Project Proposal
2. Introduction Software Requirement Specification
3. Software Function Specification
4. Design Documentation

CMPC-6703 Final Year Project-II	
Credit Hours:	4 (0-12)
Contact Hours:	0-12
Pre-requisites:	Final Year Project-I

Course Introduction:

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.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Develop, implement, and test solutions to real world problems.	C3 (Apply)

Course Outline:

1. Database Design
2. Interface Design
3. Initial Prototype
4. Implementation
5. Testing

Contents of Domain Core Courses

ITDC-5201 Web Technologies

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

Course Introduction:

The Web Technologies course provides a comprehensive understanding of internet-based technologies, covering web development, protocols, and design principles. Participants acquire skills in creating dynamic and interactive web applications.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Learn basic WWW, its structure and working.	C1 (Remember)
CLO-2	Describe the constraints that the web puts on developers.	C2 (Understand)
CLO-3	Implement basic client side and server-side languages.	C4 (Apply)
CLO-4	Design and implement a simple web application.	C4 (Apply)
CLO-5	Review an existing web application against a current web standard.	C4 (Apply)

Course Outline:

Introduction; role of algorithms in computing, Analysis on nature of input and size of input Asymptotic notations; Big-O, Big Ω, Big Θ, little-o, little-ω, 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):

1. Learning PHP, MySQL, JavaScript, and CSS, A Step-by-Step Guide to Creating Dy-namic Websites By Robin Nixon, O'Reilly Media; latest edition

2. Web Technologies: A Computer Science Perspective by Jeffrey C. Jackson, Prentice Hall; 1st Edition (August 27, 2006). ISBN-10: 0131856030
3. Web Technologies by Uttam Kumar Roy, Oxford University Press, USA (June 13, 2011). ISBN-10: 0198066228
4. Web Application Architecture: Principles, protocols and practices by Leon Shklar and Richard Rosen, Wiley; 2nd Edition (May 5, 2009). ISBN-10: 047051860X

ITDC-5202 Cyber Security	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	None

Course Introduction:

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.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
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)

Course Outline:

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; Software security; Mobile device security; Mobile app security; Cyber Terrorism and Information Warfare; Introduction to Digital Forensics; Digital Forensics Categories.

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

1. Computer Security Fundamentals by Chuck Easttom, 4th edition or latest
2. Security+ Guide to Network Security Fundamentals, by Mark Ciampa, 5th Edition
3. Security in Computing by C.P. Pfleeger, Prentice-Hall, 4th Edition or Latest

ITDC-6201 Database Administration and Management	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	None

Course Introduction:

The Database Administration and Management course covers principles and techniques for

effective database design, administration, and optimization, providing participants with skills to ensure efficient data storage, retrieval, and management in various applications.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Fully understand the concepts and technical issues of Database Administration.	C2 (Understand)
CLO-2	Have good understanding of internal functionality of Database Man-agement System.	C2 (Understand)
CLO-3	Administrator Huge Database implemented in a DBMS.	C3 (Apply)
CLO-4	Database Administration tasks i.e. Backup and Recovery and Performance Tuning of Databases.	C3 (Apply)

Course Outline:

Installation; SQL* Plus; Oracle Enterprise Manager; DBA Tools. Oracle Architectural Components: Oracle Server; Oracle Instance. Physical Structure; SGA; Shared Pool; Library Cache; Data Dictionary Cache; Large Pool; User Process; Server Process; Background Processes. Managing an Oracle Instance: Parameter File; Creating SPFILE; Oracle Managed Files; Startup and Shutdown Database; Alert Log File; Background Trace File; User Trace File. Creating Database and Data dictionary. Managing Control Files and Redo Log Files. Managing Tablespaces, Operations with Tablespaces. Data File Management, Segments, Block. Managing Undo Data, Undo Data Statistics: Managing Tables and Users: Indexes Management, Maintaining Data Integrity, Constraints. Managing Privileges. Basic Oracle Net Architecture: Types of Networks, Oracle Net Services, Oracle Shared Server, Connection Manager, Oracle Net Connections. Server Side Configuration: The Listener Process; Configuring Listener, Sessions, Creating and Managing Listener. Client Side Configuration: Host Naming Method, Local Naming Method, Net Assis-tant, Configurations. Usage and Configuration of Oracle Shared Server. Backup and Recovery, Instance and Media Recovery, Configuration of Archive log mode, User Managed Complete Recovery. Loading Data into Database, Tuning Tools, Sizing Shared Pool, Sizing Buffer Cache, I/O Issues. Tuning Rollback Segments, Latches, Rollback Segment Tuning Shared Servers, Types of Locks, Block Efficiency, Storage hierarchy. Avoiding Dynamic allocation, Statistics, PCTFREE and PCTUSED, Monitoring Index Usage.

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

1. Oracle Database 11g DBA Handbook by Bob Bryla and Kevin Loney, McGraw-Hill Osborne Media; 1st Edition (December 6, 2007). ISBN-10: 0071496637
2. Oracle Database 12c DBA Handbook by Bob Bryla, McGraw-Hill; (2015),ISBN-978-0-07-179879-2
3. Database Administration: The Complete Guide to DBA Practices and Procedures by Craig S. Mullins, Addison-Wesley Professional; 2nd Edition (October 21, 2012).
4. ISBN-10: 0321822943
5. Database Systems: A Practical Approach to Design, Implementation and Management by Thomas M. Connolly and Carolyn E. Begg, Addison-Wesley; 5th Edition (2009). ISBN-10: 0321523067
6. Oracle Database 11g The Complete Reference by Kevin Loney, McGraw-Hill Os-borne Media; 1st Edition (2008). ISBN-10: 0071598758

ITDC-6202 System and Network Administration	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (2-3) 2-3 None

Course Introduction:

The System and Network Administration course explores the fundamentals of managing and maintaining computer systems and networks, covering topics such as system configuration, security, and troubleshooting. Participants gain skills to ensure the reliable operation and security of IT infrastructure.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Describe the key terminologies and technologies of System and network administration.	C2 (Understand)
CLO-2	Explain the services and functions provided by different data centers.	C2 (Understand)
CLO-3	Identify various OS used to handle system and network administration routines.	C3 (Apply)
CLO-4	Analyze the different services of Linux and windows.	C3 (Apply)

Course Outline:

Introduction to System Administration, Systems, SA Components, Building a Site from Scratch, Growing a Small Site, Going Global, Replacing Services, Moving a Data Center, Handling a High Rate of Office Moves, Assessing a Site. Server Environment (Microsoft and Linux): Known for Reliable Products, Understand the Cost of Server Hardware, Consider Maintenance Contracts and Spare Parts, maintaining Data Integrity, Put Servers in the Data Center, Client Server OS Configuration, and Provide Remote Console Access.). Services and Comparative Analysis of most demanded OS: Important Attributes, Key Features, pros and Cons. Linux Installation and verification. Configuring Local services and managing basic system issues. Administer users and groups. Software Management. Managing Network Services and Network monitoring tools. Boot Management and Process Management. IP Tables and filtering. Securing network traffic. Advance File systems and logs. Bash Shell Scripting and Command line. Configuring Servers (FTP, DNS, Apache), Configuring Servers Cont. (DHCP, Samba, NFS) Configuring Active Directory on Windows Server

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

1. Study guide for Practice of System and Network Administration by Thomas A. Limoncelli, Cram101; 2nd Edition (2011). ISBN-10: 1428851755.
2. Linux Administration: A Beginner's Guide, Seventh Edition 7th Edition by Wale Soyinka
3. Active Directory: Designing, Deploying, and Running Active Directory Fifth Edition by Barian Desmond

ITDC-6203 Information Technology Infrastructure	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (2-3) 2-3 None

Course Introduction:

The Information Technology Infrastructure course delves into the foundational components and management of IT systems, covering hardware, software, networks, and security to ensure a

robust and efficient technological framework for organizations. Participants gain insights into designing, implementing, and maintaining IT infrastructure.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Information technology architectures including software systems, hardware, operating systems, databases, component technologies, networking, and architecture patterns.	C2 (Understand)
CLO-2	IT Infrastructure Management.	C3 (Apply)

Course Outline:

Introduction and Definition of IT Infrastructure, IT building block, process building blocks, Application building block, Application Platform building block, Infrastructure building block. Non-functional Attributes; introduction, non-functional requirements, Availability Concepts, Calculating availability, Sources of Unavailability, Availability Patterns. Performance concepts: introduction, Perceived performance, Performance during Infrastructure Design, Performance of a running system, performance pattern, Sources of Performance Metrics, Performance Pattern. Security Concepts: Risk Management, Cryptography, Computer Crime, Security Patterns. Datacentres: Introduction & History, Building Blocks, Datacentre Availability, Datacentre Security. Networking: Building Blocks, Network virtualization. Network Availability, Network Performance, Network Security. Storage: Introduction and History, Building blocks, Availability, Performance, Security. Compute: Introduction, Building Blocks, Availability, Performance, Security, Operating Systems: Introduction, Building Blocks, Implementing Various OSs, OS availability, OS Performance, OS Security. End User Devises: Introduction & History, Building Blocks, Desktop virtualization, Device Availability, Performance, Security, Infrastructure life cycle, Infrastructure deployment options: Introduction, Hosting options, Enterprise infrastructure deployment, Software defined data-centre, (Hyper) Converged Infrastructure, Cloud computing, infrastructure as a code. Purchasing Infrastructure And Services. Deploying The Infrastructure. Maintaining The Infrastructure, Deploying applications.

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

1. IT Infrastructure Architecture: Infrastructure building blocks and concepts by Sjaak-Laan, Lulu.com; 3rd edition (2017). ISBN-978-1-326-92569-7
2. IT Infrastructure and its Management by Prof Phalguni Gupta, Tata McGraw Hill Education Private Limited (October 6, 2009). ISBN-10: 0070699798
3. IT Architecture For Dummies byKalani Kirk Hausman and Susan Cook, For Dum-mies; 1st Edition (November 9, 2010). ISBN-10: 0470554231
4. Standards Policy for Information Infrastructure by Brian Kahin and, Janet Abbate, The MIT Press (August 14, 1995). ISBN-10: 026211206X
5. IT Architectures and Middleware: Strategies for Building Large, Integrated Systems by Chris Britton and Peter Bye, Addison-Wesley Professional; 2nd Edition (June 3, 2004). ISBN-10: 0321246942

ITDC-6204 Parallel and Distributed Computing

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	Object Oriented Programming, Operating Systems

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. Distributed Systems: Principles and Paradigms, A. S. Tanenbaum and M. V. Steen, Prentice Hall, 2nd Edition, 2007
2. Distributed and Cloud Computing: Clusters, Grids, Clouds, and the Future Internet, K Hwang, J Dongarra and GC. C. Fox, Elsevier, 1st Ed.

Contents of Domain Elective Courses

ITDE-6201 Cloud Computing	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	None

Course Introduction:

The Cloud Computing course explores principles and applications of leveraging scalable, on-demand computing resources over the internet, covering architecture, security, and emerging trends for effective cloud system management. Participants gain skills to design and deploy cloud-based solutions.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand of cloud computing principles, models, and technologies.	C2 (Understand)
CLO-2	Apply the models and approaches in order to become enabled to select and apply appropriate methods for a particular case	C3 (Apply)

Course Outline:

Introduction to Cloud Computing, Definition and Evolution of Cloud Computing, Key Characteristics and Service Models, Cloud Deployment Models, Benefits and Challenges of Cloud Computing, Cloud Service Models (IaaS, PaaS, SaaS), Virtualization and Containerization, Virtualization Concepts, Hypervisors and Virtual Machines, Containerization with Docker, Container Orchestration (e.g., Kubernetes), Cloud Architecture and Deployment Models, Data Storage and Retrieval in the Cloud, Cloud Storage Services, Database Services in the Cloud, Data Backup and Recovery, Serverless Computing, Cloud Security and Compliance, Cloud Migration Strategies. Planning and Assessing Cloud Migration, DevOps in the Cloud, Emerging Trends in Cloud Computing

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

1. Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood.
2. The Art of Cloud Computing: Concepts and Examples" by Thomas Erl.
3. Cloud Native Infrastructure" by Justin Garrison and Kris Nova.
4. Mastering Cloud Computing: Foundations and Applications Programming" by Rajkumar Buyya, Christian Vecchiola, and S. Thamarai Selvi.

ITEC-6202 Internet of Everything

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

Course Introduction:

This course on the Internet of Everything explores the interconnectedness of devices, people, and data, providing insights into the dynamic landscape of IoT, sensor networks, and intelligent systems. Delve into the principles and applications of IoE, understanding its transformative impact on industries, smart cities, and the evolving digital ecosystem.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand Internet of Everything, covering architectural components, applications, and societal implications.	C2 (Understand)
CLO-2	Apply analytical tools to manage and derive insights from the vast amounts of data generated within IoE ecosystems.	C3 (Apply)
CLO-3	Develop practical skills in designing and implementing IoE solutions with diverse technologies.	C3 (Apply)

Course Outline:

Introduction to IoE, Architectural components, devices, sensors, and communication protocols. Data management and analytics in the IoE context, Role of big data and analytical tools, Security and privacy challenges specific to IoE, Ethical considerations, IoE applications in various industries, including manufacturing, healthcare, transportation, and smart cities, real-world implementations case studies, Integration of IoE with cloud computing and the role of edge computing, IoE standards, interoperability, and the regulatory landscape, Societal impact of IoE, Future trends in IoE.

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

1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" by David Hanes and Gonzalo Salgueiro.
2. The Internet of Everything: How More Relevant and More Valuable Connections Will Change the World" by Dave Evans
3. IoT: Building Arduino-Based Projects" by Peter Waher.
4. Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz.

