UNIVERSITY OF SARGODHA
OFFICE OF THE REGISTRAR
(ACAD BRANCH)

NOTIFICATION

On the recommendations of Academic Council made in its 22nd (3/2024) meeting held on 30.09.2024, the Syndicate in its 69th (1/2025) meeting held on 17.01.2025 has approved the curriculum of BS-Cyber Security for implementation w.e.f. Fall 2025 (Annex-'A').

(WAQAR AHMAD)
Additional Registrar (General)

No. SU/Acad/25/ 865 Dated: 26.08.2025

Distribution:

- Chairman, Department of Information Technology
- Controller of Examinations
- Director Academics

C.C:

- Director, QEC
- Secretary to the Vice-Chancellor
- PA to Registrar
- Notification File

Curriculum
of
BS Cyber Security
for
Main Campus, and Affiliated Colleges

Department of Information Technology

University of Sargodha

(Applicable from Fall 2024)

Table of Contents

Guidelines for Affiliated Colleges 4
The Discipline of Cyber Security 5
Cyber Security Programs' Rationale 5
Underlying Principles of Cyber Security Programs 6
Vision Statement of University of Sargodha 6
Mission Statement of University of Sargodha 6
Vision Statement of Department of Information Technology 7
Mission Statement of Department of Information Technology 7
Details of BS Cyber Security 8
Program Educational Objectives 8
Graduate Attributes 8
Program's Outcome 9
Program's Structure 9
Degree Requirement 9
Duration 9
Eligibility Criteria 9
Assessment & Evaluation 9
Distribution of Courses 10
Major Area Courses 10
Course Coding Scheme 13
Scheme of Studies for BS CYBER SECURITY 14
For Main Campus 14
For Affiliated Colleges 17
Contents of Computing Core Courses 20
CMPC-5201 Programming Fundamentals 20
CMPC-5202 Object Oriented Programming 20
CMPC-5203 Database Systems 21
CMPC-5204 Digital Logic Design 22
CMPC-5205 Data Structures 23
CMPC-5206 Information Security 23
CMPC-5207 Artificial Intelligence 24
CMPC-5208 Computer Networks 25
CMPC-5101 Software Engineering 26
CMPC-5209 Computer Organization & Assembly Language 26
CMPC-6201 Operating Systems 27
CMPC-6101 Analysis of Algorithms 28
CMPC-6702 Final Year Project-I 29
CMPC-6703 Final Year Project-II 29
Contents of Domain Core Courses 30
CYDC-5201 Cyber Security 30
CYDC-5202 Information Assurance 31
CYDC-6201 Network Security 31
CYDC-6202 Secure Software Design and Development 32

CYDC-6203 Digital Forensics 33
CYDC-6204 Parallel and Distributed Computing 34
Contents of Domain Elective Courses 35
CYDE-6201 Vulnerability and Reverse Engineering 35
CYDE-6202 Basic Electronics 36
CYDE-6203 Hardware Security 37
CYDE-6204 Malware Analysis 37
CYDE-6205 Theory of Automata 38
CYDE-6206 HCI & Computer Graphics 39
CYDE-6207 Computer Architecture 41
CYDE-6208 Advanced Digital Logic Design 42
CYDE-6209 Wireless and Mobile Security 42
CYDE-6210 Embedded System 43
CYDE-6211 Cyber Law & Cyber Crime (Cyber Warfare) 44
CYDE-6212 Penetration Testing 45
CYDE-6213 Control System Security 45
CYDE-6214 Analysis of Information Systems 46
CYDE-6215 Cryptanalysis 47
CYDE-6216 Applied Cryptography 48
CYDE-6218 Embedded Systems Security 49
CYDE-6217 Deep Learning 50
CYDE-6219 Mobile Application Development 51
CYDE-6220 Introduction to Cryptography 52
CYDE-6221 Cloud Computing 53
CYDE-6222 Internet of Everything 54
CYDE-6223 Digital Marketing and Ecommerce 55
CYDE-6224 Web3 and Blockchain Fundamentals 55
CYDE-6225 UI / UX Designing 56
Preliminary Courses for Pre-Medical Students 57
URCM-5107 Mathematics I 57
URCM-5108 Mathematics II 58
Mathematics & Supporting Courses 59
MATH-5101 Multivariable Calculus 59
MATH-5102 Linear Algebra 60
MATH-5103 Probability and Statistics 61
ENGL-6101 Technical & Business Writing 61
Content of Supporting Elective Courses 62
BUSB-5107 Principles of Marketing 62
BUSB-6102 Human Resource Management 63
BUSB-5102 Financial Accounting-I 64
BUSB-5104 Introductory Business Economics 65
Content of General Education Courses 66
URCG-5118 Functional English 66
URCG-5119 Expository Writing 68
URCQ-5101 Discrete Structures 69

URCG-5105 Islamic Studies 70
URCG-5122 Ideology and Constitution of Pakistan 72
URCG-5126 Ethics 73
URCG-5128 Pakistan Studies 75
URCG-5123 Application of Information & Communication Technologies 76
URCS-6101 Professional Practices 77
URCQ-5102 Calculus and Analytical Geometry 77
URCW-5201 Applied Physics 78
URCG-5125 Civics and Community Engagement 79
URCG-5124: Entrepreneurship 81
URCG-5129: Understanding of Holy Quran/Fehm-e-Quran-I 83
URCG-5130: Understanding of Holy Quran/Fehm-e-Quran-II 87
Social Science Electives 90
URCA-5101 Introduction to Management 90
URCA-5102 Foreign Language (French, German, Arabic, Chinese etc.) 92

Guidelines for Affiliated Colleges

- BS Cyber Security 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 Cyber Security

The field of cyber security has undergone significant evolution over the past few decades. In the early days of computing, security was not a major concern as systems were largely isolated and not connected to the internet. However, with the advent of the internet and the widespread adoption of technology, security threats began to emerge. In the 1980s and 1990s, hackers and malware became a growing concern, leading to the development of basic security measures such as firewalls and antivirus software.

As technology continued to advance, so did the sophistication of cyber threats. The early 2000s saw the rise of identity theft, phishing, and other forms of social engineering. In response, the field of cyber security expanded to include new specialties such as incident response, penetration testing, and security information and event management (SIEM). The mid-2000s also saw the introduction of compliance regulations such as HIPAA and PCI-DSS, which further drove the development of cyber security measures.

Today, the field of cyber security is more complex and dynamic than ever. The rise of cloud computing, the Internet of Things (IoT), and artificial intelligence (AI) has created new vulnerabilities and attack surfaces. In response, cyber security professionals are leveraging advanced technologies such as machine learning, threat intelligence, and DevSecOps to stay ahead of threats. The field is also becoming increasingly specialized, with professionals focusing on areas such as cloud security, industrial control systems security, and cybersecurity governance. As technology continues to evolve, the field of cyber security will continue to adapt and innovate to meet the changing threat landscape.

Cyber Security Programs' Rationale

The Bachelor of Science in Cyber Security program is designed to provide students with a comprehensive understanding of the technical, social, and policy aspects of cyber security. The program's rationale is to:

Equip students with the knowledge and skills to design, implement, and maintain secure computer systems, networks, and infrastructure.
Prepare students to identify, analyze, and respond to cyber threats and vulnerabilities.
Foster an understanding of the social and ethical implications of cyber security and its impact on individuals, organizations, and society.
Develop critical thinking and problem-solving skills to address complex cyber security challenges.
Provide hands-on experience with industry-standard tools and technologies.
Prepare professionals for the field of cyber security.
Address the growing demand for skilled cyber security professionals in various industries.
Enable students to contribute to the development of secure and reliable digital systems.

By achieving these goals, BS Cyber Security programs aim to produce well-rounded, competent, and responsible cyber security professionals who can protect and defend digital assets in an increasingly connected world.

Underlying Principles of Cyber Security Programs

The curriculum of a Cyber Security program is foundational to shaping the knowledge, skills, and dispositions of future professionals in the field. Recognizing the dynamic nature of cyberspace and the evolving landscape of threats, the Department of Information Technology (UOS) has meticulously crafted its curriculum to align with the needs of stakeholders and the challenges of contemporary cybersecurity environments. Embracing the fluidity of technological advancements and the diverse demands of modern workplaces, the curriculum is designed based on the following underlying principles:

i. Broad-Based Learning: The curriculum is structured to provide students with a comprehensive understanding of cybersecurity, allowing them to traverse across various disciplines and professions within the field.
ii. Adaptability: Given the rapid pace of change in cybersecurity, the curriculum equips graduates with the agility and resilience needed to thrive in an ever-evolving landscape.
iii. Mastery Expectations: Clear guidance is provided regarding the expected level of mastery of topics, ensuring that graduates possess the necessary competencies to address real-world challenges.
iv. Innovation and Relevance: The curriculum offers realistic and adaptable recommendations, enabling innovative approaches that reflect recent developments in cybersecurity while remaining relevant across different institutions.
v. Compatibility: Curriculum contents are designed to be relevant and compatible with a variety of institutions, catering to the diverse needs and contexts of cybersecurity education.
vi. Management of Essential Knowledge: While covering a broad range of topics, the curriculum manages the size of essential knowledge to ensure depth without overwhelming students.
vii. Fundamental Skills and Knowledge: Identifying core skills and knowledge ensures that all graduates possess a foundational understanding of cybersecurity principles.
viii. Flexibility: Providing flexibility in organizing topics allows for diverse approaches to curriculum design, accommodating different learning styles and preferences.

To further enhance the curriculum, specialization tracks and courses are integrated to align with industry demands and student interests. Moreover, essential life skills such as critical thinking, communication, and ethical practices are seamlessly woven throughout the curriculum, preparing graduates not only for the technical challenges of cybersecurity but also for the ethical and professional responsibilities inherent in the field. This multidisciplinary approach ensures that graduates are well-rounded cybersecurity professionals equipped to tackle the complexities of the digital age.

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 Cyber Security.

Mission Statement of Department of Information Technology

Our mission includes:

- Imparting students with an enriching learning experience in the field of Cyber Security 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 Cyber Security.

Curriculum
for
BS Cyber Security Program

Details of BS Cyber Security

Program Educational Objectives

The aim of the BS Cyber Security 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 Cyber Security 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 Cyber Security.

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.

Graduate Attributes

To ensure our graduates are not only technically competent but also professionally and ethically prepared, the cybersecurity curriculum is aligned with defined Graduate Attributes (GAs). These attributes foster critical thinking, lifelong learning, ethical responsibility, effective communication, and teamwork—key competencies required for success in the dynamic field of cybersecurity.

1. Academic Education
2. Knowledge for Solving Computing Problems
3. Problem Analysis
4. Design/Development of Solutions
5. Modern Tool Usage
6. Individual and Teamwork
7. Communication
8. Computing Professionalism and Society
9. Ethics
10. Life-long Learning

Program's Outcome

BS CYBER SECURITY 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 BS CYBER SECURITY 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:

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 134 credit hours.
b) Must have earned CGPA (Cumulative Grade Point Average) of at least 2.5 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/ICS
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, Eco, Comp
2) At least 60% marks in DAE (1st & 2nd Year) in a relevant discipline [for BS-Cyber Security 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

BS CYBER SECURITY			
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	34	15
	Total	**134**	**47**

Major Area Courses

Computing Core Courses – 46 Credit Hours - 14 Courses				
#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
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 (3-0)
5	CMPC-5205	CMPC-5201	Data Structures	4 (3-3)
6	CMPC-5206	-	Information Security	3 (2-3)
7	CMPC-5207	-	Artificial Intelligence	3 (3-0)
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	-	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)

Domain Core – 18 Credit Hours - 06 Courses				
#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
1	CYDC-5201	-	Cyber Security	3 (3-0)
2	CYDC-5202	-	Information Assurance	3 (3-0)
3	CYDC-6201	-	Network Security	3 (3-0)

4	CYDC-6202	-	Secure Software Design and Development	3 (3-0)
5	CYDC-6203	-	Digital Forensics	3 (3-0)
6	CYDC-6204	-	Parallel & Distributed Computing	3 (3-0)

Domain Elective – 21 Credit Hours - 07 Courses				
#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
1	CYDE-6201	-	Vulnerability Assessment & Reverse Engineering	3 (3-0)
2	CYDE-6202	-	Basic Electronics	3 (3-0)
3	CYDE-6203	-	Hardware Security	3 (3-0)
4	CYDE-6204	-	Malware Analysis	3 (3-0)
5	CYDE-6205	-	Theory of Automata	3 (3-0)
6	CYDE-6206	-	HCI & Computer Graphics	3 (3-0)
7	CYDE-6207	-	Computer Architecture	3 (3-0)
8	CYDE-6208	-	Advanced Digital Logic Design	3 (3-0)
9	CYDE-6209	-	Wireless and Mobile Security	3 (3-0)
10	CYDE-6210	-	Embedded Systems	3 (3-0)
11	CYDE-6211	-	Cyber Law & Cyber Crime (Cyber Warfare)	3 (3-0)
12	CYDE-6212	-	Penetration Testing	3 (3-0)
13	CYDE-6213		Control System Security	3 (3-0)
14	CYDE-6214	-	Analysis of Information Systems	3 (3-0)
15	CYDE-6215	-	Cryptanalysis	3 (3-0)
16	CYDE-6216	-	Applied Cryptography	3 (3-0)
17	CYDE-6217		Deep Learning	3 (3-0)
18	CYDE-6218	-	Embedded Systems Security	3 (3-0)
19	CYDE-6219	-	Mobile Application Development	3 (3-0)
20	CYDE-6220	-	Introduction to Cryptography	3 (3-0)
21	CYDE-6221	-	Cloud Computing	3 (3-0)
22	CYDE-6222	-	Internet of Everything	3 (3-0)
23	CYDE-6223	-	Digital Marketing and Ecommerce	3 (3-0)
24	CYDE-6224	-	Web3 and Blockchain Fundamentals	3 (3-0)
25	CYDE-6225	-	UI / UX Designing	3 (3-0)

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	-	Linear Algebra	3 (3-0)
3	MATH-5103	-	Probability & Statistics	3 (3-0)
4	ENGL-6101	-	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-5107	-	Principles of Marketing	3 (3-0)
2	BUSB-6102	-	Human Resource Management	3 (3-0)
3	BUSB-5102	-	Financial Accounting-I	3 (3-0)
4	BUSB-5104	-	Introductory Business Economics	3 (3-0)

General Education – 34 Credit Hours - 15 Courses				
#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
1	URCG-5123	-	Applications of Information Communication Technologies	3 (2-3)
2	URCG-5118	-	Functional English	3 (3-0)
3	URCG-5119	-	Expository Writing	3 (3-0)
4	URCQ-5101	-	Quantitative Reasoning I (Discrete Structures)	3 (3-0)
5	URCQ-5102	-	Quantitative Reasoning – 2 (Calculus and Analytic Geometry) *	3 (3-0)
6	URCG-5105	-	Islamic Studies	2 (2-0)
7	URCG-5126	-	Ethics (for non-Muslims)	2 (2-0)
8	URCG-5122	-	Ideology and Constitution of Pakistan	2 (2-0)
9	URCG-5128	-	Pakistan Studies	2 (2-0)
10	URCA-5102	-	Social Science Elective	2 (2-0)
11	URCW-5201	-	Applied Physics	3 (3-0)
12	URCS-6101	-	Professional Practices	2 (2-0)
13	URCG-5125	-	Civics and Community Engagement	2 (2-0)
14	URCG-5124	-	Entrepreneurship	2 (2-0)
15	URCG-5129	-	Understanding of Holy Quran/Fehm-e-Quran-I	1 (0-3)
16	URCG-5130	-	Understanding of Holy Quran/Fehm-e-Quran-II	1 (0-3)

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

Social Science Electives – 3 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)