ITDE-6203 IoT Data Analytics

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

Course Introduction

This course in IoT Data Analytics navigates through leveraging data generated by IoT devices, offering insights into advanced analytics for actionable decision-making. Explore techniques to analyze, interpret, and derive valuable insights from the diverse and voluminous data streams in the Internet of Things

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand IoT data analytics principles, including the challenges and opportunities associated with processing diverse and real-time datasets.	C2 (Understand)
CLO-2	Apply advanced data analytics techniques including machine learning algorithms effectively, developing predictive models for forecasting trends and anomalies within IoT datasets.	C3 (Apply)
CLO-3	Apply ethical considerations and security measures to address privacy concerns and ensure data integrity within IoT analytics, showcasing practical skills in implementing secure solutions.	C3 (Apply)

Course Outline:

Fundamentals of IoT data analytics, Techniques for collecting diverse IoT data, Pre-processing strategies for quality enhancement, Importance of real-time analytics, Implementation and optimization strategies, Introduction to machine learning algorithms, Application of ML in IoT data analytics, Developing predictive models for IoT data, Evaluation and refinement of predictive models, Techniques for effective data visualization, Tools and platforms for creating meaningful visualizations, Addressing security challenges in IoT data analytics, Implementing privacy-preserving measures, Exploring ethical considerations in IoT data analytics, Latest trends in IoT data analytics

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

1. IoT Analytics: A Guide for Business Professionals and Students" by Ron Schmelzer.
2. Data Science for IoT: Start Here!" by Ajit Jaokar.
3. Internet of Things. A Hands-On Approach" by Arshdeep Bahga and Vijay Madisetti.
4. IoT Data Analysis with MATLAB" by Vishal M. Patel.

ITDE-6204 Virtual Systems and Services	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

Course Introduction:

The Virtual Systems and Services course provides a concise exploration of virtualization technologies, covering fundamental principles, practical implementations, and their integration in cloud computing and networking. Participants gain hands-on experience in managing virtualized environments for enhanced efficiency and resource optimization.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand Virtualization principles, technologies, and their applications in various IT domains, including server infrastructure, networking, and storage.	C2 (Understand)
CLO-2	Apply virtualization concepts to design and deploy practical solutions, showcasing the ability to implement and manage virtual systems effectively in diverse environments.	C3 (Apply)
CLO-3	Analyze virtualized environments for performance optimization, security vulnerabilities, and resource utilization, fostering the ability to assess and enhance the efficiency of complex virtual systems and services.	C4(Analyze)

Course Outline:

Overview of virtualization technology and its application, Comparison of traditional and virtual systems, Overview of Intel x86 platform, Parallel and distributed systems, Types of virtualization, Virtualization at Software and Hardware level, Virtual Machines and configuration of VMs: Managing CPU, storage, networking etc. for VMs, Key features of VMs, Hypervisors and Configuration of Vmware, Hyper-V and Xen hypervisors, Types of hypervisors: Type-1 and Type-2 hypervisor, Features and limitations of hypervisors, Para-virtualization and Para-virtualized software components, Vmware ESXi, Xen and Microsoft virtualization implementation in the context of datacenters (lab sessions), Virtualization in Cloud Computing, Virtualization in IoT, Virtualization security: security at hypervisor level, VM security, Future of Virtualization, Semester project

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

1. Virtualization from Desktop to the Enterprise, Chris Wolf and Erick M. Halter, Latest Edition
2. The Definitive Guide to the Xen Hypervisor, David Chisnall, Latest Edition
3. Windows Server 2012 Hyper-V Installation and Configuration Guide, Aidan Finn, Michel Luescher, Patrick Lownds, 2013
4. Xen Hypervisor Case Study - Designing Embedded Virtualized Intel® Architecture Platforms
5. Handbook of Virtual Environments: Design, Implementation, and Applications (Human Factors and Ergonomics), Edited by Kay M Stanney, Lawrence Erlbaum Associates Virtual Reality Technology by GRIGORE

ITDE-6205 Ubiquitous, Pervasive, and Autonomic Computing

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

Course Introduction:

This course on Ubiquitous, Pervasive, and Autonomic Computing provides a profound exploration of pervasive technologies and autonomic systems. Delve into the principles shaping ubiquitous computing, understanding how pervasive technologies and autonomic computing contribute to seamless, adaptive, and intelligent computing environments.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand Ubiquitous, pervasive, and autonomic computing principles, discerning their applications and significance in modern computing landscapes.	C2(Understand)
CLO-2	Apply theoretical concepts to design and implement intelligent systems in various domains, showcasing proficiency in creating technology that seamlessly integrates into daily life.	C3(Apply)

Course Outline:

Introduction to Ubiquitous and Pervasive Computing, Pervasive Computing Technologies (Sensor Networks, IoT Devices), Autonomic Computing Principles (Self-Management, Self-Optimization), Ubiquitous Computing in Wearable Devices, Pervasive Computing in Smart Environments (Smart Homes, Cities), Autonomic Computing in Cloud Environments (Self-Healing, Fault Tolerance), Security and Privacy in Ubiquitous Systems, and Practical Applications and Case Studies. Integration of computing into everyday environments, adaptive and self-managing systems, Challenges and applications of ubiquitous and pervasive technologies.

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

1. Ubiquitous Computing: Smart Devices, Environments and Interactions" by Stefan Poslad.
2. Autonomic Computing: Concepts, Infrastructure, and Applications" by Manish Parashar and Salim Hariri.
3. Pervasive Computing: The Mobile World" by Uwe Hansmann et al.
4. Ubiquitous Computing Fundamentals" by John Krumm.

ITDE-6206 Fog Computing, Edge Computing, and Mobile Fog Computing

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

Course Introduction:

This course introduces Fog Computing, Edge Computing, and Mobile Fog Computing, providing a comprehensive exploration of distributed computing paradigms. Delve into the principles and applications of fog and edge computing, along with the unique challenges and opportunities presented by mobile fog computing in the evolving landscape of decentralized computing architectures.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	A deep understanding of Fog Computing, Edge Computing, and Mobile Fog Computing, discerning their architectures, applications, and integration strategies.	C2 (Understand)
CLO-2	Apply computing principles in real-world scenarios, optimizing resource utilization and enabling quick decision-making in decentralized environments.	C3 (Apply)
CLO-3	Analyzing real-world case studies and develop problem-solving skills through hands-on projects, addressing challenges in fog, edge, and mobile computing	C4 (Analyze)

Course Outline:

Introduction, Understanding Cloud, Edge, Fog, and Mobile Fog Computing, Evolution and Key Concepts, Use Cases and Industry Applications, Fundamentals of Fog Computing, Fog Computing Architecture, Edge Computing Basics, Distinctions Between Edge and Fog Computing, Edge Computing Architecture, Integration with Fog and Cloud Environments, Mobile Fog Computing Foundations, Integration of Mobile Devices into Fog and Edge Computing, Mobile Fog Computing Architecture, Challenges and Opportunities in Mobile Fog Computing, Resource Optimization Strategies in Fog, Edge and Mobile Fog computing, Real-Time Decision-Making, Real-time Data Processing Applications, Case Studies and Use Case Analysis, Addressing Security Challenges in Fog, Edge and Mobile Fog Computing, Privacy-Preserving Measures, Data Integrity and Confidentiality in Edge-Fog-Cloud and Edge-Fog-Cloud Interactions, Application of Fog, Edge and Mobile Computing Principles with development of Hands-On Projects, Group Assignments and Case Studies, Exploring Challenges and emerging Trends and Innovations in fog, edge and mobile fog computing.

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

1. Fog and Edge Computing: Principles and Paradigms" by Rajkumar Buyya and Satish Narayana Srirama.
2. Edge Computing: A Primer" by Hashim H. Abbasi.
3. Mobile Fog: A Tool for Data Collection" by Muhammad Waseem et al.
4. Fog Computing in the Internet of Things: Intelligence at the Edge" by Zaigham Mahmood. Modern Database Management by Jeffrey A. Hoffer, V. Ramesh, and Heikki Topi. Pearson; 12th Edition (2015). ISBN-10: 1292101857

ITDE-6207 Machine Learning in Fog/Edge	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

Course Introduction:

This course on Machine Learning in Fog-Edge Computing delves into advanced techniques, exploring the integration of machine learning algorithms in decentralized computing environments. Gain insights into optimizing data processing, enhancing decision-making, and addressing challenges unique to the intersection of machine learning and fog-edge computing paradigms.

CLO No.	Course Learning Outcomes	Bloom Taxonomy

CLO-1	Understand machine learning principles in fog-edge computing, recognizing the significance and challenges of decentralized environments.	C2 (Understand)
CLO-2	Apply machine learning algorithms at the edge and fog, optimizing models for resource efficiency in fog computing and real-time decision making	C3 (Apply)

Course Outline:

Key Machine Learning Concepts and Algorithms, Model Training and Evaluation, Applications in Decentralized Environments, Edge Computing and Machine Learning Integration, Challenges and Opportunities in Integrating Machine Learning Models, Real-world Use Cases and Success Stories, Fog Computing Architectures for Machine Learning, Integration of Machine Learning Models in Fog Environments, Real-time Decision-Making in Fog-Edge Environments through Machine Learning, Security Challenges in Machine Learning at the Edge and Fog, Implementing Privacy-Preserving Measures, Ensuring Data Integrity and Confidentiality, Applying Machine Learning in Fog-Edge, Real-world Case Studies and Implementation Challenges.

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

1. Fog and Edge Computing: Principles and Paradigms" by Rajkumar Buyya and Satish Narayana Srirama.
2. Edge Computing: A Primer" by Hashim H. Abbasi.
3. Mobile Fog: A Tool for Data Collection" by Muhammad Waseem et al.
4. Fog Computing in the Internet of Things: Intelligence at the Edge" by Zaigham Mahmood. Modern Database Management by Jeffrey A. Hoffer, V. Ramesh, and Heikki Topi. Pearson; 12th Edition (2015). ISBN-10: 1292101857

ITDE-6208 Application Development Using Microservices & Serverless	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

Course Introduction:

This course initiates Application Development Using Microservices & Serverless, offering insights into modular architecture and serverless computing. Explore advanced techniques in building scalable, resilient, and cloud-native applications through microservices and serverless technologies.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand microservices and serverless computing principles, discerning their benefits, challenges, and applications in contemporary software development.	C2 (Understand)
CLO-2	Apply microservices and serverless technologies in hands-on projects, showcasing the ability to design, deploy, and manage scalable and resilient applications.	C3 (Apply)
CLO-3	Analyze practical case studies to develop problem-solving skills through, addressing challenges related to scalability, resilience, and cost management in microservices and serverless environments.	C3 (Analyze)

Course Outline:

Microservices Architecture Principles, Serverless Computing Fundamentals, Microservices Development Lifecycle (design, development, testing, and deployment, with a focus on Continuous Integration and Continuous Deployment (CI/CD), Serverless Application Development (Frameworks, Tools, Event-Driven Architecture, Function-as-a-service (FaaS)), Scalability and Resilience in Microservices, Cost Management in Serverless Environments, Security Considerations in Microservices and Serverless, Practical Projects and Case Studies.

Reference Materials (or use any other standard and latest books):
1. Building Microservices, Sam Newman.
2. Serverless Architecture on AWS, Peter Sbarski.
3. Microservices Patterns, Chris Richardson.
4. Programming AWS Lambda, John Chapin.

ITDE-6209 Semantic Web

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

Course Introduction:

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)

Course Outline:

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)

Reference Materials (or use any other standard and latest books):
1. A Semantic Web Primer third edition Grigoris Antoniou, Paul Groth, Frank van Harmelen, Rinke Hoekstra ISBN:0262018284 9780262018289
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
3. Explorer's Guide to the Semantic Web by Thomas B. Passin

ITDE-6210 Digital Marketing and Ecommerce		
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (2-3) 2-3 None	

Course Introduction:

This course introduces Digital Marketing and E-commerce, offering insights into online strategies and tools for navigating the dynamic landscape of digital business. Explore effective approaches to enhance online presence, engage customers, and drive business growth in the digital realm.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand of digital marketing and e-commerce principles, frameworks, and best practices.	C2(Understand)
CLO-2	Apply theoretical concepts to real-world scenarios, demonstrating proficiency in executing effective digital marketing and e-commerce strategies.	C3(Apply)
CLO-3	Develop analytical skills to measure and optimize the performance of digital marketing and e-commerce initiatives, utilizing relevant metrics.	C4(Analyze)

Course Outline:

Introduction to fundamental concepts of digital marketing, digital marketing strategy and planning, emphasizing website design and user experience (UX). Search engine optimization (SEO), social media marketing, email campaigns, and pay-per-click (PPC) advertising. Introduction to e-commerce, including platform selection, operational considerations, and effective marketing strategies. Analytics and measurement techniques, legal and ethical considerations, and exploration of emerging trends, such as influencer marketing and augmented reality, round out the comprehensive curriculum.

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

1. Digital Marketing: Strategy, Implementation, and Practice" by Dave Chaffey and Fiona Ellis-Chadwick.
2. E-commerce Evolved: Essential Tactics to Grow Your Business" by Tanner Larsson.
3. Influence: The Psychology of Persuasion" by Robert B. Cialdini.
4. Epic Content Marketing" by Joe Pulizzi.

ITDE-6211 E-Commerce Application Development		
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (2-3) 2-3 	

Course Introduction:

This course in E-Commerce Application Development empowers students to create user-friendly online platforms, providing hands-on experience to bring digital storefront ideas to life.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand the concepts and standards related to the discipline	C2(Understand)

		of E-Commerce.	
CLO-2		Apply web development technologies to design and develop a responsive and dynamic interface for an E-Commerce application.	C3(Apply)
CLO-3		Analyze the security features of an E-Commerce application, evaluating the effectiveness of authentication and authorization mechanisms and proposing improvements.	C4(Analyze)

Course Outline:

An overview of e-Commerce, Brick 'N Mortar stores vs Service-based companies, e-Commerce Models, e-Commerce popular sites: iStockphoto, WooThemes, eBay, Amazon, Play.com, Planning an e-Commerce Framework: Designing a framework, Patterns, ModelView-Controller, Registry, Singleton, Structure, Building a framework, Routing requests, Products and Categories: Product information, Category information, Structuring Content, Versioning, Building products, categories, and content functionality, Routing products and categories, Product Variations and User Uploads: Giving users choice, Giving users control, Shopping, Enhancing the User Experience: The importance of user experience, Search, Providing wish lists, Making Recommendations, Stock Checking, Customer's Feed Back, Processing reviews/comments, The Shopping Basket: Creating A Basket, Basket Contents, Managing the Basket, Cleaning the Basket, The Checkout and Order Process: The Process, Authentication, Payment Method, Order Processed, Shipping and Tax: Shipping Methods, Shipping Costs, Shipping Rules, Tracking, Tax Calculation, Discounts, Vouchers, and Referrals: Discount codes, Purchasable Voucher Codes, Referrals, Checkout: Checkout process consideration, Order process review, Authentication & Confirmation, Taking Payment for Orders: Taking payment, Payment System, Payment gateway, Taking Payment Online, Taking payment offline, User Account Features: User Account Area, Changing Details, Viewing & Managing Orders, Administration: Dashboard, Managing Products and Categories, Managing Orders, Customers, Refunds, Voucher Codes, Shipping, Deploying, Security, and Maintenance, SEO.