Mathematics (For Pre-Medical Students only) – 02 Courses (Applicable only for Pre-medical students)				
#	Code	Pre-Req	Course Title	Cr. Hrs. (Contact Hrs)
1	URCM-5107	-	Mathematics I	Non-Credit

2	URCM-5108	-	Mathematics II	Non-Credit

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
CYDC	Cyber Security Domain Core
CYDE	Cyber Security 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
URCG	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 BS CYBER SECURITY

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	URCG-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	URCG-5118	-	Functional English	GER	3 (3-0)
6	BUSB-6101	-	Principles of Marketing	SS	3 (3-0)
7	URCM-5107	-	Mathematics-I*	MATH	Non-Credit
				Total Credit Hours	**19 (17-6)**

*Applicable only for Pre-medical students

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 (3-0)
4	MATH-5101	URCQ-5102	Multivariable Calculus	MATH	3 (3-0)
5	MATH-5102	-	Linear Algebra	MATH	3 (3-0)
6	URCG-5128	-	Pakistan Studies	GER	2(2-0)
7	URCM-5108	-	Mathematics-II*	MATH	Non-Credit
				Total Credit Hours	**19 (17-6)**

*Applicable only for Pre-medical students

Semester – III

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-5205	CMPC-5201	Data Structures	Core	4 (3-3)
2	CMPC-5206	-	Information Security	Core	3 (2-3)
3	CMPC-5207	-	Artificial Intelligence	Core	3 (3-0)
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)
7	URCG-5129	-	Understanding of Holy Quran/Fehm-e-Quran-I	GER	1 (0-3)
				Total Credit Hours	**20 (16-12)**

Semester – IV

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

			Assembly Language		
2	CYDC-5201	-	Cyber Security	Domain Core	3 (3-0)
3	CYDC-5202	-	Information Assurance	Domain Core	3 (3-0)
4	URCG-5105	-	Islamic Studies	GER	2 (2-0)
5	URCG-5126	-	Ethics*	GER	2 (2-0)
6	URCW-5201	-	Applied Physics	GER	3 (3-0)
7	URCG-5119	-	Expository Writing	GER	3 (3-0)
8	URCG-5130	-	Understanding of Holy Quran/Fehm-e-Quran-II	GER	1 (0-3)
				Total Credit Hours	**18 (16-6)**

*Non-Muslims students will study Ethics instead of Islamic Studies

Semester – V

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-6201	-	Operating Systems	Core	3 (2-3)
2	CYDC-6201	-	Network Security	Domain Core	3 (3-0)
3	CYDC-6202		Secure Software Design and Development	Domain Core	3 (3-0)
4	CYDE-6xxx	-	Domain Elective 1	Domain Elective	3 (3-0)
5	CYDE-6xxx	-	Domain Elective 2	Domain Elective	3 (3-0)
6	URCA-xxxx	-	Social Science Elective	GER	2 (2-0)
				Total Credit Hours	**17 (16-3)**

Semester – VI

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CYDC-6203	-	Digital Forensics	Domain Core	3 (3-0)
2	CYDC-6204		Parallel & Distributed Computing	Domain Core	3 (3-0)
3	CYDE-6xxx	-	Domain Elective 3	Domain Elective	3 (3-0)
4	CYDE-6xxx	-	Domain Elective 4	Domain Elective	3 (3-0)
5	CYDE-6xxx	-	Domain Elective 5	Domain Elective	3 (3-0)
6	CYDE-6xxx	-	Domain Elective 6	Domain Elective	3 (3-0)
				Total Credit Hours	**18 (18-0)**

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	-	Analysis of Algorithms	Core	3 (3-0)

3	CYDE-6xxx	-	Domain Elective 7	Domain Elective	3 (3-0)
4	ENGL-6101	-	Technical & Business Writing	EN	3 (3-0)
5	URCG-5124	-	Entrepreneurship	GER	2 (2-0)
				Total Credit Hours	**13 (11-6)**

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)
				Total Credit Hours	**10 (6-12)**

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	URCG-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	URCG-5118	-	Functional English	GER	3 (3-0)
6	BUSB-6101	-	Principles of Marketing	SS	3 (3-0)
7	URCM-5107	-	Mathematics-I*	MATH	Non-Credit
				Total Credit Hours	**19 (17-6)**

*Applicable only for Pre-medical students

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 (3-0)
4	MATH-5101	URCQ-5102	Multivariable Calculus	MATH	3 (3-0)
5	MATH-5102	-	Linear Algebra	MATH	3 (3-0)
6	URCG-5128	-	Pakistan Studies	GER	2(2-0)
7	URCM-5108	-	Mathematics-II*	MATH	Non-Credit
				Total Credit Hours	**19 (17-6)**

*Applicable only for Pre-medical students

Semester – III

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-5205	CMPC-5201	Data Structures	Core	4 (3-3)
2	CMPC-5206	-	Information Security	Core	3 (2-3)
3	CMPC-5207	-	Artificial Intelligence	Core	3 (3-0)
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)
7	URCG-5129	-	Understanding of Holy Quran/Fehm-e-Quran-I	GER	1 (0-3)
				Total Credit Hours	**20 (16-12)**

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	CYDC-5201	-	Cyber Security	Domain Core	3 (3-0)
3	CYDC-5202	-	Information Assurance	Domain Core	3 (3-0)
4	URCG-5105	-	Islamic Studies	GER	2 (2-0)
5	URCG-5126	-	Ethics*	GER	2 (2-0)
6	URCW-5201	-	Applied Physics	GER	3 (3-0)
7	URCG-5119	-	Expository Writing	GER	3 (3-0)
8	URCG-5130	-	Understanding of Holy Quran/Fehm-e-Quran-II	GER	1 (0-3)
				Total Credit Hours	**18 (16-6)**

*Non-Muslims students will study Ethics instead of Islamic Studies

Semester – V

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CMPC-6201	-	Operating Systems	Core	3 (2-3)
2	CYDC-6201	-	Network Security	Domain Core	3 (2-3)
3	CYDC-6202	-	Secure Software Design and Development	Domain Core	3 (2-3)
4	CYDE-6221	-	Cloud Computing	Domain Elective	3 (2-3)
5	CYDE-6225	-	UI / UX Designing	Domain Elective	3 (2-3)
6	URCA-5101	-	Introduction to Management	GER	2 (2-0)
				Total Credit Hours	**17 (16-3)**

Semester – VI

S#	Code	Pre-requisite	Course Title	Domain	CH (Cont Hrs)
1	CYDC-6203	-	Digital Forensics	Domain Core	3 (2-3)
2	CYDC-6204	-	Parallel & Distributed Computing	Domain Core	3 (2-3)
3	CYDE-6204	-	Malware Analysis	Domain Elective	3 (2-3)
4	CYDE-6212	-	Penetration Testing	Domain Elective	3 (2-3)
5	CYDE-6219	-	Mobile Application Development	Domain Elective	3 (2-3)
6	CYDE-6223	-	Digital Marketing and Ecommerce	Domain Elective	3 (2-3)
				Total Credit Hours	**18 (18-0)**

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	-	Analysis of Algorithms	Core	3 (3-0)

3	CYDE-6209	-	Wireless and Mobile Security	Domain Elective	3 (3-0)
4	ENGL-6101	-	Technical & Business Writing	EN	3 (3-0)
5	URCG-5124	-	Entrepreneurship	GER	2 (2-0)
				Total Credit Hours	**13 (11-6)**

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)
				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. Object Oriented Programming in C++ latest edition by Robert Lafore.
2. C++ How to Program latest Edition by Paul Deitel and Harvey Deitel
3. Starting Out with Programming Logic and Design: latest edition by Tony Gaddis.
4. C++ How to Program latest Edition by Paul Deitel and Harvey Deitel
5. Problem Solving and Program Design in C++, latest 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 No.	Course Learning Outcomes	Bloom 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. Object Oriented Programming in C++ latest edition by Robert Lafore.
2. C++ How to Program latest Edition by Paul Deitel and Harvey Deitel
3. Starting Out with Programming Logic and Design: latest edition by Tony Gaddis.
4. C++ How to Program latest Edition by Paul Deitel and Harvey Deitel
5. Problem Solving and Program Design in C++, latest Edition by Jeri R. Hanly& Elliot B.