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

1. PHP 5 E-commerce Development by Michael Peacock, Packt Publishing (January 20, 2010). ISBN-10: 184719964X[TB]
2. E-Commerce, Kenneth Laudon and Carol Guercio Traver, 13th Edition, Pearson, 2017.
3. PHP 5 E-commerce Development, Michael Peacock, Packt Publishing, 2010.
4. Introduction to E-Commerce, Jeffrey F. Rayport, McGraw-Hill, 2nd Edition, 2007.
5. Electronic Commerce, Gary Schneider, Course Technology; 12th Edition 2016

ITDE-6212 Enterprise Systems	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	None

Course Introduction:

This course on Enterprise Systems offers an in-depth exploration of strategic implementation and management, focusing on advanced business systems. Students will delve into the selection, implementation, and practical utilization of modern ERP systems for effective enterprise

solutions.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand Core concepts and components of enterprise systems, role of enterprise systems in optimizing organizational processes.	C2 (Understand)
CLO-2	Apply enterprise software applications to address real-world business challenges that enhance efficiency and effectiveness in organizational workflows.	C3 (Apply)
CLO-3	Analyze the effects of enterprise systems on business processes, data management, and overall organizational strategy.	C4 (Analyze)

Course Outline:

Introduction to Enterprise system management, Business Process Management and system integration, Architecture and Platform of Enterprise systems, Enterprise Systems and development lifecycle technology, Enterprise Systems and Business Process Re-engineering, implementation and strategies, Software and vendor selection, Operation and post-implementation, Program and project management, Global, Ethics and security management, Supply chain management, Customer Relationship management and its factor.

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

1. Enterprise Systems for Management, Published by PEARSON, Luvai F. Motiwalla and Jeff Thompson (latest edition)
2. Modern ERP: Select, Implement & Use Today's Advanced Business Systems by Marianne Bradford, lulu.com (latest edition).
3. Business Process Management: Concepts, Languages, Architectures by Mathias Weske, Springer; (latest edition)
4. Business Process Management Common Body Of Knowledge by Yvonne Lederer Antonucci, et. al., CreateSpace Independent Publishing Platform (latest edition)

ITDE-6213 Mobile and Wireless Networks	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	Computer Networks

Course Introduction:

This course provides an in-depth exploration of mobile and wireless networks, covering fundamental concepts, architectures, protocols, and practical applications. Students will gain a comprehensive understanding of the evolution of mobile technologies, wireless communication principles, and the challenges and opportunities in the field.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand Core concepts and components of mobile and wireless network, wireless communication principles, and architecture of cellular networks, including handover and roaming concepts.	C2 (Understand)

CLO-2	Apply wireless technologies by designing and implementing secure WLANs with IEEE 802.11 standards and addressing real-world challenges through the application of Mobile IP, IPv6, Bluetooth, Zigbee, and PAN technologies.	C3 (Apply)
CLO-3	Analyze networks by assessing the performance of transport layer protocols in wireless environments, scrutinizing Wireless Sensor Networks (WSNs), proposing energy-efficient protocols, and critically evaluating challenges for future optimization.	C4 (Analyze)

Course Outline:

Overview of Mobile and Wireless Networks, Wireless Communication Principles, Radio frequency spectrum, Modulation techniques, Signal propagation and channel capacity, Challenges in wireless communication, Mobile Network Architecture, Cellular Network Components, , Handover and Roaming Concepts, IEEE 802.11 Standards, Introduction to Wi-Fi, 802.11a/b/g/n/ac standards, WLAN Architecture and Components, Security in WLANs, Threats and vulnerabilities, Best practices for securing WLANs, Emerging security technologies in WLANs, Personal Area Networks (PANs), Bluetooth technology, Zigbee technology, Applications and scenarios for PANs, Week 7-8: Mobile Network Protocols, Mobile IP and IPv6, Mobile IP fundamentals, IPv6 and its role in mobile networks, Transport Layer Protocols in Mobile Networks, Transmission Control Protocol (TCP) in wireless environments, User Datagram Protocol (UDP) in mobile networks, Optimization techniques for mobile networks, Wireless Sensor Networks, Introduction to Wireless Sensor Networks (WSNs), Characteristics and applications of WSNs, Sensor node architecture and components, Security and Energy Efficiency in WSNs, Security challenges in WSNs, Energy-efficient communication protocols, Mobile Network Management and Optimization, Mobile Network Planning and Optimization, Coverage and capacity planning, Optimization techniques for mobile networks, Challenges and Future Trends in Mobile and Wireless Networks, Emerging technologies (e.g., 6G), Industry challenges and research directions, Real-world Examples of Successful Deployments.

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

1. Wireless Networking: Know It All By Praphul Chandra, Daniel M. Dobkin, Dan Bensky, Ron Olexa, David Lide, Farid Dowla: Publisher: Newnes
2. Wireless Communications & Networks (latest Edition) by William Stallings. ISBN: 0131918354. Revised in 2009.
3. Wireless Networks: Design and Integration for LTE, EVDO, HSPA and Wimax by Clint Smith 3rd edition (2014). ISBN-10: 0071819835

ITDE-6214 Network Design and Management	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

Course Introduction:

This course provides a comprehensive understanding of network architecture and management. Through a blend of theoretical foundations and practical applications, students enhance their skills in designing, securing, and optimizing computer networks, preparing them for real-world

challenges in the field.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand Network Design Principles by defining key concepts and elucidating the fundamental elements that contribute to an efficient, secure, and scalable network architecture.	C2 (Understand)
CLO-2	Apply Network Management Strategies by implementing practical approaches for optimal performance and leveraging network monitoring tools and protocols to address real-world challenges in network administration.	C3 (Apply)
CLO-3	Analyze and Evaluate Network Architectures by assessing the performance of diverse network structures, critically evaluating strengths and weaknesses in existing networks, and proposing improvements to enhance overall efficiency and security.	C4 (Analyze)

Course Outline:

Analyzing Business Goals and Constraints: Using a Top-Down Network Design Methodology, Analyzing Business Goals, Analyzing Business Constraints. Analyzing Technical Goals and Tradeoffs, Scalability, Availability, Network Performance, Security, Manageability, Usability, Adaptability, Affordability, Making Network Design Tradeoffs, Characterizing the Existing Internetwork: Characterizing the Network Infrastructure, Checking the Health of the Existing Internetwork. Characterizing Network Traffic: Characterizing Traffic Flow, Characterizing Traffic Load, Characterizing Traffic Behavior, Characterizing Quality of Service Requirements, Designing a Network Topology: Hierarchical Network Design, Redundant Network Design Topologies, Modular Network Design, Designing a Campus Network Design Topology, Virtual LANs, Wireless LANs, Redundancy and Load Sharing in Wired LANs, Server Redundancy, Workstation-to-Router Redundancy, Designing the Enterprise Edge Topology, Secure Network Design Topologies, Designing Models for Addressing and Numbering: Guidelines for Assigning Network Layer Addresses, Designing a Model for Naming. Selecting Switching and Routing Protocols: Making Decisions as Part of the Top Down Network Design Process, Selecting Switching Protocols, Selecting Routing Protocols, IP Routing, Developing Network Security Strategies: Network Security Design, Security Mechanisms, Modularizing Security Design, Developing Network Management Strategies: Network Management Design, Network Management Architectures, Selecting Network Management Tools and Protocols, Physical Network Design: Selecting Technologies and Devices for Campus Networks: LAN Cabling Plant Design, LAN Technologies, Selecting Internetworking Devices for a Campus Network Design, Example of a Campus Network Design, Selecting Technologies and Devices for Enterprise Networks: Remote-Access Technologies, Selecting Remote-Access Devices for an Enterprise, WAN Technologies, Example of a WAN Design, Testing Network Design: Using Industry Tests, Building and Testing, Prototype Network System, Writing and Implementing a Test Plan for Network Design, Tools for Testing a Network Design, Optimizing Network Design: Optimizing Bandwidth Usage with IP Multicast Technologies, Reducing Serialization Delay, Optimizing Network Performance to Meet Quality of Service Requirements, Cisco IOS Features for Optimizing Network Performance. Documenting Network Design: Responding to a Customer's Request for Proposal, Contents of a Network Design Document.

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

1. Top-Down Network Design by Priscilla Oppenheimer, Cisco Press; 3rd Edition (September 3, 2010). ISBN-10: 1587202832 (TB1)

2. Networking Systems Design and Development by Lee Chao, CRC Press; 1st Edition (December 21, 2009). ISBN-10: 142009159X (TB2)
3. Networks: Design and Management by Steven Karris, Orchard Publications (August 2002). ISBN-10: 0970951140
4. Network Design: Management and Technical Perspectives by Teresa C. Piliourasand KornelTerplan, CRC Press (August 19, 1998). ISBN-10: 0849334047

ITDE-6215 Routing and Switching	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	None

Course Introduction:

This course introduces the fundamentals of networking. The students will gain expertise in designing, configuring, and troubleshooting networks using routers and switches. They will acquire the skills essential for building robust and efficient communication infrastructures in the ever-evolving world of IT.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand the switching details and mechanism	C1 (Knowledge)
CLO-2	Understanding of the architecture and operating principle of router	C2 (Understand)
CLO-3	Operations of wireless LANs, WANs	C2 (Understand)
CLO-4	Solutions and effectiveness of routing protocols and configurations	C3 (Apply)

Course Outline:

Ethernet Basic: Ethernet Layer 1, Ethernet Layer 2, Switching and Bridging Logic, SPAN and RSPAN. Virtual LANs and VLAN Trunking: VLANs, VLAN Trunking Protocols, VLAN Trunking: ISL and 802.1Q, Configuring PPPoE. Spanning Tree Protocol: 802.1d Spanning Tree Protocol, Optimizing Spanning Tree, Protecting STP, Troubleshooting Complex Layer 2 Issues. IP Addressing: IP Addressing &Subnetting, CIDR, Private Addressing, and NAT. IP Services: ARP, Proxy ARP, Reverse ARP, BOOTP, and DGCP; HSRP, VRRP,and GLBP; Syslog, Web Cache Communication Protocol, Implementing and Using: IP-SLA, NetFlow, Router IP Traffic Export, FTP, Embedded Event Manager, Remote Monitoring, TFTP Server, Secure Copy Protocol, HTTP and HTTPs Access, Telnet Access, SSH Access. IP Forwarding (Routing): IP Forwarding, Muti-layer Switching, Policy Routing, Optimized Edge Routing and Performance Routing. EIGRP: Basic States, EIGRP Convergence, EIGRP Configuration. OSPF: OSPF Database Exchange, OSPF Design and LSAs, OSPF Configurations, Virtual Link Configuration, Configuring OSPF Authentication, OSPF Stub Router Configuration. IGP Routing: Routing Map, Prefix Lists, and Administrative Distance; Router Redistribution, Router Summarization, Default Routes, Troubleshooting Complex Layer 3 Is-sues. Fundamentals of BGP Operations: Building BGP Neighbor Relationships, Building the BGP Table, Building the IP Routing Table. BGP Routing Policies: Routing Filtering and Routers Summarization, BGP Path Attributes and the BGP Decision Processes, Configuring BGP Policies. Wide Area Network: Point-to-Point Protocol, Frame Relay Concepts, Frame Relay Configuration. IP Multicasting: Need of Multicasting, Multicasting IP Addresses, Managing Distribution of Multicast Traffic with

IGMP, LAN Multicast Optimizations. IP Multicast Routing: Basic, Dense-Mode Routing Protocols, LAN- Specific Issues with PIM-DM and PIM-SM, Sparse-Mode Routing Protocols.

Reference Materials (or use any other standard and latest books):
1. CCIE Routing and Switching Certification Guide (4th Edition) by Wendell Odom, Rus Healy and Denise Donohue, Cisco Press; 4th Edition
2. Packet Guide to Routing and Switching by Bruce Hartpence, O'Reilly Media (September 3, 2011). ISBN-10: 1449306551
3. CCIE Routing and Switching v4.0 Quick Reference by Brad Ellis, Jacob Uecker and Steven Means, Cisco Press (October 4, 2010). ASIN: B00452V45O

ITDE-6215 Web3 and Blockchain Fundamentals	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	None

Course Introduction:

This course introduces Web3 and Blockchain, offering a deep dive into decentralized technologies that redefine online interactions and secure data practices. Explore the foundations and applications of blockchain, gaining insights into the transformative potential of Web3 in shaping the future of digital ecosystems.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand blockchain fundamentals, including the technology's decentralized nature, cryptographic principles, and its transformative potential for various industries.	C2 (Understand)
CLO-2	Acquire hands-on experience in developing smart contracts, interacting with decentralized applications, and exploring real-world use cases of blockchain technology.	C3 (Apply)
CLO-3	Analyze the ethical, legal, and societal implications of Web3 and blockchain, contributing to informed decision-making in this evolving landscape.	C3 (Analyze)

Course Outline:

Introduction to Blockchain Technology, Cryptocurrencies and Tokenization, Decentralized Applications (Dapps), Smart Contracts Development, Web3 Architecture and its components, Decentralized Identity and Authentication, Blockchain Consensus Mechanisms, Decentralized Finance (DeFi), Interoperability and Standards, Privacy and Security in Web3, Web3 Use Cases and Applications, Future Trends and Developments.

Reference Materials (or use any other standard and latest books):
1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies" by Andreas M. Antonopoulos.
2. Blockchain Basics: A Non-Technical Introduction in 25 Steps" by Daniel Drescher.
3. Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World" by Don Tapscott and Alex Tapscott.
4. The Age of Cryptocurrency: How Bitcoin and Digital Money are Challenging the Global Economic Order" by Paul Vigna and Michael J. Casey.

ITDE-6216 Network Security

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	Introduction to Cyber Security

Course Introduction:

This module aims to develop core competencies in the fields of Network security and offer the opportunity of learning the current network security landscape, understanding current threats and vulnerabilities and examining ways of developing effective countermeasures. It also provides a brief overview to network forensics for analyzing network traffic for the purposes of information gathering, legal evidence, or intrusion detection.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	To be able to understand network security threats and methods for security networks	C2 (Understand)
CLO-2	To be able to secure wired networks by deploying various methods	C3 (Apply)
CLO-3	To be able to secure wireless networks by deploying various methods	C3 (Apply)

Course Outline:

An introduction to network security, Networking Concepts and Protocols, Network Threats and Vulnerabilities, Network Security Planning and Policy, Access Control, Defense against Network Attacks, DOS and DDOS detection and prevention, Firewalls, Intrusion Detection and Prevention Systems, Antivirus Filtering, Naming and DNS Security, DNSSEC, IP security, Secure Sockets Layer, VPN, Packet Sniffing and spoofing, Honeypot, Ethernet Security, Wireless Security, Wireless Attacks, Wireless LAN Security with 802.11i, Wireless Security Protocols, Wireless Intrusion Detection, Physical access and Security, Tor Network, Network Forensics. Defense against Network Attacks.

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

1. Network Security Assessment: Know Your Network by Chris McNab, 3rd Edition or latest.
2. Corporate Computer Security, by Randall J. Boyle, 3th Edition
3. Bulletproof Wireless Security by Praphul Chandra
4. Network Security Essentials: Applications and Standards by William Stallings, 3rd Edition or Latest
5. Cryptography and Network Security Principles and Practices by William Stallings, Latest Edition

ITDE-6217 Digital Forensics

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

Course Introduction:

This course is an introduction to computer forensics and investigation. It provides an understanding of how to conduct investigations to correctly gather, analyze and present digital evidence to different audiences. It also outlines the tools to locate and analyze digital evidence

on a variety of devices, how to keep up to date with changing technologies, and laws and regulations in digital forensics.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	To develop knowledge about forensic law, standards, regulations and ethical values	C2 (Understand)
CLO-2	To be able to conduct digital forensics for multiple platforms and applications by various tools	C3 (Apply)
CLO-3	To be able to generate reports based on digital forensic tools for security systems and platforms	C3 (Apply)

Course Outline:

An introduction to Digital Forensics; use of digital forensics; Key technical concepts; Challenges in Digital Forensics ; The Difference between Computer Experts and Digital Forensics Experts; Investigative Process Methodologies ; Education, Training, and Awareness; Laws, Standards, and Regulations; Ethics and Professional Conduct; Digital Evidence Management; Collecting evidence; Antiforensics; Network forensics; Mobile and Embedded Forensics; Cloud forensics; Internet Forensics; social media forensics; Investigation Methods for Collecting Digital Evidence; Digital Forensic Readiness; Digital forensics tools; Discovery of Computers and Storage Media; Discovery of Audio/ Video Evidence; Data Visualization; Data Sources; Graphing and Charting; Analyzing Data; Data Distributions; Analysis Scenarios; Data Visualization Tools.

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

1. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics by John Sammons, 2nd Edition or latest
2. Digital Forensics and Incident Response : Incident Response Techniques and Procedures to Respond to Modern Cyber Threats, 2nd Edition
3. Guide to Digital Forensics : A Concise and Practical Introduction by Joakim Kävrestad (latest edition)

ITDE-6218 UI / UX Designing

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	-

Course Introduction:

In this course, students will learn to craft seamless user experiences and visually stunning interfaces through hands-on projects, industry best practices, and design thinking principles. This will elevate their skills and embark on a journey to shape the future of digital interactions.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Create prototypes of mobile, tablet and web user experience designs based on industry user experience design principles.	C2 (Understand)
CLO-2	Critique existing user experience designs.	C3 (Apply)
CLO-3	Design effective and useable mobile, tablet and web applications.	C3 (Apply)
CLO-4	Use industry standard user experience design processes and tools for prototyping.	C4 (Analyze)

Course Outline:

Introduction to UI/UX Web Designing. Exploration of principles and practices essential for designing effective and user-centric web interfaces and learning key tools and software. The course covers user research, persona creation, and the importance of data-driven design decisions. Hands-on modules delve into wireframing, prototyping, and visual design principles, ensuring participants develop skills in creating aesthetically pleasing and functional websites. Responsive design concepts are emphasized for designing across various devices, and interaction design principles are explored to create engaging user experiences. Usability testing methodologies and collaboration with stakeholders, including developers, providing a holistic understanding of the design process. Then a final project, to apply knowledge to a real-world scenario.

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

1. Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability, Steve latest edition
2. The Design of Everyday Things, Don Norman, latestEdition
3. A Project Guide to UX Design: For User Experience Designers in the Field or in the Making, Russ Unger and Carolyn Chandle (latest edition)

CSDC-6202 Computer Architecture

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	Computer Organization & Assembly Language

Course Introduction:

This course delves into the fundamental principles and intricacies of computer architecture, offering a comprehensive understanding of system organization and design. Through theoretical exploration and practical application, students will explore the intricate interplay between hardware and software components in modern computing systems. Emphasizing foundational concepts and emerging trends, this course equips learners with the knowledge necessary to analyze, design, and optimize computer systems for diverse computational tasks.

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 (Solve)

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, Magnatic 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. Digital Design and Computer Architecture & Organization by David Harris and Sarah Harris, Morgan Kaufmann; 2ndEdition (August 7, 2012). ISBN-10: 0123944244
2. Essentials of Computer Organization and Architecture by Linda Null and Julia Lobur, Jones & Bartlett Learning; 3rdEdition (December 17, 2010)
3. Computer Architecture & Organization: A Quantitative Approach (Fifth Edition) by John L. Hennessy and David A. Patterson, Morgan Kaufmann; 5thEdition (September 30,2011). ISBN-10: 012383872X
4. Digital Design and Computer Architecture & Organization by D. M. Harris and S. L. Harris and Morgan Kaufmann, Morgan Kaufmann; 1stEdition (March 16, 2007). ISBN-10: 0123704979

CSDC-5101 Theory of Automata	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	-

Course Introduction:

This course helps the students delving into the theoretical foundations of computation and automata theory. It uncovers the principles behind formal languages, regular expressions, finite automata, and Turing machines, gaining insights into the theoretical underpinnings of computer science. They will immerse themselves in the study of computation, algorithms, and the abstract machinery that powers modern computing systems.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Fundamental concepts of automata theory and formal languages to form basic models of computation which provide foundation of many branches of computer science, e.g. compilers, software engineering, concurrent systems.	C1 (Knowledge)

Course Outline:

Introduction to Automata: The Methods and the Madness, Introduction to Formal Proof, Inductive Proofs, the Central Concepts of Automata Theory. Finite Automata: Introduction of Finite Automata, Deterministic Finite Automata, Nondeterministic Finite Automata, Finite Automata with Epsilon Transitions. Regular Expressions and Languages, Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions. Properties of Regular Languages, Proving Languages Not to Be Regular, Closure Properties of Regular Languages, Decision Properties of Regular Languages, Equivalence and Minimization of Automata. Context-Free Grammars and Languages: Context-Free Grammars, Parse Trees, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages. Pushdown Automata: Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDAs and CFGs, Deterministic Pushdown Automata. Properties of

Context-Free Languages: Normal Forms for Context-Free Grammars, The Pumping Lemma for Context-Free Languages, Closure Properties of Context-Free Languages, Decision Properties of CFLs. Introduction to Turing Machines: Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Restricted Turing Machines, Turing Machines and Computers. Un-decidability: A Language That Is Not Recursively Enumerable, Un-decidable Problem That Is RE, Un-decidable Problems About Turing Machines, Posts Correspondence Problem, Other Un-decidable Problems. Intractable Problems: The Classes P and NP, an NP-Complete Problem, A Restricted Satisfiability Problem.

Reference Materials (or use any other standard and latest books):
1. Introduction to Automata Theory, Languages, and Computation by J. Hopcroft, R. Motwani, and J. Ullman, 3rdEdition, 2006, Addison-Wesley.
2. An Introduction to Formal Language and Automata by Peter Linz, Jones & Bartlett Pub; 4th Edition (2006). ISBN-10: 0763737984
3. 3. Automata and Formal Languages: An Introduction by Dean Kelley, Prentice Hall (1995). ISBN-10: 0134977777

CSDC-6201 HCI & Computer Graphics	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	None

Course Introduction:
This course examines the dynamic intersection of Human-Computer Interaction (HCI) and Computer Graphics, probing the symbiotic relationship between user experience and graphical representation in digital interfaces. Exploring principles of visual communication, interaction design, and perceptual psychology, this course navigates the intricate landscape of designing compelling and intuitive user interfaces. Through theoretical discourse and practical exercises, students will gain insights into optimizing user engagement and usability in interactive systems through effective graphical representation and interaction paradigms.

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 for people from the perspective of age and disabilities.	C3 (Apply)
CLO-3	Analyze techniques for user-centered design for a medium sized software.	C2 (Understand)

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. Human-Computer Interaction by Alan Dix, Janet E. Finlay, Gregory D. Abowd, Russell Beale, Prentice Hall; 4th Edition (October 2012).
2. Designing the User Interface: Strategies for Effective Human-Computer Interaction, Ben Shneiderman and Catherine Plaisant, 6th Ed, Pearson Inc, 2016.
3. Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design, Benyon, D. 3rd Ed., Pearson. 2013
4. About Face: The Essentials of Interaction Design, Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, 4th Ed, Wiley, 2014

CSDE-6202 Mobile Application Development I

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	-

Course Introduction:

Mobile Application Development I equips learners with fundamental skills to create responsive and feature-rich mobile applications. Explore key concepts in UI/UX design, programming, and mobile platforms, fostering proficiency in app development. Gain hands-on experience to launch their journey into the dynamic realm of mobile application creation.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Discuss different architectures & framework for Mobile Application development.	C1 (Knowledge)
CLO-2	Develop mobile applications using current software development environments.	C3 (Apply)

CLO-3	Compare the different performance tradeoffs in mobile application development.	C3 (Apply)

Course Outline:

What is Android? Obtaining the Required Tools, Installing and Configuring the Android SDK Manager, Creating Your First Android Application, Anatomy of an Android Application. The Big Picture, How to Get Started, Your First Android Project, A bit About Eclipse, Enhancing Your First Project. Understanding Activities, Linking Activities Using Intents, Fragments, Calling Built-In Applications Using Intents, Displaying Notifications. Understanding the Components of a Screen, Adapting to Display Orientation, Managing Changes to Screen Orientation, Utilizing the Action Bar, Creating the User Interface Programmatically, and Listening for UI Notifications. Using Basic Views, Using Picker Views, Using List View to Display Long Lists, Understanding Specialized Fragments. Using Image Views to Display Pictures, Using Menus with Views, Analog Clock and Digital Clock Views. Saving and Loading User Preferences, Persisting Data to Files, Creating and Using Databases. Sharing Data in Android, using a Content Provider, Creating Your Own Content Providers, Using the Content Provider. Sending SMS Messages Programmatically, Getting Feedback after Sending a Message, Sending SMS Messages Using Intent, Receiving SMS Messages, Sending E-mail. Displaying Maps, Getting Location Data, Monitoring a Location, Building a Location Tracker. Consuming Web Services Using HTTP, Accessing Web Services Using the Get Method, Consuming JSON Services, Sockets Programming. Creating Your Own Services, Establishing Communication between a Service and an Activity, Binding Activities to Services, Understanding Threading. Android games Development, Publishing Android Applications. Handling Telephone Calls, Fonts.

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

1. "Android Programming: The Big Nerd Ranch Guide" by Bill Phillips and Chris Stewart - A comprehensive guide for Android app development with hands-on examples and practical insights.
2. Professional Android application development, Reto Meier, Wrox Programmer to Programmer, 2015.
3. React Native in Action by Nader Dabit - A valuable resource for those interested in cross-platform mobile app development using React Native, offering practical guidance and examples.
4. Flutter in Action by Eric Windmill - A comprehensive book for learning Flutter, Google's UI toolkit for building natively compiled applications for mobile, web, and desktop.
5. Android Programming: The Big Nerd Ranch Guides, Phillips, B. & Hardy, B., 2nd Edition, 2014.

CSDE-6205 Web Engineering

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

Course Introduction:

In this course students will dive into the world of "Web Engineering," where creativity meets technology in crafting dynamic and responsive web solutions. This course will guide them through the intricacies of designing, developing, and deploying websites, covering essential

technologies, frameworks, and best practices. They will learn the art of building robust and user-friendly web applications for the modern digital landscape.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Discuss how web standards impact software development.	C1 (Remember)
CLO-2	Describe the constraints that the web puts on developers.	C2 (Understand)
CLO-3	Design and Implement a simple web application.	C3 (Apply)
CLO-4	Review an existing web application against a current web standard.	43 (Analyze)

Course Outline:

Web programming languages (e.g., HTML5, CSS 3, Java Script, PHP/JSP/ASP.Net). Design principles of Web based applications, Web platform constraints, Software as a Service (SaaS). Web standards, Responsive Web Design, Web Applications, Browser/Server Communication, Storage Tier. Cookies and Sessions, Input Validation. Full stack state management. Web App Security - Browser Isolation, Network Attacks, Session Attacks, Large scale applications. Performance of Web Applications. Data Centers, Web Testing and Web Maintenance.

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

1. Web Engineering, Rajiv Chopra, Prentice-Hall of India, 2016
2. Web Engineering, Emilia Mendes and Nile Mosley, Springer Verlag, 2010.
3. Web Engineering: A Practitioners' Approach, Roger S. Pressman, McGraw Hill, 2008.
4. Dynamic HTML: The Definitive Reference: A Comprehensive Resource for XHTML, CSS, DOM, JavaScript 3rd Edition, O'Reilly Media 2007.
5. JavaScript: The Definitive Guide, 8th Edition, David Flanagan. O'Reilly Media. 2014.

SEDC-6202 Software Project Management

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	-

Course Introduction:

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.