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: **Contact Hours:** **Pre-requisites:**	3 (3-0) 3-0 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:	4 (3-3)
Contact Hours:	3-3
Pre-requisites:	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 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

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:	None

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:	None

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

CYDC-5201 Cyber Security	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
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

CYDC-5202 Information Assurance	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (3-0) 3-0 None

Course Introduction:

To understand the role and interaction of policies, laws, procedures, management issues, and technical issues in protecting information resources.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Apply security governance principles; organizational processes; developing and implementing a documented security policy.	C3 (Apply)
CLO-2	Understand and apply risk management concepts	C2 (Understand)
CLO-3	To understand the business, legal, and technical knowledge needed to secure vital government and business assets.	C2 (Understand)

Course Outline:

Introduction to (IS) Information System (Concept, Design, Functions, Architecture, Components and applications of IS); Secure System Planning and Administration; Information Security Policies and Procedures; Asset Management; Organizational and Human Security; Cyber Security Management Concepts; NIST Cyber Security Framework; Enterprise Roles and Structures; Strategic Planning; Security Plans and Policies; Contingency Planning; Laws; Laws and Regulatory Requirements; Security Standards and Controls, Risk Management Process, NIST Risk Management Framework, Security Metrics and Key Performance Indicators (KPIs); Physical Security and Environmental Events; Contingency Planning; Security Education, ISO 27001 Compliance, Training, and Awareness

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

1. Principles of Information Security by Michael E. Whitman, 6th Edition, 2017
2. Reference Material: CISSP Study Guide, 7th Edition
3. Information Assurance: Managing Organizational IT Security Risks by Joseph Boyce and Daniel Jennings, 1 Edition or Latest
4. Information Assurance: Security in the Information Environment by Andrew Blyth and Gerald L. Kovacich, Springer, 2nd Edition or Latest

CYDC-6201 Network Security	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (3-0) 3-0 None

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
1. Cryptography and Network Security Principles and Practices by William Stallings, Latest Edition

CYDC-6202 Secure Software Design and Development

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

Course Introduction:

The module aims to develop core competencies in the fields of Secure Software Concepts, Secure Software Requirements, Secure Software Design, Secure Software Implementation/Coding, and Secure Software Testing. The course details the software security activities that need to be incorporated throughout the software development lifecycle. It provides comprehensive coverage that includes the people, processes, and technology components of software, networks, and host defenses.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	A good comprehension of software security standards, models, processes and best practices that need to be incorporated throughout the software development lifecycle.	C2 (Understand)

CLO-2	Identify insecure programming patterns and the ability to replace them with secure alternatives.	C2 (Understand)
CLO-3	Know tools for software security analysis and testing, and the ability to use them in practice and understand their capabilities and limitations.	C3 (Apply)

Course Outline:

Secure software concepts; System issues; System properties; Software Project Time Management; Software Project Costing; Software Quality Assurance; Security Concepts in the SDLC; Risk management; Security standards (e.g., coding standards, NIST standards. Federal Information Processing Standards); Best practices (e.g., OWASP development guide, OWASP code review guide, OWASP testing guide); Security methodologies (e.g., Socratic Methodology, Operationally Critical Threat, Asset, and Vulnerability Evaluation, STRIDE and DREAD, Open Source Security Testing Methodology Manual); Security frameworks (e.g., Zachman Framework, Control Objectives for Information and Related Technology, Sherwood Applied Business Security Architecture (SABSA)); Regulations- Privacy and Compliance; Security Models (e.g., BLP Confidentiality Model, Clark and Wilson Model (Access Triple Model)); Trusted Computing; Secure Software Requirements (Sources for Security Requirements, Types of Security Requirements); Secure Software Design (Design consideration, Information Technology Security Principles and Secure Design, Designing Secure Design Principles): Design Processes; Secure Software Implementation/Coding; Software Development Methodologies; Common Software Vulnerabilities and Controls; Defensive Coding Practices—Concepts and Techniques; Code Vulnerabilities and Avoiding Polymorphic Malware Attacks: Buffer overflow, Format string bug, Code vulnerabilities SQL Injection, Cross-site Scripting, Cross-site Request Forgery, Session management, Replication of vulnerabilities and exploitation; Secure Software Testing; Security Testing Methodologies; Software Security Testing; Software Acceptance; Legal Protection Mechanisms; Software Deployment-Operations- Maintenance and Disposal.

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

1. Official (ISC)2 Guide to the CSSLP (latest)
2. Software Security: Building Security In, 1st Edition by Gary McGraw

CYDC-6203 Digital Forensics	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

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,	C2 (Understand) regulations and

		ethical values
CLO-2	To be able to conduct digital forensics for multiple	C3 (Apply) platforms and applications by various tools
CLO-3	To be able to generate reports based on digital forensic	C3 (Apply) tools

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; Ant forensics; 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)

CYDC-6204 Parallel and Distributed Computing	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

Course Introduction:

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

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

Course Outline:

Asynchronous/synchronous computation/communication, concurrency control, fault tolerance, GPU architecture and programming, heterogeneity, interconnection topologies, load balancing,

memory consistency model, memory hierarchies, Message passing interface (MPI), MIMD/SIMD, multithreaded programming, parallel algorithms & architectures, parallel I/O, performance analysis and tuning, power, programming models (data parallel, task parallel, process-centric, shared/distributed memory), scalability and performance studies, scheduling, storage systems, synchronization, and tools (Cuda, Swift, Globus, Condor, Amazon AWS, OpenStack, Cilk, gdb, threads, MPICH, OpenMP, Hadoop, FUSE).
Reference Materials (or use any other standard and latest books):
1. 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

CYDE-6201 Vulnerability and Reverse Engineering	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

Course Introduction:

This course develops a rigorous understanding of software and system vulnerabilities and foundational skills in reverse engineering. Students learn vulnerability taxonomies (CWE/CVE), risk rating (CVSS), assessment workflows, and reporting practices, along with binary reverse engineering concepts such as instruction set basics, control-flow, data-flow, and common protection mechanisms. The course emphasizes responsible disclosure, ethics, and mitigation strategies

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Explain common vulnerability classes, assessment methodologies, and the reverse engineering workflow, including ethics and responsible disclosure.	C2 (Understand)
CLO-2	Apply static and dynamic analysis techniques using industry tools to inspect binaries, identify weaknesses, and verify findings.	C3 (Apply)
CLO-3	Analyze root causes of vulnerabilities and articulate exploitation potential and mitigations in a professional report.	C4 (Analyze)

Course Outline:

Vulnerability taxonomies (CWE, CVE), threat modeling, and risk rating (CVSS). Information gathering and enumeration; scanning vs. manual validation. Executable formats (PE/ELF/Mach-O), calling conventions, stack vs. heap. Static analysis workflow: disassembly, control-flow graphs, data-flow, function discovery (e.g., IDA/Ghidra concepts). Dynamic analysis workflow: debugging concepts, breakpoints, tracing, and sandboxing ideas. Memory corruption classes: buffer overflows, format strings, UAF, integer overflows; exploitability considerations. Mitigations and bypass themes: ASLR, DEP/NX, stack canaries; ROP fundamentals (conceptual). Obfuscation and packing concepts; anti-debug and anti-VM themes. Patch diffing concepts and root-cause analysis; secure coding guidelines. Reporting structure: PoC, impact

assessment, remediation guidance, and executive summaries
Reference Materials (or use any other standard and latest books):
1. Dowd, M., McDonald, J., & Schuh, J. (2007). *The art of software security assessment identifying and preventing software vulnerabilities*. Addison-Wesley.