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	C3 (Apply)

		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.	
CLO-4		Present strategies for gaining confidence in managing projects through simple project planning examples.	C3 (Apply)

Course Outline:

Introduction: Software Project Versus Other Type of Projects Dimensions of a Software Project, Activities in SPM, Setting Goals & 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 & Product Activities, Work Break Down Structure. Project Evaluation: Strategic Assessment, Technical Assessment, Economic Assessment, Project Portfolio Management, Cost-Benefit Analysis, Cash Flow Forecasting, 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 (2009). ISBN-10: 0077122798
2. A Guide to the Project Management Body of Knowledge, 3rdEdition (PMBOK Guides), ISBN-13: 978-1930699458
3. Applied Software Project Management by Andrew Stellman and Jennifer Greene, O'Reilly Media; 1st Edition (2005). ISBN-10: 0596009488

4. Software Project Survival Guide (Pro -- Best Practices) by Steve McConnell, Microsoft Press; 1stEdition (1997), ISBN-10: 1572316217
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; 6th Edition (2011). ISBN-10: 111801619X
7. The Software Project Manager's Handbook - Principles that work at work by Dwayne Phillips, 2ndEdition, IEEE Computer Society Press and Wiley Inter-science, 2004. ISBN 0-471-67420-6

SEDC-6204 Software Requirement Engineering

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	-

Course Introduction:

This course delves into the critical discipline of Software Requirements Engineering, which serves as the cornerstone of successful software development projects. By elucidating methodologies for eliciting, analyzing, and managing software requirements, this course equips students with the necessary tools to bridge the communication gap between stakeholders and developers. Through theoretical exploration and practical case studies, participants will master techniques for specifying, validating, and evolving requirements to ensure the delivery of software systems that meet user needs and expectations.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	To understand Issues in Requirements Engineering, to understand and apply Requirements Engineering Process,	C2 (Understand)
CLO-2	To understand and use Requirements Elicitation and Specification,	C2 (Understand)
CLO-3	To understand and use Formal Techniques,	C2 (Understand)
CLO-4	To understand modeling and analysis of Non-Functional Requirements.	C2 (Understand)
CLO-5	Manage and control changes in Requirement	C2 (Understand)

Course Outline:

Requirements Engineering (RE): Essential Software Requirement, Bad Requirements, Characteristics and Benefits Requirement Engineering, Requirements from the Customer's Perspective. RE Processes: Requirements Elicitation, Requirements Analysis, Requirements Specification, Requirements Validation, Requirements Management, and Requirements Development Process. The Requirements Analyst Role, Tasks, Essential Skills & Knowledge, Defining the Vision through Business Requirements, Vision and Scope Document. Dealing with Customers: Elicitation Techniques, Interviews, Surveys, Workshops, Classifying Customer Input, Incomplete Requirements (Finding Missing Requirements). Prototype Categories (Throwaway, evolutionary, paper and electronic), evaluation, Risks, Validating the Requirements: Requirements Review and Inspection, Requirements Review Challenges, Acceptance Criteria. Documenting the Requirements: The Software Requirements Specification, Labelling, Dealing with Incompleteness, User Interfaces and the SRS, A Software Requirements

Specification Template, The Data Dictionary. Non Functional Requirements: Software Quality Attributes: Defining, Performance Requirements, Defining Non-functional Requirements Using Planguage, Attribute Tradeoffs, Implementing Non-functional Requirements. Setting Requirements Priorities: Why Prioritize Requirements? Play with Priorities, A Prioritization Scale, Prioritizing Based on Value, Cost, and Risk. Special Requirements Challenges: Requirements for Maintenance Projects, Begin Capturing Information, New Requirements Techniques, Follow the Traceability Chain, Consider Business Rules, Requirements for Outsourced Projects, Requirements for Emergent Projects. Requirements Development Plans, Estimation, Scheduling, From Requirements to Designs, Code, Tests and Success. Requirements Management Principles and Practices, Baseline, Procedures, Requirements Version Control, Tracking Requirements Status. Requirements Creeping, Managing Scope Creep, The Change Control Process, The Change Control Board, Change-Control Tools, Measuring Change Activity, Impact Analysis. Tracing Requirements introduction, The Requirements Traceability Matrix, Tools for Requirements Traceability, Requirements Traceability Procedure, Is Requirements Traceability Feasible? Tools for Requirements Management: Benefits and Capabilities of tool for Requirements Management, Requirements Management Automation, selecting a Tool, Changing the Culture. Software Requirements Risk Management: Fundamentals, Elements, Documenting Project Risks, Planning for Risk Management, Requirements-Related Risks

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

1. Software Requirements 2 by Karl Wiegers, 2nd Edition (2003). Microsoft Press; ISBN-10: 0735618798
2. Requirements Engineering: Processes and Techniques, Kotonya and Sommerville, John Wiley Sons, 1998. ISBN-10: 0471972088
3. Software Requirements Engineering, 2nd Edition by Richard H. Thayer and Merlin Dorfman, Wiley-IEEE Computer Society Pr; 2nd Edition (1997). ISBN-10: 0818677384
4. Requirements Engineering: From System Goals to UML Models to Software Specifications by A. van Lamsweerde, Wiley; 1st Edition (2009). ISBN-10: 0470012706.
5. Requirements Engineering: Fundamentals, Principles, and Techniques by Klaus Pohl, Springer; 1st Edition (July 23, 2010). ISBN-10: 3642125778
6. Requirements Engineering by Hull, Jackson, and Dick, Springer; 3rd Edition (October 11, 2010). ISBN-10: 1849964041

DSDC-5201 Introduction to Data Science	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

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.
7. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil and Rachel Schutt, O'Reilly. 2014.
8. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education Services, John Wiley & Sons, 2015.

DSDC-6201 Data Mining	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

Course Introduction:

The Data Mining has emerged at the confluence of artificial intelligence, statistics, and databases as a technique for automatically discovering hidden patterns in large datasets. The main purpose of this course is the ability to analyze and construct knowledge from data.

The aims of this course are to:
- Expand on the student's understanding and awareness of the concepts of data mining basics, techniques, and application.
- Introduce the concepts of *Data Pre-processing and Summary Statistics.*
- Introduce the concepts of *Frequent Item Set Generation, Associations and Correlations measures.*

	Introduce the concepts of *Classification, Prediction, and Clustering algorithms*. Build on the programming and problem-solving skills developed in previous subjects studied by the student, to achieve an understanding of the development of Classification, Prediction, and Clustering applications..	
CLO No.	**Course Learning Outcomes**	**Bloom Taxonomy**
CLO-1	Apply preprocessing techniques on any given raw data.	C3 (Apply)
CLO-2	Select and apply proper data mining algorithm to discover interesting patterns	C3 (Apply)
CLO-3	Analyze and extract patterns to solve problems and point out how to deploy solution	C4 (Analyze)
CLO-4	Evaluate systematically supervised, semi supervised and unsupervised models and algorithms with respect to their accuracy	C4 (Analyze)

Course Outline:

Introduction to data mining and basic concepts, Pre-Processing Techniques & Summary Statistics, Association Rule mining using Apriori Algorithm and Frequent Pattern Trees, Introduction to Classification Types, Supervised Classification (Decision trees, Naïve Bae Classification, K-Nearest Neighbors, Support Vector Machines etc.), Unsupervised Classification (K Means, K Median, Hieratical and Divisive Clustering, Kohonan Self Organizing maps), outlier & anomaly detection, Web and Social Network Mining, Data Mining Trends and Research Frontiers. Implementing concepts using Python

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

1. Jiawei Han & Micheline Kamber, Jian Pei (2011). Data Mining: Concepts and Techniques, 3rd Edition.
2. Pang-Ning Tan, Michael Steinbach, and Vipin Kumar (2005). Introduction to Data Mining.
3. Charu C. Aggarwal (2015). Data Mining: The Textbook
4. D. Hand, H. Mannila, P. Smyth (2001). Principles of Data Mining. MIT Press.

DSDC- 6203 Data Warehousing & Business Intelligence	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (2-3) 2-3

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

DSDE-6201 Big Data Analytics	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

Course Introduction:

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)

Course Outline:

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

Reference Materials (or use any other standard and latest books):
1. White, Tom. "Hadoop: The definitive guide." O'Reilly Media, Inc., 2012.
2. Karau, Holden, Andy Konwinski, Patrick Wendell, and Matei Zaharia. "Learning spark: lightning-fast big data analysis." O'Reilly Media, Inc., 2015.
3. Miner, Donald, and Adam Shook. "MapReduce design patterns: building effective algorithms and analytics for Hadoop and other systems." O'Reilly Media, Inc., 2012.

AIDC-5201 Programming for Artificial Intelligence

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	-

Course Introduction:

This course aims to introduce standard programming practices and to help develop programming skills necessary for designing and implementing Artificial Intelligence systems. The course introduces classical as well as modern state of the art programming language for Artificial Intelligence (Lisp, Prolog, Python, and R), and builds up the necessary programming background for the main courses like Machine Learning, Artificial Neural Networks & Deep Learning, Natural Language Processing, and Speech Processing. This course will help the students of Artificial Intelligence develop the programming acumen and style. The ultimate aim of this course is to help students in using the AI programming languages to solve problems of interest to them.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand the fundamental constructs of Lisp, Prolog, and Python programming languages.	C2 (Understand)
CLO-2	Comprehend the fundamental constructs of programming languages for data analysis and representation.	C2 (Understand)
CLO-3	Understand and apply the Object-oriented concepts in the programming languages.	C2 (Understand)
CLO-4	Apply various libraries for plotting, interpreting and analyzing data in Python.	C3 (Apply)

Course Outline:

The first objective of the course is to introduce and then build the proficiency of students in different AI programming languages. The basics include IDE for the languages, variables, expressions, operands and operators, loops, control structures, debugging, error messages, functions, strings, lists, object-oriented constructs and basic graphics in the languages. Special emphasis is given to writing production quality clean code in the programming language. Once the classical programming languages are properly introduced, the course should introduce some libraries necessary for interpreting, analyzing and plotting numerical data in Python (e.g., NumPy, MatPlotLib, Anaconda and Pandas for Python) and give examples of each library using simple use cases and small case studies.

Reference Materials (or use any other standard and latest books):
1. Russell, S. and Norvig, P. "Artificial Intelligence. A Modern Approach", 3rd ed, Prentice Hall, Inc., 2015.

2. Norvig, P., "Paradigms of Artificial Intelligence Programming: Case studies in Common Lisp", Morgan Kaufman Publishers, Inc., 1992.
3. Luger, G.F. and Stubblefield, W.A., "AI algorithms, data structures, and idioms in Prolog, Lisp, and Java", Pearson Addison-Wesley. 2009.
4. Severance, C.R., 2016. "Python for everybody: Exploring data using Python 3." CreateSpace Independent Publ Platform.
5. Miller, B.N., Ranum, D.L. and Anderson, J., 2019. "Python programming in context." Jones & Bartlett Pub.
6. McKinney, W., 2012. "Python for data analysis: Data wrangling with Pandas, NumPy, and IPython." O'Reilly Media, Inc.
7. Reference Book:
8. Joshi, P., 2017. "Artificial intelligence with python." Packt Publishing Ltd.
9. Janert, P.K., 2010. "Data analysis with open source tools: a hands-on guide for programmers and data scientists." O'Reilly Media, Inc.

DSDE-6202 Advanced Database Management System	

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	Database Systems

Course Introduction:

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.

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)

Course Outline:

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)

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

1. Database Systems: A Practical Approach to Design, Implementation, and Management, 6th Edition by Thomas Connolly and Carolyn Begg
2. Database Management Systems, 3rd Edition by Raghu Ramakrishnan, Johannes Gehrke

3. Database System Concepts, 6th Edition by Avi Silberschatz, Henry F. Korth and S. Sudarshan.
4. Database Systems: The Complete Book, 2nd Edition by Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom

AIDC-5202 Machine Learning	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (2-3) 2-3

Course Introduction:

Machine learning is one of the fastest growing areas of computer science, with far-reaching applications. The aim of this course is to: a) Present the basic machine learning concepts; b) Present a range of machine learning algorithms along with their strengths and weaknesses; c) Apply machine learning algorithms to solve problems of moderate complexity.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Describe basic machine learning concepts, theories and applications.	C1 (Knowledge)
CLO-2	Apply supervised learning techniques to solve classification problems of moderate complexity.	C3 (Apply)
CLO-3	Apply unsupervised learning techniques to solve clustering problems of moderate complexity	C3 (Apply)
CLO-4	Apply reinforcement learning algorithms to environments with complex dynamics.	C3 (Apply)
CLO-5	Develop a reasonable size project using suitable machine learning technique	C6 (Create)

Course Outline:

Introduction to machine learning; concept learning: General-to-specific ordering of hypotheses, Version spaces Algorithm, Candidate elimination algorithm; Supervised Learning: decision trees, Naive Bayes, Artificial Neural Networks, Support Vector Machines, Overfitting, noisy data, and pruning, Measuring Classifier Accuracy; Linear and Logistic regression; Unsupervised Learning: Hierarchical Aglomerative Clustering. k-means partitional clustering; Self-Organizing Maps (SOM) k-Nearest-neighbor algorithm; Semisupervised learning with EM using labeled and unlabled data; Reinforcement Learning: Hidden Markov models, Monte Carlo inference Exploration vs. Exploitation Trade-off, Markov Decision Processes; Ensemble Learning: Using committees of multiple hypotheses. Bagging, boosting.

Reference Materials (or use any other standard and latest books):
1. Machine Learning, Tom, M., McGraw Hill, 1997.
2. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press,2012

AIDC-6201 Computer Vision	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (2-3) 2-3

Course Introduction:

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.

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)

Course Outline:

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)

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

Text Book:
1. Computer Vision: Algorithms and Applications, by Richard Szeliski.
Reference Book:
3. Multiple View Geometry in Computer Vision, by Richard Hartley and Andrew Zisserman.
4. Computer Vision: A Modern Approach, by David Forsyth and Jean Ponce.
5. Digital Image Processing, by Rafael Gonzalez and Richard Woods.

AIDE-6202 Advanced Statistics	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (3-0) 3-0 Probability and Statistics

Course Introduction:

Statistical methods are used for analysis of different datasets for forecasting the values, predicting the unknowns, relating the variables for getting deeper insights and relating data differences with real world complexities. Data Science extracts knowledge from data on the basis of hidden patterns which can be made explicit by incorporating the statistical algorithms in it. This course is designed to prepare students on statistical techniques with a purview of artificial intelligence and data science.

CLO No.	Course Learning Outcomes	Bloom Taxonomy

CLO-1	Describe what part of statistics is meant for data scientist and what the applications of statistics in data science are.	C1 (Understand)
CLO-2	Apply Statistical techniques in real life problems.	C3 (Apply)
CLO-3	Analyze, Correlate, Forecast data by using different statistical techniques	C2 (Understand)
CLO-4	Apply basic data science statistical techniques by using SPSS on real world datasets.	C3 (Apply)

Course Outline:

Introduction to Statistics, Use of Statistics in Data Science, Experimental Design, Statistical Techniques for Forecasting, Interpolation/ Extrapolation, Introduction to Probability, Conditional Probability, Prior and Posterior Probability, Random number generation (RNG), Techniques for RNG, Correlation analysis, Chi Square Dependency tests, Diversity Index, Data Distributions Multivariate Distributions, Error estimation, Confidence Intervals, Linear transformations, Gradient Descent and Coordinate Descent, Likelihood inference, Revision of linear regression and likelihood inference, Fitting algorithms for nonlinear models and related diagnostics, Generalized linear model; exponential families; variance and link functions, Proportion and binary responses; logistic regression, Count data and Poisson responses; log-linear models, Overdispersion and quasi-likelihood; estimating functions, Mixed models, random effects, generalized additive models and penalized regression; Introduction to SPSS, Probability/ Correlation analysis/ Dependency tests/ Regression in SPSS.

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

1. Probability and Statistics for Computer Scientists, 2nd Edition, Michael Baron.
2. Probability for Computer Scientists, online Edition, David Forsyth
3. Discovering Statistics using SPSS for Windows, Andy Field

AIDE-5201 Natural Language Processing

Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	

Course Introduction:

Natural Language Processing (NLP) is the application of computational techniques to the analysis and synthesis of natural language and speech. This course is an introduction to NLP with prior programming experience in Python.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand techniques for information retrieval, language translation, and text classification.	C2 (Understand)
CLO-2	Understand the advantages of using standard corpora. Identify examples of current corpora for a variety of NLP tasks.	C2 (Understand)
CLO-3	Understand and contrast deterministic and stochastic grammars, providing examples to show the adequacy of each	C2 (Understand)
CLO-4	Solve classic and stochastic algorithms for parsing natural language.	C3 (Apply)

Course Outline:

Introduction & History of NLP, Parsing algorithms, Basic Text Processing, Minimum Edit Distance, Language Modeling, Spelling Correction, Text Classification, Deterministic and stochastic grammars, CFGs, Representing meaning /Semantics, Semantic roles, Semantics and Vector models, Sentiment Analysis, Temporal representations, Corpus-based methods, N-grams and HMMs, Smoothing and backoff, POS tagging and morphology, Information retrieval, Vector space model, Precision and recall, Information extraction, Relation Extraction (dependency, constituency grammar), Language translation, Text classification, categorization, Bag of words model, Question and Answering, Text Summarization.

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

1. Daniel Jurafsky and James H. Martin. 2018. Speech and Language Processing: An Introduction to Natural Language Processing. Third Edition. Prentice Hall
2. Foundations of Statistical Natural Language Processing, Manning and Schütze, MIT Press. Cambridge, MA: May 1999

AIDE-6203 Reinforcement Learning

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

Course Introduction:

This course helps to understand how algorithms learn to make decisions by interacting with their environment. It also explores the foundations of machine learning, focusing on how agents learn through trial and error, adapting strategies to maximize rewards. It unravels the principles behind intelligent decision-making systems in this dynamic and evolving field.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Students will be able to recall and explain the fundamental concepts of reinforcement learning, including key terminologies, algorithms, and theoretical principles.	C1 (Remember)
CLO-2	Students will learn about several algorithms that can learn near optimal policies based on trial and error interaction with the environment---learning from the agent's own experience.	C2 (Understand)
CLO-3	Through hands-on exercises and simulations, students will demonstrate the application of reinforcement learning algorithms in solving complex problems, showcasing the ability to implement and adapt these techniques in various scenarios.	C3 (Apply)

Course Outline:

Intro to Course. The K-Armed Bandit Problem, Markov Decision Processes, Value Functions & Bellman Equations, Dynamic Programming, Sample Based Learning Methods. Monte Carlo Methods for Prediction & Control, Temporal Difference Learning Methods for Prediction, Temporal Difference Learning Methods for Control, Planning, Learning, & Acting, Prediction and Control with Function Approximation, On-policy Prediction with Approximation. Policy Gradient. Introduction to Deep Reinforcement Learning.

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

1. Sutton, Richard S., and Andrew G. Barto. Reinforcement learning: An introduction. MIT press, 2018.

2. Link: https://www.coursera.org/specializations/reinforcement-learning.

Preliminary Courses for Pre-Medical Students

URCM-5107 Mathematics I	
Credit Hours: **Contact Hours:** **Pre-requisites:**	Non-Credit Hour 3 None
Course Content:	
The goal of Mathematics I is to prepare students for first-year Calculus. Helping students gain proficiency in their understanding and ability to utilize real-valued functions, the primary tool in Calculus, accomplishes this goal. Students are presented a broad set of 'function tools', including a general understanding of function properties together with a 'library' of commonly used functions. It is intended that students become skilled at recognizing the different families of functions and the primary properties that set each apart, are able to apply the general function properties to each type of function, and are able to use the special set of algebraic skills associated with each. Students are also expected to become adept in utilizing and interpreting the results from graphing calculators, as an important investigative tool.	
Reference Materials:	
1. Thomas, G. B., & Finney, A. R. *(2005)*. *Calculus*. Reading: Addison-Wesley. 2. Anton, H., Bevens. I., & Davis, S. (2005). *Calculus: A new horizon* (8th ed.). New York: John Wiley. 3. Stewart, J. (1995). *Calculus* (3rd ed.). Pacific Grove, California: Brooks/Cole. 4. Swokowski, E. W. (1983). *Calculus and analytic geometry*. Boston: PWS-Kent Company. 5. Thomas, G. B., & Finney, A. R. (2005). *Calculus* (11th ed.). Reading: Addison-Wesley.	

URCM-5108 Mathematics II	
Credit Hours: **Contact Hours:** **Pre-requisites:**	Non-Credit Hour 3 None
Course Content:	
Calculus is the mathematical study of continuous change. It has two major branches, differential calculus and integral calculus. Both branches make use of the fundamental notions of convergence of infinite sequences and infinite series to a well-defined limit. Modern calculus is considered to have been developed in 17th century. A course in calculus is a gateway to other, more advanced courses in mathematics devoted to the study of functions and limits, broadly called mathematical analysis. Calculus is used in every branch of the physical sciences, actuarial science, computer science, medicine, demography, and in other fields. It allows one to go from rates of change to the total change or vice versa, and many times in studying a problem we know one and are trying to find the other. This course aims to provide students with the essential concepts of mathematics and how these can be employed for analyzing real data.	
Reference Materials:	
1. Thomas, G. B., & Finney, A. R. *(2005)*. *Calculus*. Reading: Addison-Wesley. 2. Anton, H., Bevens. I., & Davis, S. (2005). *Calculus: A new horizon* (8th ed.). New York: John Wiley.	

3. Stewart, J. (1995). *Calculus* (3rd ed.). Pacific Grove, California: Brooks/Cole.
4. Swokowski, E. W. (1983). *Calculus and analytic geometry*. Boston: PWS-Kent Company.
5. Thomas, G. B., & Finney, A. R. (2005). *Calculus* (11th ed.), Reading: Addison-Wesley.

Mathematics & Supporting Courses

MATH-5101 Multivariable Calculus	
Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	Calculus and Analytical Geometry

Course Introduction:

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Develop the skills to have ground knowledge of multivariate calculus and appreciation for their further computer science courses.	C2 (Understand)

Course Outline:

Multivariable Functions and Partial Derivatives: Functions of Several Variables. Limits and Continuity. Partial Derivatives. Differentiability, Linearization, and Differentials. The Chain Rule. Partial Derivatives with Constrained Variables. Directional Derivatives, Gradient Vectors, and Tangent Planes. Extreme Values and Saddle Points. Lagrange Multipliers. Taylor's Formula. Multiple Integrals: Double Integrals. Areas, Moments, and Centers of Mass. Double Integrals in Polar Form. Triple Integrals in Rectangular Coordinates. Masses and Moments in Three Dimensions. Triple Integrals in Cylindrical and Spherical Coordinates. Substitutions in Multiple Integrals. Laplace Transforms: Laplace Transform. Inverse Transform. Linearity. First Shifting Theorem (s-Shifting). Transforms of Derivatives and Integrals. ODEs. Unit Step Function (Heaviside Function). Second Shifting Theorem (t-Shifting). Short Impulses. Dirac's Delta Function. Partial Fractions. Convolution. Integral Equations. Differentiation and Integration of Transform. Systems of ODEs. Laplace Transform: General Formulas. Table of Laplace Transforms. Fourier Analysis: Fourier Series, Arbitrary Period. Even and Odd Function. Half-Rang Expansions. Forced Oscillations. Approximation by Trigonometric Polynomials. SturmLiouville Problems. Orthogonal Functions. Orthogonal Series. Generalized Fourier Series. Fourier Integral. Fourier Cosine and Sine Transforms. Fourier Transform. Power Series, Taylor Series: Sequences, Series, Convergence Tests. Power Series. Functions Given by Power Series. Taylor and Maclaurin Series. Laurent Series. Residue Integration: Laurent Series. Singularities and Zeros. Infinity. Residue Integration Method. Residue Integration of Real Integrals.

Reference Materials (or use any other standard and latest books):
1. Calculus & Analytic Geometry by Thomas, Wiley; 10th Edition (August 16, 2011). ISBN-10: 0470458364
2. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley; 10th Edition (August 16, 2011). ISBN-10: 0470458364
3. Multivariable Calculus by James Stewart, Brooks Cole; 7th Edition (January 1, 2011). ISBN-10: 0538497874

4. Multivariable Calculus by James Stewart 6th Edition, 2007, Cengage Learning publishers.
5. Calculus and Analytical Geometry by Swokowski, Olinick and Pence, 6th Edition, 1994, Thomson Learning EMEA, Ltd.
6. Elementary Multivariable Calculus by Bernard Kolman William F. Trench, 1971, Academic Press.
7. Multivariable Calculus by Howard Anton, Albert Herr 5th Edition, 1995, John Wiley

MATH-5102 Linear Algebra

Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	Calculus and Analytical Geometry

Course Introduction:

To provide fundamentals of solution for system of linear equations, operations on system of equations, matrix properties, solutions and study of their properties.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Develops students fundamental skills of solving ordinary differential equations, and developing differential equations for real-world problems	C2(Understand)

Course Outline:

Algebra of linear transformations and matrices. determinants, rank, systems of equations, vector spaces, orthogonal transformations, linear dependence, linear Independence and bases, eigenvalues and eigenvectors, characteristic equations, Inner product space and quadratic forms.

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

1. Introduction to Linear Algebra by Gilbert Strang, Wellesley Cambridge Press; latest Edition
2. Elementary Linear Algebra with Applications by Bernard Kolman, David Hill, latest Edition, Prentice Hall.

MATH-5103 Probability and Statistics

Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	None

Course Introduction:

To provide fundamentals of solution for system of linear equations, operations on system of equations, matrix properties, solutions and study of their properties.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Develops students fundamental skills of solving ordinary differential equations, and developing differential equations for real-world problems	C2(Understand)

Course Outline:

Introduction to Statistics and Data Analysis, Statistical Inference, Samples, Populations, and the Role of Probability. Sampling Procedures. Discrete and Continuous Data. Statistical Modeling. Types of Statistical Studies. Probability: Sample Space, Events, Counting Sample Points, Probability of an Event, Additive Rules, Conditional Probability, Independence, and the Product Rule, Bayes' Rule. Random Variables and Probability Distributions. Mathematical Expectation: Mean of a Random Variable, Variance and Covariance of Random Variables, Means and Variances of Linear Combinations of Random Variables, Chebyshev's Theorem. Discrete Probability Distributions. Continuous Probability Distributions. Fundamental Sampling Distributions and Data Descriptions: Random Sampling, Sampling Distributions, Sampling Distribution of Means and the Central Limit Theorem. Sampling Distribution of S2, t-Distribution, FQuantile and Probability Plots. Single Sample & One- and Two-Sample Estimation Problems. Single Sample & One- and Two-Sample Tests of Hypotheses. The Use of PValues for Decision Making in Testing Hypotheses (Single Sample & One- and TwoSample Tests), Linear Regression and Correlation. Least Squares and the Fitted Model, Multiple Linear Regression and Certain, Nonlinear Regression Models, Linear Regression Model Using Matrices, Properties of the Least Squares Estimators.

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

1. Probability and Statistics for Engineers and Scientists by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying E. Ye, Pearson; 9th Edition (January 6, 2011). ISBN-10: 0321629116
2. Probability and Statistics for Engineers and Scientists by Anthony J. Hayter, Duxbury Press; 3rd Edition (February 3, 2006), ISBN-10:0495107573
3. Schaum's Outline of Probability and Statistics, by John Schiller, R. Alu Srinivasan and Murray Spiegel, McGraw-Hill; 3rd Edition (2008). ISBN-10:0071544259

ENGL-6101 Technical & Business Writing

Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	Functional English

Course Introduction:

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.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	-	-

Course Outline:

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.

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

1. Technical Report Writing, by Pauley and Riordan, Houghton Mifflin Company, 8th Edition.
2. Effective Technical Communication by Ashraf Rizvi, Tata McGraw-Hill.

Content of Supporting Elective Courses

BUSB-6101 Introduction to Marketing

Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	None

Course Introduction:

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	-	-

Course Outline:

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

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

1. Technical Report Writing, by Pauley and Riordan, Houghton Mifflin Company, 8th Edition.
2. Effective Technical Communication by Ashraf Rizvi, Tata McGraw-Hill.

BUSB-6102 Human Resource Management

Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	None

Course Introduction:

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	-	-

Course Outline:

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.

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

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]
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

BUSB-6103 Financial Accounting

Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	None

Course Introduction:

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	-	-

Course Outline:

Syllabus will be approved by the BOS, Department Business Administration

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

BUSB-6104 Business Economics	
Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	None

Course Introduction:

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	-	-

Course Outline:

Syllabus will be approved by the BOS, Department Business Administration

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

Content of General Education Courses

URCE-5118 Functional English	
Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	None

Course Introduction:

This is first course in English to the Bachelor of Science students and covers all the fundamental concept of English composition and comprehension. The course is designed in such a way that students can use this knowledge to further enhance their language skills in English. The course aims at enhancing students' skill and competence in communicating their ideas in writing and speaking in English language. It will primarily focus on four areas of language to help the students achieve proficiency in language use, develop skills in listening comprehension, improve reading efficiency, use the conventions of standard written English with skill and assertion, build-up vocabulary, and clearly and accurately reproduce specific data. It will illustrate the force and effectiveness of simple and direct English.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	-	-

Course Outline:

Principles of writing good English, understanding the composition process: writing clearly; words, sentence and paragraphs; Comprehension and expression; Use of grammar and punctuation. Process of writing, observing, audience collecting, composing, drafting and revising, persuasive writing, reading skills, listening skills and comprehension, skills for taking notes in class, skills for exams; Business communications; planning messages, writing concise but with impact. Letter formats, mechanics of business, letter writing, letters, memo and applications, summaries, proposals, writing resumes, styles and formats, oral communications,

verbal and non-verbal communication, conducting meetings, small group communication, taking minutes. Presentation skills; presentation strategies, defining the objective, scope and audience of the presentation, material gathering material organization strategies, time management, opening and concluding, use of audio-visual aids, delivery and presentation.