CYDE-6202 Basic Electronics	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

Course Introduction:

This course introduces fundamental principles of electronics, including circuit laws, passive and active components, time- and frequency-domain analysis, and basic analog and digital building blocks. Emphasis is placed on problem solving, circuit intuition, and interpreting measurements and simulations.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Explain core electrical quantities, circuit laws, and characteristics of basic electronic components.	C2 (Understand)
CLO-2	Apply circuit analysis techniques (KCL/KVL, Thevenin/Norton, phasors) to solve DC/AC problems.	C3 (Apply)
CLO-3	Analyze simple analog building blocks (rectifiers, biasing, op-amp circuits, filters) and interpret results.	C4 (Analyze)

Course Outline:

Units, safety, ideal vs. real components, signals and waveforms. Ohm's law; KCL/KVL; series and parallel networks; voltage/current division. Network theorems: Thevenin/Norton, superposition, maximum power transfer. Capacitors and inductors; transient response of RC/RL circuits. Sinusoidal steady-state; phasors; complex impedance; average and reactive power. Diodes: I–V characteristics; rectifiers; clipping/clamping; Zener regulation. BJTs and MOSFETs: operation regions, biasing concepts, small-signal view. Operational amplifiers: ideal op-amp rules; inverting/non-inverting; summing; integrator/differentiator. First-order filters: RC low/high pass; basic active filters with op-amps. Introduction to digital logic levels (TTL/CMOS), logic gates, and basic combinational circuits. Measurement concepts: DMM, oscilloscope, function generator; prototyping practices. Application examples and mini design case studies.

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

1. Floyd. Electronic Devices. Pearson.
2. Horowitz & Hill. The Art of Electronics. Cambridge University Press.

CYDE-6203 Hardware Security	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (3-0) 3-0 None

Course Introduction:

This course provides a comprehensive study of hardware security threats and countermeasures across the integrated circuit and system life cycle. Students will explore secure design principles, roots of trust, and key technologies such as secure boot, PUFs, and TRNGs. The course covers side-channel and fault-injection attacks, as well as microarchitectural vulnerabilities and mitigation techniques. FPGA/SoC security, IP protection methods, and secure memory management are also discussed. Practical case studies and compliance standards are integrated to connect theory with industry applications.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Explain hardware threat models, attack surfaces, and secure design principles across the supply chain.	C2 (Understand)
CLO-2	Apply conceptual techniques for evaluating side-channel and fault-injection risks and propose countermeasures.	C3 (Apply)
CLO-3	Analyze hardware security architectures (root of trust, secure boot, memory protection) and evaluate trade-offs.	C4 (Analyze)

Course Outline:

Overview of hardware security and life-cycle threats; supply-chain and test-time exposures. Roots of trust, device identity, key storage; secure boot concepts; TPM/TEE overview. Physically Unclonable Functions (PUFs) and True Random Number Generators (TRNGs). Side-channel attacks: timing, power, EM; leakage models and countermeasure themes (masking, hiding, balancing). Fault injection: voltage/clock glitching, EMFI, laser; detection and recovery strategies. Microarchitectural attacks (cache timing, Spectre/Meltdown themes). DRAM Rowhammer; mitigations and performance trade-offs. FPGA/SoC security: bitstream encryption/authentication; secure debug and JTAG lockdown. IP protection and anti-tamper: obfuscation, watermarking, logic locking. Secure memories and key management; eFuses and lifecycle states. Secure hardware development flows; verification and validation for security; Trojan detection concepts. Compliance and certification themes; case studies from industry incidents

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

1. Tehranipoor & Wang. Introduction to Hardware Security and Trust. Springer.
2. Woudenberg & O'Flynn. The Hardware Hacking Handbook. No Starch Press.

CYDE-6204 Malware Analysis	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (3-0) 3-0 None

Course Introduction:

This course introduces the principles and practices of malware analysis, emphasizing safe workflows, ethical considerations, and secure lab environments. Students will gain familiarity with executable formats, packing/obfuscation techniques, and both static and dynamic analysis methods. Topics include identifying behavioral indicators, persistence mechanisms, code injection techniques, and anti-analysis strategies. The course also covers network traffic inspection, memory forensics, and extraction of indicators of compromise. Practical exercises and reporting skills are integrated to prepare students for real-world threat analysis and mitigation.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Explain malware types, infection vectors, and analysis ethics and safety, including relevant OS internals.	C2 (Understand)
CLO-2	Apply static and dynamic analysis techniques to triage samples, extract indicators, and document behavior.	C3 (Apply)
CLO-3	Analyze persistence, evasion, and C2 techniques and synthesize actionable detection/reporting artifacts.	C4 (Analyze)

Course Outline:

Malware landscape, terminology, and ethics; safe analysis workflows and environment isolation concepts. Windows PE and Linux ELF fundamentals; packers and obfuscation themes. Static triage: strings, hashes, metadata, imports/exports; basic YARA concepts. Disassembly and control-flow concepts; recognizing common library/API patterns. Dynamic behavior: processes/threads, registry and file system activity, services, and drivers (conceptual). Network indicators: DNS, HTTP(S), common C2 patterns; basics of traffic inspection. Persistence mechanisms: Run keys, services, scheduled tasks, startup folders, cron, LD_PRELOAD ideas. Code injection and API hooking concepts; DLL search order issues and reflective loading ideas. Anti-analysis and evasion: anti-debug/anti-VM, timing checks, environment awareness; counter-techniques (conceptual). Memory forensics overview; artifacts and timeline reasoning; IOC extraction. Reporting structure: technical write-up, IOCs, and mitigation recommendations: mapping to ATT&CK concepts

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

1. Sikorski & Honig. Practical Malware Analysis. No Starch Press.
2. Ligh, Case, Levy, Walters. The Art of Memory Forensics. Wiley.
3. Ligh, Adair, Hartstein, Richard. Malware Analyst's Cookbook. Wiley.

CYDE-6205 Theory of Automata	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
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.

CYDE-6206 HCI & Computer Graphics	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
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

CYDE-6207 Computer Architecture	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (3-0) 3-0 None

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

CYDE-6208 Advanced Digital Logic Design	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

Course Introduction:

This course provides an in-depth study of modern digital logic design methodologies. It builds upon the foundational concepts of logic gates and sequential circuits, introducing advanced design techniques for large-scale systems. Students will explore programmable logic devices and hardware description languages to implement and simulate complex designs. The course bridges theoretical understanding with practical implementation skills.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand theoretical and practical aspects of advanced digital logic design.	C2 (Understand)
CLO-2	Apply principles and techniques of advanced digital logic design to solve problems.	C3 (Apply)
CLO-3	Analyze and evaluate solutions in advanced digital logic design.	C4 (Analyze)

Course Outline:

Review of combinational and sequential logic concepts; Advanced minimization techniques using Karnaugh maps and Quine-McCluskey method; Synchronous circuit design with flip-flops and latches; Design and analysis of asynchronous circuits; Timing hazards and metastability issues; Finite state machine design using Mealy and Moore models; Design methodologies using VHDL and Verilog; Implementation of digital systems on FPGAs; Testing and verification techniques; Power consumption and optimization in digital designs; Industry case studies in hardware design.

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

1. M. Morris Mano, Michael D. Ciletti, Digital Design with an Introduction to the Verilog HDL, VHDL, and SystemVerilog, Pearson.
2. Stephen Brown, Zvonko Vranesic, Fundamentals of Digital Logic with VHDL Design. McGraw-Hill.

CYDE-6209 Wireless and Mobile Security	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

Course Introduction:

This course examines security challenges unique to wireless and mobile communication systems. It focuses on threats, vulnerabilities, and countermeasures in environments like WLANs, MANETs, and WSNs. Students will learn about encryption techniques, authentication protocols, and intrusion detection systems tailored for mobile platforms. Real-world attacks and security frameworks are analyzed to prepare students for practical security problem-solving.

CLO	Course Learning Outcomes	Bloom

No.		Taxonomy
CLO-1	Understand theoretical and practical aspects of wireless and mobile security.	C2 (Understand)
CLO-2	Apply principles and techniques of wireless and mobile security to solve problems.	C3 (Apply)
CLO-3	Analyze and evaluate solutions in wireless and mobile security	C4 (Analyze)

Course Outline:

Introduction to wireless and mobile networks; Security vulnerabilities in wireless communication; WLAN security protocols including WPA3; Mobile device security challenges; Cryptographic techniques for mobile systems; Authentication and authorization protocols; Secure routing in MANETs and WSNs; Intrusion detection and prevention systems; Privacy protection and anonymity in mobile environments; Case studies of real-world wireless attacks; Emerging trends in mobile security.

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

1. Yi-Bing Lin, Ai-Chun Pang, Wireless and Mobile Network Security, Wiley.
2. William Stallings, Wireless Communications & Networks, Pearson.

CYDE-6210 Embedded System	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

Course Introduction:

This course introduces the principles and practices of embedded systems design. It covers both hardware and software aspects, enabling students to create real-time applications with microcontrollers and embedded processors. The course emphasizes interfacing, control logic, and power efficiency. Hands-on lab sessions ensure practical skills in programming and debugging embedded devices.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand theoretical and practical aspects of embedded system.	C2 (Understand)
CLO-2	Apply principles and techniques of embedded systems to solve problems.	C3 (Apply)
CLO-3	Analyze and evaluate solutions in embedded systems	C4 (Analyze)

Course Outline:

Overview, applications, and characteristics of embedded systems, Microcontroller architectures, selection criteria, and performance considerations, Memory organization, address mapping, and I/O interfacing techniques, Embedded C programming for hardware control and system logic, Timers, interrupts, and efficient event-driven programming, Serial and parallel communication protocols (UART, SPI, I2C) for device connectivity, Interfacing with sensors, actuators, and display modules. Real-time operating systems (RTOS) concepts, scheduling, and task management, Power optimization strategies, debugging tools, testing methods, and industrial

case studies.
Reference Materials (or use any other standard and latest books):
1. Raj Kamal, Embedded Systems: Architecture, Programming and Design, McGraw-Hill. 2. Frank Vahid, Tony Givargis, Embedded System Design: A Unified Hardware/Software Introduction, Wiley.

CYDE-6211 Cyber Law & Cyber Crime (Cyber Warfare)	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (3-0) 3-0 None

Course Introduction:

This course provides a comprehensive understanding of the legal frameworks governing cyberspace. It examines the nature and scope of cybercrimes, cyber warfare tactics, and international legal standards. Students will explore the ethical, social, and political dimensions of cybersecurity policies. Case studies of high-profile cyber attacks are analyzed to understand the application of laws in practice.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand theoretical and practical aspects of cyber law & cyber crime (cyber warfare)	C2 (Understand)
CLO-2	Apply principles and techniques of cyber law & cyber crime (cyber warfare) to solve problems	C3 (Apply)
CLO-3	Analyze and evaluate solutions in cyber law & cyber crime	C4 (Analyze)

Course Outline:

Introduction to cyber law and digital rights; National and international cybercrime legislation; Types and classifications of cybercrimes; Cyber forensics and evidence handling; Understanding cyber warfare strategies and state-sponsored attacks; Privacy laws and data protection regulations; International cooperation in combating cybercrime; Case studies of legal proceedings in cybercrime cases; Emerging trends in cyber legislation; Ethical issues in cybersecurity governance.

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

1. Jonathan Clough, Principles of Cybercrime, Cambridge University Press.
2. Nandan Kamath, Law Relating to Computers, Internet and E-Commerce, Universal Law Publishing.

CYDE-6212 Penetration Testing	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (3-0) 3-0 None

Course Introduction:

This course equips students with the knowledge and practical skills required to assess and strengthen the security of computer systems, networks, and applications through ethical hacking practices. It covers full penetration testing lifecycle—from reconnaissance and vulnerability assessment to exploitation and post-exploitation activities—using industry-standard tools and methodologies. Students will learn how to simulate real-world cyberattacks in a controlled and legal environment, analyze discovered vulnerabilities, and provide professional security recommendations. The course emphasizes legal and ethical considerations to ensure responsible security testing in compliance with organizational policies and laws.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand penetration testing concepts, phases, and associated legal and ethical considerations.	C2 (Understand)
CLO-2	Apply penetration testing tools and techniques to identify and exploit security vulnerabilities.	C3 (Apply)
CLO-3	Analyze penetration testing findings, document results, and recommend remediation measures	C4 (Analyze)

Course Outline:

Introduction to penetration testing, ethical considerations, and legal compliance, Penetration testing lifecycle including planning, scoping, and engagement rules, Reconnaissance and information gathering through passive and active techniques, Vulnerability scanning, analysis, and prioritization of identified flaws, Exploitation of network, application, and endpoint vulnerabilities, Web application and API testing with emphasis on OWASP Top 10, Wireless and IoT penetration testing methodologies, AI-driven penetration testing tools and automation strategies, Security testing approaches for cloud environments and quantum-resistant systems, Post-exploitation procedures, reporting, and delivery of actionable recommendations.

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

1. A comprehensive and timely guide that covers the modern penetration testing lifecycle—from reconnaissance to reporting.
2. Includes real-world case studies, AI-driven tools, and insights into cloud and quantum-resistant security.

CYDE-6213 Control System Security	
Credit Hours: **Contact Hours:** **Pre-requisites:**	3 (3-0) 3-0 None

Course Introduction:

This course provides an in-depth understanding of control system security, focusing on protecting Supervisory Control and Data Acquisition (SCADA) systems, Distributed Control Systems (DCS), and Programmable Logic Controllers (PLCs) from cyberattacks. Students will

explore security architectures, threat models, standards (such as NIST SP 800-82 and ISA/IEC 62443), defense strategies, and incident response techniques. Through a combination of lectures, case studies, and hands-on labs, participants will develop the skills needed to assess risks, design secure architectures, and implement effective defenses for industrial environments.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand industrial control system (ICS) architectures, components, and unique security challenges.	C2 (Understand)
CLO-2	Apply security frameworks, tools, and best practices to protect ICS and SCADA environments.	C3 (Apply)
CLO-3	Evaluate risks, detect threats, and design effective incident response strategies for control systems	C5 (Evaluate)

Course Outline:

Introduction to Control System Security – definition of cybersecurity for Automation and Control Systems (ACS) or Industrial Control Systems (ICS), history and notable incidents such as Stuxnet and Olympic Pipeline, importance of confidentiality, integrity, and availability in control environments, key reading from *Handbook of SCADA/Control Systems Security*. Architecture and components of ICS – core elements including sensors, actuators, controllers, PLCs, DCS, SCADA, HMIs, and historians, use of the Purdue Reference Model, segmentation, and network zones, reference from *Industrial Network Security* by Knapp & Langill. Threats and attack vectors – common vulnerabilities such as insecure connectivity, legacy protocols, and hard-coded passwords, advanced threats like Stuxnet and pin-control attacks on PLCs, emerging risks from ICS-IT integration and IoT exposure, reading from *NIST SP 800-82 Rev2 – Guide to ICS Security*. Security standards and frameworks – overview of IEC / ISA-IEC 62443 standards and lifecycle approach for IACS security, IEC 62351 for power-system communication protocols, NIST frameworks including SP 800-82 and the NIST Cybersecurity Framework. Defense strategies and resilience – defense-in-depth approaches, zoning, segregation, and network controls, security architectures for resilient ICS systems, information flow control, anomaly detection, and active defense mechanisms. Risk assessment and governance – threat identification, risk modeling, and vulnerability analysis, governance, regulations, and compliance requirements such as ISA/IEC 62443, NIST, CSSP, NCCIC, policies for incident reporting, and recovery planning. Incident response and forensics – monitoring, detection, and event log analysis, forensics for ICS breaches, case studies of real incidents and effective responses. Hands-on labs and case studies – practical work on PLC programming, HMI analysis, and SCADA protocol capture, simulated exploration of real-world attack scenarios, and applying resilient architectures and defense tools in practice.

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

1. Handbook of SCADA/Control Systems Security – foundational concepts and practical insights.
2. Industrial Control Systems Security and Resiliency – Springer book on architecture and resilience in ICS.