Reference Materials (or use any other standard and latest books):
1. Practical Business English, Collen Vawdrey, 1993, ISBN = 0256192740
2. Effective Communication Skills: The Foundations for Change, John Nielsen, 2008, ISBN = 1453506748
3. College Writing Skills with Readings, by John Langan, McGraw-Hill, 5th Edition.
4. A Textbook of English Prose and Structure by Arif Khattak, et al, GIKI Institute, 2000

URCE-5119 Expository Writing

Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	Functional English

Course Introduction:

The course introduces students to the communications so they can effectively communicate their message. The course also covers how to make an effective presentation both written and verbal. Various modern techniques of communication and presentation skills are covered in this course. Further the course aims to enhance students' linguistic command, so they could communicate effectively in diversified socio-cultural situations; create larger stretches of interactive text in speech and writing; and identify and repair any instances of potential communication break-up.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	-	-

Course Outline:

Principles of writing good English, understanding the composition process: writing clearly; words, sentence and paragraphs; Comprehension and expression; Use of grammar and punctuation. Process of writing, observing, audience collecting, composing, drafting and revising, persuasive writing, reading skills, listening skills and comprehension, skills for taking notes in class, skills for exams; Business communications; planning messages, writing concise but with impact. Letter formats, mechanics of business, letter writing, letters, memo and applications, summaries, proposals, writing resumes, styles and formats, oral communications, verbal and non-verbal communication, conducting meetings, small group communication, taking minutes. Presentation skills; presentation strategies, defining the objective, scope and audience of the presentation, material gathering material organization strategies, time management, opening and concluding, use of audio-visual aids, delivery and presentation.

Reference Materials (or use any other standard and latest books):
1. Practical Business English, Collen Vawdrey, 1993, ISBN = 0256192740
2. Effective Communication Skills: The Foundations for Change, John Nielsen, 2008, ISBN = 1453506748
3. College Writing Skills with Readings, by John Langan, McGraw-Hill, 5th Edition.
4. A Textbook Prose and Structure by Arif Khattak, et al, GIKI Institute, 2000

URCQ-5101 Discrete Structures

Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	-

Course Introduction:

Introduces the foundations of discrete mathematics as they apply to Computer Science, focusing on providing a solid theoretical foundation for further work. Further, this course aims to develop understanding and appreciation of the finite nature inherent in most Computer Science problems and structures through study of combinatorial reasoning, abstract algebra, iterative procedures, predicate calculus, tree and graph structures. In this course more emphasis shall be given to statistical and probabilistic formulation with respect to computing aspects.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand the key concepts of Discrete Structures such as Sets, Permutations, Relations, Graphs and Trees etc.	C2 (understand)
CLO-2	Apply formal logic proofs and/or informal, but rigorous, logical reasoning to real problems, such as predicting the behavior of software or solving problems such as puzzles.	C3 (Apply)
CLO-3	Apply discrete structures into other computing problems such as formal specification, verification, databases, artificial intelligence, and cryptography.	C3 (Apply)
CLO-4	Differentiate various discrete structures and their relevance within the context of computer science, in the areas of data structures and algorithms, in particular	C4 (Differentiate)

Course Outline:

Mathematical reasoning, propositional and predicate logic, rules of inference, proof by induction, proof by contraposition, proof by contradiction, proof by implication, set theory, relations, equivalence relations and partitions, partial orderings, recurrence relations, functions, mappings, function composition, inverse functions, recursive functions, Number Theory, sequences, series, counting, inclusion and exclusion principle, pigeonhole principle, permutations and combinations. Algorithms, Searching and Sorting Algorithms, elements of graph theory, planar graphs, graph coloring, Graph Algorithms, euler graph, Hamiltonian path, rooted trees, traversals.

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

1. Discrete Mathematics and Its Applications, 7th edition by Kenneth H. Rosen
2. Discrete Mathematics with Applications, 4th Edition by Susanna S. Epp
3. Discrete Mathematics, 7th edition by Richard Johnson Baugh
4. Discrete Mathematical Structures, 4th edition by Kolman, Busby & Ross
5. Discrete and Combinatorial Mathematics: An Applied Introduction by Ralph P. Grimaldi
6. Logic and Discrete Mathematics: A Computer Science Perspective by Winifred Grassman

URCI-5105 Islamic Studies

Credit Hours:	2 (2-0)
Contact Hours:	2
Pre-requisites:	-

Course Introduction:

To provide Basic information about Islamic Studies. To enhance understanding of the students regarding Islamic Civilization. History of Islam, understanding of the worship and its usefulness. The basic concept of Quran Pak: wisdom, patience, loyalty. The comparative analysis of Islam with other religions. The Concept and Value of *Haqooq ul Ibad* (Bandon Kay Haqooq) in Islam. What is The rights of people in Islamic Point of View. Islamic point of view about other religions.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	To further enhance the knowledge of Islam.	
CLO-2	To understand the basic concept of Islam and Quran Pak.	
CLO-3	To understand the concept of Haqooq ul ibad in the light of Quran.	
CLO-4	To know the importance of Islamic concept about other religions.	

Course Outline:

Basic Themes of Quran, Introduction to Sciences of Hadith, Introduction to Islamic Jurisprudence, Primary & Secondary Sources of Islamic Law, Makken & Madnian life of the Prophet, Islamic Economic System, Political theories, Social System of Islam. Definition of Akhlaq. The Most Important Characters mentioned in the Holy Qur'an and Sunnah, SIDQ (Truthfulness) Generosity Tawakkaul(trust on Allah) Patience Taqua (piety). Haqooq ul ibad in the light of Quran & Hadith - the important characteristic of Islamic Society.

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

1. Introduction to Islam by Dr Hamidullah, Papular Library Publishers Lahore
2. Principles of Islamic Jurisprudence by Ahmad Hassan, Islamic Research Institute, IIUI
3. Muslim Jurisprudence and the Quranic Law of Crimes, By Mir Waliullah, Islamic Books Services

URCI-5122 Ideology and Constitution of Pakistan	
Credit Hours: **Contact Hours:** **Pre-requisites:**	2 (2-0) 2 -

Course Introduction:

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

- to develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideological background of Pakistan.
- To study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

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	

Course Outline:

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 geopoliticaldimension, Pakistan and International Affairs, Pakistan and the challenges ahead.

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

1. The Emergence of Pakistan, Chaudary M., 1967
2. The making of Pakistan, Aziz. 1976
3. A Short History of Pakistan, I. H. Qureshi, ed., Karachi, 1988

URCA-5123 Application of Information & Communication Technologies

Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	None

Course Introduction:

This is an introductory course in Computer Science designed for beginners. Apart from leading the participants through a whirlwind history of computing, the course also develops a feel for web programming through a series of lectures that help the students develop their own web page. Main objective of the course is to build an appreciation for the fundamental concepts in computing and to become familiar with popular PC productivity software.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand basics of computing technology	C1 (Knowledge)
CLO-2	Do number systems conversions and arithmetic	C2 (Understand)
CLO-3	Have knowledge of types of software	C2 (Understand)
CLO-4	Have knowledge of computing related technologies	C3 (Apply)

Course Outline:

Brief history of Computer, Four Stages of History, Computer Elements, Processor, Memory, Hardware, Software, Application Software its uses and Limitations, System Software its Importance and its Types, Types of Computer (Super, Mainframe, Mini and Micro Computer), Introduction to CBIS (Computer Based Information System), Methods of Input and Processing, Class2. Organizing Computer Facility, Centralized Computing Facility, Distributed Computing Facility, Decentralized Computing Facility, Input Devices. Keyboard and its Types, Terminal (Dump, Smart, Intelligent), Dedicated Data Entry, SDA (Source Data Automation), Pointing Devices, Voice Input, Output Devices. Soft- Hard Copies, Monitors and its Types, Printers and its Types, Plotters, Computer Virus and its Forms, Storage Units, Primary and Secondary Memories, RAM and its Types, Cache, Hard Disks, Working of Hard Disk, Diskettes, RAID, Optical Disk Storages (DVD, CD ROM), Magnetic Types, Backup System, Data Communications, Data Communication Model, Data Transmission, Digital and Analog Transmission, Modems, Asynchronous and Synchronous Transmission, Simplex. Half Duplex,

Full Duplex Transmission, Communications, Medias (Cables, Wireless), Protocols, Network Topologies (Star, Bus, Ring), LAN, LAN, Internet, A Brief History, Birthplace of ARPA Net, Web Link, Browser, Internet Services provider and Online Services Providers, Function and Features of Browser, Search Engines, Some Common Services available on Internet.

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

1. Charles S. Parker, Understanding Computers: Today and Tomorrow, Course Technology, 25 Thomson Place, Boston, Massachusetts 02210, USA
2. Livesley, Robert Kenneth. An introduction to automatic digital computers. Cambridge University Press, 2017.
3. Zawacki-Richter, Olaf, and Colin Latchem. "Exploring four decades of research in Computers & Education." Computers & Education 122 (2018): 136-152.
4. Sinha, Pradeep K., and Priti Sinha. Computer fundamentals. BPB publications, 2010.
5. Goel, Anita. Computer fundamentals. Pearson Education India, 2010.

URCS-6101 Professional Practices

Credit Hours:	2 (2-0)
Contact Hours:	2
Pre-requisites:	None

Course Introduction:

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.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
-	-	-

Course Outline:

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.

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

1. Professional Issues in Software Engineering by Frank Bott, Allison Coleman, Jack Eaton and Diane Rowland, CRC Press; 3rd Edition (2000). ISBN-10: 0748409513

2. Computer Ethics by Deborah G. Johnson, Pearson; 4th Edition (January 3, 2009). ISBN-10: 0131112414
3. A Gift of Fire: Social, Legal, and Ethical Issues for Computing and the Internet (3rd Edition) by Sara Baase, Prentice Hall; 3rd Edition (2008). ISBN-10: 0136008488
4. Applied Professional Ethics by Gregory R. Beabout, University Press of America (1993). ISBN-10: 0819193747.

URCQ-5102 Calculus and Analytic Geometry	
Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	-

Course Introduction:

To provide foundation and basic ground for calculus and analytical geometry background.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
-	-	

Course Outline:

Limits and Continuity; Introduction to functions, Introduction to limits, Techniques of funding limits, Indeterminate forms of limits, Continuous and discontinuous functions and their applications, Differential calculus; Concept and idea of differentiation, Geometrical and Physical meaning of derivatives, Rules of differentiation, Techniques of differentiation, Rates of change, Tangents and Normals lines, Chain rule, implicit differentiation, linear approximation, Applications of differentiation; Extreme value functions, Mean value theorems, Maxima and Minima of a function for single-variable, Concavity, Integral calculus; Concept and idea of Integration, Indefinite Integrals, Techniques of integration, Riemann sums and Definite Integrals, Applications of definite integrals, Improper integral, Applications of Integration; Area under the curve, Analytical Geometry; Straight lines in R3, Equations for planes.

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

1. Calculus and Analytic Geometry by Kenneth W. Thomas.
2. Calculus by Stewart, James.
3. Calculus by Earl William Swokowski; Michael Olinick; Dennis Pence; Jeffery A. Cole

URCW-5201 Applied Physics	
Credit Hours:	3 (2-3)
Contact Hours:	2-3
Pre-requisites:	None

Course Introduction:

The course introduces students with the basic concept of Physics and electronics. Students are also taught Physics laws and other associate topics to prepare them for the advanced level courses in this area. The focus of the course on electric force and its applications and related problems, conservation of charge, charge quantization, Electric fields due to point charge and lines of force and many other useful topics.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
-	-	

Course Outline:

Electric force and its applications and related problems, conservation of charge, charge quantization, Electric fields due to point charge and lines of force. Ring of charge, Disk of charge, A point charge in an electric field, Dipole in a n electric field, The flux of vector field, The flux of electric field, Gauss' Law, Application of Gauss' Law, Spherically symmetric charge distribution, A charge isolated conductor, Electric potential energy, Electric potentials, Calculating the potential from the field and related problem Potential due to point and continuous charge distribution, Potential due to dipole, equipotential surfaces, Calculating the field from the potential, Electric current, Current density, Resistance, Resistivity and conductivity, Ohm's law and its applications, The Hall effect, The magnetic force on a current, The Biot-Savart law, Line of B, Two parallel conductors, Amperes' s Law, Solenoid, Toroids, Faraday's experiments, Faraday's Law of Induction, Lenz's law, Motional emf, Induced electric field, Induced electric fields, The basic equation of electromagnetism, Induced Magnetic field, The displacement current, Reflection and Refraction of light waves, Total internal reflection, Two source interference, Double Slit interference, related problems, Interference from thin films, Diffraction and the wave theory, related problems, Single-Slit Diffraction, related problems, Polarization of electromagnetic waves, Polarizing sheets, related problems.

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

1. Fundamentals of Physics (Extended), 10th edition, Resnick and Walker
2. Narciso Garcia, Arthur Damask, Steven Schwarz., "Physics for Computer Science Students", Springer Verlag, 1998.

URCC-5125 Civics and Community Engagement	
Credit Hours:	2 (2-0)
Contact Hours:	2
Pre-requisites:	None

Course Introduction:

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	C2 (Understand)

	within their communities.	
CLO-2	Develop students' knowledge, skills and attitudes necessary for active and responsible citizenship	C2 (Understand)

Course Outline:

Introduction to Civics & Community Engagement (Overview of the course: Civics & 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 & 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

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

1. Kennedy. J. K., & Brunold, A. (2016). Regional context and Citizenship education in Asia andEurope. New Yourk: Routledge, Falmer.
2. Henslin, James M. (2018). Essentials of Sociology: A Down to Earth Approach (13th 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 andDemocracy in the United States. Kettering Foundation Press.
7. Bloemraad, I. (2006). Becoming a Citizen: Incorporating Immigrants and Refugees in the UnitedStates and Canada. University of California Press.
8. Kuyck, 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 PathTowards Finding and Mobilizing a Community's Assets. ACTA Publications.
12. Patterson, T. E. (2005). Engaging the Public: How Government and the Media Can ReinvigorateAmerican Democracy. Oxford University Press.
13. Love, N. S., & Mattern, M. (2005). Doing Democracy: Activist Art and Cultural Politics. SUNY Press

URCE-5124: Entrepreneurship	
Credit Hours:	2 (2-0)
Contact Hours:	2
Pre-requisites:	None

Course Introduction:

This course helps to ignite the student's passion for innovation and business leadership. Explore the essential principles of creating and managing a successful venture, from ideation to execution. Equip them with the entrepreneurial mindset and skills necessary to navigate the dynamic world of business and turn their ideas into reality.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	The course gives students the tools necessary to think creatively, to plan out whether their idea is marketable to investors, guide them through the launch their own business, or to support an employer in launching and growing an entrepreneurial venture.	C2 (Understand)

Course Outline:

Entrepreneurship and the Entrepreneurial Mind-Set, Entrepreneurial Intentions and Corporate Entrepreneurship. Entrepreneurial Strategy: Generating and Exploiting New Entries. Creativity and the Business Idea. Identifying and Analyzing Domestic and International Opportunities. Intellectual Property and Other Legal Issues for the Entrepreneur. The Business Plan: Creating and Starting the Venture. The Marketing Plan. The Organizational Plan. The Financial Plan. Sources of Capital. Informal Risk Capital, Venture Capital, and Going Public. Strategies for Growth and Managing the Implication of Growth. Succession Planning and Strategies for Harvesting and Ending the Venture.