CYDE-6214 Analysis of Information Systems	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

Course Introduction:

This course provides students with the tools and techniques for analyzing information systems requirements. The course covers three units – systems analysis fundamentals, information requirements analysis, and the analysis process. The systems analysis fundamentals unit stresses the basics that students need to know about what an analyst does: how information systems fit into organizations; how to determine whether a systems project is worthy of commitment; and how to manage a systems project. The information requirements analysis unit emphasizes the use of systematic and structured methodologies for conducting such requirements analysis. The analysis process builds on the other previous two units and move students into analysis of data flow as well as structured and semi-structured decisions. It includes details on how to use structured techniques to draw data flow diagrams.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand the fundamentals of systems analysis, the role of an analyst, and how information systems align with organizational needs.	C2 (Understand)
CLO-2	Apply systematic and structured methodologies to conduct information requirements analysis for systems projects.	C3 (Apply)
CLO-3	Analyze data flows and decision processes using structured techniques such as data flow diagram.	C4 (Analyze)

Course Outline:

Types of information systems and their appropriate implementation levels within organizations; Roles and responsibilities of a systems analyst; Overview of development methodologies and their benefits for systems analysis; Key factors in assessing the feasibility and worthiness of a system project; Project management techniques using Gantt Charts and PERT Diagrams; Analysis techniques for identifying and understanding user requirements; Application of structured techniques to construct data flow diagrams; Representation of structured decisions using Structured English, Decision Tables, and Decision Trees; Preparation and writing of a comprehensive systems proposal.

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

1. Open Textbook on Systems analysis/Software engineering/Software development.
2. Supplementary Readings/Resources: Systems Analysis and Design. 9th. Edition. Kendall and Kendall. Prentice Hall

CYDE-6215 Cryptanalysis	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

Course Introduction:

This course delves into advanced topics in cryptanalysis and post-quantum cryptography, equipping students with the knowledge and skills to understand, evaluate, and attack modern cryptographic systems. It covers a wide range of cryptanalytic techniques, including discrete logarithm and factoring methods, lattice-based approaches, quantum cryptanalysis, and classical attack models such as linear, differential, and algebraic attacks. Students will explore cutting-edge methods like sponge and cube attacks, advanced differential strategies, and statistical

ineffective fault attacks, along with protocol-level vulnerabilities in systems like TLS. The course also introduces post-quantum cryptographic paradigms, focusing on coding-based and lattice-based schemes, as well as the Learning With Errors (LWE) problem. By the end of the course, students will be prepared to critically assess cryptographic security in both classical and quantum contexts.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand advanced cryptanalysis techniques and their impact on modern cryptographic systems.	C2 (Understand)
CLO-2	Apply classical, algebraic, and protocol-level attacks to evaluate cryptographic security.	C3 (Apply)
CLO-3	Analyze and assess post-quantum cryptographic schemes including coding-based and lattice-based approaches.	C4 (Analyze)

Course Outline:

Discrete logarithm problem and its role in cryptography; Factoring techniques and applications of continued fractions in cryptanalysis; Introduction to lattices and their use in cryptographic constructions and attacks; Fundamentals of quantum cryptanalysis and its implications for classical cryptosystems; Linear cryptanalysis techniques for symmetric ciphers; Differential cryptanalysis principles and methods; Sponge functions and cube attacks in stream and hash-based cryptography; Advanced differential attacks targeting modern ciphers; Algebraic attacks and equation-solving approaches in breaking cryptosystems; TLS security analysis and protocol-level attack strategies; Statistical ineffective fault attacks and applications of Shor's algorithm in breaking public key cryptography; Post-quantum cryptography with a focus on coding-based schemes; Lattice-based cryptography and Learning With Errors (LWE) problems as foundations for PQC.

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

Applied Cryptanalysis Breaking cipher in the real world Mark Stamp & Richard M. Low San Jose State University Wiley Inter science ISBN 978-0-470-11489-5

CYDE-6216 Applied Cryptography

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

Course Introduction:

Applied Cryptography is a core discipline in cybersecurity that provides the mathematical and practical tools necessary to protect data integrity, confidentiality, authentication, and non-repudiation. This course focuses on *how cryptographic algorithms and protocols are used in real-world applications*, such as secure communications, digital signatures, public key infrastructures (PKI), and blockchain systems.The course combines theoretical foundations with practical implementation insights to enable students to apply cryptography effectively in systems development and analysis.

CLO No.	Course Learning Outcomes	Bloom Taxonomy

CLO-1	Understand key cryptographic concepts and goals.	C2 (Understand)
CLO-2	Apply symmetric and asymmetric cryptographic techniques in real-world scenarios.	C3 (Apply)
CLO-3	Use hashing and digital signatures for data integrity and authentication.	C4 (Analyze)

Course Outline:

Introduction to cryptography including its history, evolution, and core principles of confidentiality, integrity, authentication, and non-repudiation, along with classical ciphers such as Caesar, Vigenère, and the one-time pad; Symmetric-key cryptography covering stream and block ciphers, DES, 3DES, AES, and modes of operation including ECB, CBC, CFB, OFB, and CTR; Asymmetric-key cryptography focusing on RSA, Diffie–Hellman key exchange, and elliptic curve cryptography (ECC); Cryptographic hash functions including MD5, SHA-1, SHA-2, SHA-3, their security properties, and HMAC; Digital signatures and certificates covering DSA, ECDSA, PKI, and X.509 certificates; Secure communication protocols including TLS/SSL, IPsec, SSH, PGP, and S/MIME; Cryptanalysis and vulnerabilities such as brute-force, differential and linear cryptanalysis, side-channel attacks, and weaknesses in random number generation; Practical cryptographic implementations using libraries like OpenSSL, Bouncy Castle, and Libsodium, with encryption/decryption coding and key management; Applications of cryptography in blockchain and cryptocurrency including hashing in Bitcoin/Ethereum, key usage in wallets, smart contracts, and cryptographic proofs; Emerging trends such as post-quantum cryptography, homomorphic encryption, and zero-knowledge proofs; Legal, ethical, and regulatory aspects of cryptography including export controls and compliance with GDPR, HIPAA, and national laws; Final projects involving analysis or implementation of cryptographic applications or protocols.

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

1. Applied Cryptography: Protocols, Algorithms, and Source Code in C, Bruce Schneier, Wiley, ISBN 978-1119096726

CYDE-6218 Embedded Systems Security	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

Course Introduction:

Embedded systems are specialized computing systems designed to perform dedicated functions within larger systems. These systems are commonly found in critical infrastructures, medical devices, automobiles, IoT devices, and industrial control systems. As their use grows, so does the risk of cyber-attacks, making embedded system security an essential part of modern cybersecurity education. This course introduces students to the fundamentals of embedded systems and the unique security challenges they face. It explores hardware and software vulnerabilities, secure firmware development, cryptographic implementations, attack surfaces, and real-world case studies. By the end of this course, students will be equipped to design and analyze secure embedded systems

CLO	Course Learning Outcomes	Bloom

No.		Taxonomy
CLO-1	Understand the fundamentals of embedded systems, their applications, and unique security challenges.	C2 (Understand)
CLO-2	Analyze hardware and software vulnerabilities, attack surfaces, and real-world security incidents in embedded systems.	C3 (Apply)
CLO-3	Apply secure design principles, firmware development practices, and cryptographic techniques to protect embedded systems.	C4 (Analyze)

Course Outline:

Introduction to embedded systems including definitions, examples, and their roles in critical infrastructure and IoT, along with architectures involving microcontrollers, SoCs, and related components; Embedded system design basics covering real-time operating systems (RTOS), memory types and constraints, instruction sets, and considerations for power and resource limitations; Threat modeling for embedded systems with attack surface analysis, differentiation between physical and remote attacks, and identification of common vulnerabilities such as buffer overflows and firmware exploits; Cryptography for embedded devices including lightweight algorithms, key management in constrained environments, and secure communication protocols like TLS and DTLS; Secure boot and firmware protection principles with code signing, firmware encryption, and update mechanisms; Hardware security features including Trusted Platform Modules (TPM), Trusted Execution Environments such as ARM TrustZone, and Physical Unclonable Functions (PUFs); Reverse engineering and attack methods including side-channel attacks, fault injection, and exploitation via JTAG or UART interfaces; Case studies of notable incidents such as Stuxnet, Mirai botnet, Jeep hack, and pacemaker attacks, with analysis of vulnerabilities; Secure development lifecycle practices for embedded systems covering threat modeling tools, static analysis, fuzzing, testing, and validation strategies; Regulatory and compliance considerations including ISO/IEC 27001, NIST guidelines, and IoT or embedded system security laws