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

1. Entrepreneurship by Robert Hisrich, Michael Peters and Dean Shepherd, McGrawHill/Irwin; 9th Edition (September 27, 2012). ISBN-10: 0078029198
2. Entrepreneurship: Ideas in Action by Cynthia L. Greene, South-Western Educational Pub; 5th Edition (January 6, 2011). ISBN-10: 0538496894
3. Entrepreneurship by William D. Bygrave and Andrew Zacharakis, Wiley; 2nd Edition (October 12, 2010). ISBN-10: 0470450371
4. Entrepreneurship: Theory, Process, and Practice by Donald F. Kuratko, South-Western College Pub; 8th Edition (November 14, 2008). ISBN-10: 0324590911
5. Entrepreneurship: Successfully Launching New Ventures by Bruce R. Barringer and Duane Ireland, Prentice Hall; 4th Edition (October 27, 2011)

URCQ-5111: Translation of the Holy Quran - I	
Credit Hours:	Non-Credit
Contact Hours:	-
Pre-requisites:	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 to keys and fundamentals of recitation of the holy Quran.	-
CLO-2	To develop the skill of the students of recitation the last revelation.	-
CLO-3	Students will learn the basic Arabic grammar in a practical way.	-
CLO-4	To develop an eagerness among the students to explore the lastdivine Book.	-

Course Outline:

تیسواں پارہ   ـ   ناظرہ مع تجوید
بنیادی عربی گرامر
اسم اور اسکے متعلقات : اسم فاعل ،مفعول ،تفضیل ،مبالغہ
فعل اور اسکی اقسام : ماضی ،مضارع ،امر ، نہی
حرف اور اسکی اقسام : حروف علت ،حروف جارہ ،مشبہ بالفعل
تیسویں پارے کی آخری بیس سورتیں (حفظ مع ترجمہ)

URCQ-5111: Translation of the Holy Quran – II	
Credit Hours:	Non-Credit
Contact Hours:	-
Pre-requisites:	None

Course Introduction:

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

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Students will come to know about the real nature, significance and relevance of the Islamic beliefs in light of the text of the Holy Quran.	-
CLO-2	Students will seek knowledge of translation and transliteration of the Holy Book Quran.	-
CLO-3	To familiarize the students with the concept of Ibādah (Its significance, scope and relevance) and its types in Islam.	-
CLO-4	Students will learn literal and idiomatic way of translation of the Holy Book.	-
CLO-5	Students will learn about the polytheism and its incompatibility in Islamhighlighted by the Holy Quran.	-
CLO-6	To highlight the significance of learning through using all human faculties provided by the almighty Allah and familiarize the students about condemnation of ignorance mentioned in the Quranic text.	-
CLO-7	To develop Awareness among the students about rights and duties ofdifferent circles of society in the light of Holy Quran.	-
CLO-8	To introduce the students to Quranic Arabic grammar in practical manner.	-

Course Outline:

ایمانیات اور عبادات

اللہ پر ایمان، فرشتوں پر ایمان، رسولوں پر ایمان، آسمانی کتابوں پر ایمان، یوم آخرت پر ایمان، تقدیر پر ایمان نماز، روزہ، زکوۃ، حج، جہاد۔

معاشرے کے حقوق

خاندان کی تکوین، حق مہر، رضاعت و حمل، اولاد کو قتل کرنے کے ممانعت، شوہر کی نافرمانی، طلاق، بیوہ کی عدت کے احکام، نکاح کا پیغام بھیجنا، عورت کی وراثت (اس کے شوہر کی طرف سے)، والدین کے حقوق، بیویوں اور اولاد کے بیچ عداوت، خاندان کے حقوق، مہمان کی عزت، اجازت طلب کرنے کے اصول، مجلس کے آداب، تعاون اور بھائی چارہ، گروہ بندی، محبت، لوگوں کے درمیان صلح، عفو و درگزر، غصہ پر قابو اور معاف کرنا، شعوب و قبائل، لوگوں کے بیچ اختلافات، حمایت و نگہبانی۔

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

منتخب آیات مع ترجمہ و تجوید

- البقرہ (۱۱۴، ۲۳۸، ۴۵، ۱۱۸، ۲۲۸، ۱۲۲، ۷۵، ۳۴۲، ۱۵۸، ۲۱۸، ۲۲۸، ۵۳، ۲۲۸، ۲۸۴، ۳۳۸، ۲۲، ۸۲، ۲۸۴، ۲۲۸، ۴۲۸، ۱۱۸، ۲۳۲، ۲۲۲، ۱۱۲، ۲۲۸، ۵۲۷، ۳۲۲، ۲۲۸، ۲۲۷، ۲۲۲، ۷۵۸، ۱۸۸، ۲۸۸، ۱۳۸، ۲۸۸، ۲۸۸، ۲۳۸، ۱۳۸، ۳۳۸، ۱۳۸، ۸۲، ۵۲۷، ۳۳۸، ۸۲، ۱۲۲، ۳۳)
- النساء (۳۲، ۸۲، ۲۳۲، ۲۳، ۲۲، ۲۲، ۳۲۷، ۱۲، ۲۲، ۲۲، ۲۱۲، ۸۲، ۳۴، ۲۸۴، ۵۳، ۷۷، ۲۲، ۵، ۲۱۲، ۵۸، ۴۸، ۲۲، ۷۷، ۲۸۴، ۲۲، ۳۴، ۱۸، ۲۲۲، ۲، ۲۷۷، ۷، ۱۸، ۳۴، ۲۷۲، ۷۲، ۲۵۷، ۵۴، ۲۸۴، ۷۲)
- الانعام (۸۸، ۵۲، ۸۲، ۱۳۴، ۲۷۴، ۲۵، ۵۴)
- آل عمران (۱۲، ۲۳، ۳۲، ۲۸۴، ۵۲، ۵۵۷، ۷، ۲۷)
- المائدہ (۵۴، ۸، ۸۲، ۲۲، ۲۳، ۸۲، ۸، ۴)
- الاعراف (۴۳، ۲۲۲، ۲۲۲)
- التوبہ (۱۸، ۲۴، ۷۱)
- ہود (۸۷)
- الزمر (۲)
- النور (۵۴، ۸۴، ۲۸، ۱۸، ۱۲، ۲۸)
- محمد (۳۳)
- انفال (۱۸، ۸۲)
- الرعد (۳)
- الطلاق (۵)
- الحج (۴)

URCQ-5111: Translation of the Holy Quran – III	
Credit Hours:	Non-Credit
Contact Hours:	-
Pre-requisites:	None

Course Introduction:

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.	-

Course Outline:

اخلاق(تعارف،ضرورت واہمیت،اقسام،معنویت)

اخلاق حسنہ:

برائی کو نیکی سے مٹانا، نیکی کے کاموں میں مسابقت، لوگوں کے درمیان صلح، عدل وانصاف، 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۔

اخلاق سیئہ:

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۔

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

منتخب آیات مع ترجمہ و تجوید

- البقرہ (۷۷، ۲۷۸، ۲۵۸، ۳۳، ۷۱۲، ۷۱۲، ۷۱۲، ۷۱۲، ۸۳، ۳۳۲، ۱۱۲، ۱۳۸، ۳۸۲، ۳۸۲، ۸۸۸، ۱۸، ۱۱، ۷۸، ۲۵۲، ۷۲۱،
  ۲۱۲، ۲۸۵، ۸۲۸، ۸۲۸، ۸۲، ۳۸۲، ۷۳۸، ۷۱، ۵۸۷، ۲۸۸، ۳۲، ۲۸۸، ۳۳۲، ۱۲)

- آل عمران (۲۵۷، ۵۷، ۵۸، ۳۲۲، ۷۸، ۲۵۲، ۳۵۷، ۷۵۲، ۷۱، ۱۱۸، ۳۸۲، ۳۳۲، ۷۷۵، ۲۱۵، ۲۱۵، ۲۸، ۲۱،
  ۷۴۲، ۱۵۲، ۲۵۷)

- النساء (۳۳۴، ۳۸، ۸۸، ۲۱۲، ۷۱۲، ۷۱۲، ۵۴، ۱۸، ۱۸، ۳۱۲، ۲۳، ۴۸، ۵۸، ۱۵، ۱۴، ۵۸)

- المائدۃ (۲۴، ۱۴، ۳۲، ۳۲، ۲، ۲۵، ۷۲)

- النحل (۱۲، ۲۸۲، ۷۱۲، ۳۲۲، ۱۳، ۲۸۲، ۲۸۲)

- الرعد (۳۸، ۱۸، ۵۸، ۸۸، ۲)

- الاعراف (۲۳، ۷، ۲۲، ۷۲، ۲۵۲، ۱۵، ۵، ۱۸، ۵۵۷، ۲۲۲، ۳۲، ۷۲)

- القصص (۵۴، ۵۲)

- فصلت (۵۳)

- الانعام (۸۳، ۱۱، ۷۷، ۱۳۷، ۳۳۲، ۷۲۱)

- النمل (۱۲، ۲۵)

- الحج (۱۳، ۲۷، ۱۲، ۲۲، ۱۱)

- الحجرات (۲، ۷۷، ۲، ۲۲، ۳، ۲۸، ۷۴، ۱۲)

- الاحزاب (۳۸، ۱۴، ۲۲، ۲۲، ۸۴، ۳۳، ۳۳، ۲۲، ۳۴، ۵۸، ۳۴)

- الحشر (۲)

- طٰہ (۸۱)

- الانعام (۲۵۷، ۲۵۲، ۲۲۲، ۷۴۲، ۳۲، ۱۸۷)

- ق (۵۳)

- الانفال (۱۸، ۲۵، ۷۲)

- الفتح(۲۷)
- یونس(۱۷،۲۷،۸۲،۲۲،۸۸،۸۸)
- الفرقان(۳۲،۲۸،۱۲،۳۲)
- النور(۳۸،۲،۵،۱۳،۲۳،۳۳،۳۳،۲۷،۲۳،۸۸)
- لقمان(۲،۳۳،۲۷،۸۳،۲۷)
- الاسراء(۱۳،۷۷،۱۲،۳،۱۳)
- النزل(۲۷)
- المدثر(۲،۵)
- المدثر(۵۱)
- فاطر(۸۳)
- الفتح(۲۸)
- البلد(۱۷)
- الزمر(۳،۱۷)
- الحجر(۳۲)
- النجم(۲۳)
- الرحمٰن(۱۲)
- هود(۲،۱۷،۸،۳)
- الکہف(۸،۲۳)
- الشوری(۱۳)
- غافر(۲۸،۱۸)
- الحدید(۱۸،۱۸)
- مریم(۲۳)
- النازعات(۴۵)
- التوبہ(۳۲،۵۲،۱۱)
- الھمزہ(۷)

URCQ-5111: Translation of the Holy Quran – IV	
Credit Hours:	Non-Credit
Contact Hours:	-
Pre-requisites:	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 inheritancementioned in the Quranic text (with the help of Urdu translation).	-
CLO-2	To introduce the students to scientific facts and miracles of the HolyQuran and Quranic stress on deep study of Allah's explored universe.	-
CLO-3	To motivate the students for reading and exploring the last Holy Bookrevealed by Almighty Allah.	
CLO-4	Through memorization students will develop their relation with lastrevelation.	-

Course Outline:

تجارت اور وراثت:

مال کی تقسیم، نادان کامال، عوام الناس کامال، عورتوں کامال، یتیموں کامال، کفار کامال، جائزمال، معاہدے، رہن، 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 اِن کے اطلاقات (متن قرآنی پر اطلاق سے توضیحات)

منتخب آیات مع ترجمہ و تجوید

- البقرہ(۲۲۸، ۲۸۸، ۲۸۸، ۲۲۸، ۲۲۸، ۲۸، ۲۲۸، ۵۲۸، ۲۱۸، ۷، ۲۸، ۳۱۸، ۸۲۸، ۸۲۸، ۸۲۸، ۵۱۸، ۲۱۸، ۳۲، ۱۱۷، ۳۱۸، ۳۱۸، ۲۱۸، ۷، ۱۸، ۳۸۸، ۲۸۰، ۳۸، ۳۳۸، ۵۲۷، ۲۲۸، ۵۲۷، ۵۲۷، ۱۳، ۱۲، ۵۲۷، ۱۸، ۷، ۲۸، (۱، ۸۲، ۳۲)
- آل عمران(۷۷، ۱۸، ۱۲۷، ۱۳۷، ۵۳۷، ۲۲)
- النساء(۲۸، ۸، ۲۸، ۲۷)
- المائدہ(۲۲، ۳۲، ۳۱، ۲۲، ۱۲)
- التوبہ(۲۲، ۵۸، ۲۲، ۵۸، ۵۸، ۱۲، ۵)
- الاعراف(۸۱۷، ۲۲۷، ۱۴، ۲۲۳، ۳۲۲، ۱۲۷، ۱۵، ۳۳۷، ۲۱۷، ۲۲۷)
- الرعد(۷، ۵)
- الطور(۵۵)
- الانعام(۲۳، ۳۲، ۷۵۲، ۲۵۷، ۳۳)
- الانفال(۲۸، ۲۳، ۷۵)
- الکہف(۲۳، ۷، ۲۱۷، ۱۵، ۸۳، ۳۵، ۱۲، ۳۵)