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

1. Security Engineering for Embedded and Cyber-Physical Systems, A. Valdes, R. Poovendran Springer ISBN: 978-3030298370

CYDE-6217 Deep Learning	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

Course Introduction:

Deep neural networks have achieved state of the art performance on several compute vision and speech recognition benchmarks. Deep learning algorithms extract layered high and low level features from raw data. With increasing non-line hidden layers, the discriminative power of the network improves. This course builds on the fundamentals of Neural networks and artificial intelligence and covers advanced topics in neural networks, convolutional and recurrent network structures, deep unsupervised and reinforcement learning. It also embeds applications of these algorithms to several real-world problem in computer vision, speech recognition, natural language processing, game theory, etc.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Apply deep learning algorithms to real-world problems	C3 (Apply)
CLO-2	Analyze results from deep learning to select appropriate solutions	C4 (Analyze)
CLO-3	Code the novel neural network architectures from scratch and evaluating the performance on application specific standard benchmarks	C3 (Apply)

Course Outline:

Basics of deep learning, learning networks, Shallow vs. Deep learning etc.; Machine learning theory – training and test sets, evaluation, etc. Theory of Generalization; Multi-layer perceptrons, error back-propagation; Deep convolutional networks, Computational complexity of feed forward and deep convolutional neural networks; Unsupervised deep learning including auto-encoders; Deep belief networks; Restricted Boltzman Machines; Deep Recurrent Neural Networks (BPTT, LSTM, etc.); GPU programming for deep learning CuDNN; Generative adversarial networks (GANs); Sparse coding and auto-encoders; Data augmentation, elastic distortions, data normalization; Mitigating overfitting with dropout, batch normalization, dropconnect; Novel architectures, ResNet, GoogleNet, etc

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

1. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville (http://www.deeplearningbook.org/)
2. Deep learning with python by Francoise Chollet, ISBN-10: 9781617294433, 2017

CYDE-6219 Mobile Application Development

Credit Hours:	3 (3-0)
Contact Hours:	3-0
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.

CYDE-6220 Introduction to Cryptography	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	None

Course Introduction:

This course offers a rigorous exploration of the mathematical principles underlying modern cryptography, bridging abstract theory with practical applications in secure communication. It equips students with a solid grounding in number theory, algebra, and finite fields, enabling them to understand and design cryptographic algorithms. Beginning with foundational arithmetic and modular mathematics, the course advances through classical and modern cryptosystems, public key infrastructures, primality testing, and factoring techniques. Special emphasis is placed on elliptic curves and their role in encryption, digital signatures, and cryptographic protocols. By combining mathematical theory with algorithmic implementation, students will gain the skills necessary to analyze, implement, and evaluate secure systems against emerging cryptographic challenges.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand mathematical foundations of cryptography including number theory, algebra, and finite fields.	C2 (Understand)
CLO-2	Apply cryptographic algorithms and protocols such as RSA, discrete logarithm schemes, and elliptic curve cryptography.	C3 (Apply)
CLO-3	Analyze and evaluate cryptographic systems using primality testing, factoring algorithms, and advanced security techniques.	C4 (Analyze)

Course Outline:

Mathematical foundations for cryptography including essential concepts from number theory and algebra; Time estimates for arithmetic operations, divisibility rules, Euclidean algorithm, and modular congruences with direct applications in factoring; Exploration of finite fields, quadratic residues, and the law of quadratic reciprocity as a basis for cryptographic primitives; Study of classical cryptosystems and matrix-based enciphering methods; Public key cryptography including RSA, discrete logarithm-based schemes, knapsack cryptosystems, and advanced concepts such as zero-knowledge protocols and oblivious transfer; Primality testing techniques and factoring algorithms including pseudoprimes, Pollard's rho method, Fermat factorization, continued fraction method, and the quadratic sieve; Introduction to elliptic curves, their algebraic properties, and their use in cryptosystems, primality testing, and factorization; Integration of theoretical tools and algorithmic approaches for the design, analysis, and evaluation of modern cryptographic protocols

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

1. Basics of Number Theory: Time estimates for doing arithmetic, Divisibility and the Euclidean algorithm, Congruences, Some applications to factoring.
2. Finite Fields and Quadratic Residues: Finite fields, Quadratic residues and reciprocity.

CYDE-6221 Cloud Computing

Credit Hours:	3 (3-0)
Contact Hours:	3-0
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.

CYDE-6222 Internet of Everything

Credit Hours:	3 (3-0)
Contact Hours:	3-0
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.

CYDE-6223 Digital Marketing and Ecommerce	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
Pre-requisites:	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.

CYDE-6224 Web3 and Blockchain Fundamentals	
Credit Hours:	3 (3-0)
Contact Hours:	3-0
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.

CYDE-6225 UI / UX Designing

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

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 usable 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)

Preliminary Courses for Pre-Medical Students

URCM-5107 Mathematics I

Credit Hours:	Non-Credit
Contact Hours:	3
Pre-requisites:	None

Course Introduction:

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.

Course Contents

1. Preliminaries
2. Real-number system, complex numbers
3. Introduction to sets, set operations, functions, types of functions.
4. Matrices Introduction to matrices, types, matrix inverse, determinants, system of lim Cramer's rule.
5. Quadratic Equations

6. Solution of quadratic equations, qualitative analysis of roots of a quadratic
7. Equations reducible to quadratic equations
8. Cube roots of unity, relation between roots and coefficients of quadratic
9. Sequences and Series
10. Arithmetic progression
11. Geometric progression
12. Harmonic progression
13. Binomial Theorem
14. Introduction to mathematical induction
15. Binomial theorem with rational and irrational indices.
16. Trigonometry, Fundamentals of trigonometry, Trigonometric identities.

Reference Materials:

Recommended Text

1. Thomas. G. B.. & Finney, A. R. (2005). Calculus. Reading: Addison-Wesley.
2. Anton. H., Bevens. L., & Davis. S. (2005). Calculus: A new horizon (8th ed.). New York: Joll Wiley.

Suggested Readings

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

URCM-5108 Mathematics II

Credit Hours:	Non-Credit
Contact Hours:	3
Pre-requisites:	None

Course Introduction:

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.

Course Contents:

1. Preliminaries
2. Real-number line
3. Functions and their graphs
4. Solution of equations involving absolute values, inequalities.
5. Limits and Continuity
6. Limit of a function
7. Left-hand and right-hand limits
8. Continuity

9. Continuous functions.
10. Derivatives and their Applications
11. Differentiable functions
12. Differentiation of polynomial
13. Rational and transcendental functions, derivatives.
14. Integration and Definite Integrals
15. Techniques of evaluating indefinite integrals
16. Integration by substitution, integration by parts
17. Change of variables in Indefinite integrals.

Reference Materials:

Recommended Text

1. Thomas. G. B.. & Finney. A. R. (2005). Calculus. Reading: Addison-Wesley.
2. Anton. H., Bevens. L., & Davis. S. (2005). Calculus: A new horizon (8th ed.). New York: Joll Wiley.

Suggested Readings

1. Stewart. J. (1995). Calculus (3rd ed.). Pacific Grove, California: Brooks/Cole.
2. Swokowski, E. W. (1983). Calculus and analytic geamerry. Boston: PWS-Kent Company.
3. 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:	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:

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:	None

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-5107 Principles of Marketing

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

Course Introduction:

The basic objective of those subjects is to introduce the marketing concept and how we identify, understand and satisfy the needs of customers and markets. To analyze companies and competitors and to introduce marketing strategy to increase awareness of the strategic and tactical decisions behind today's top performing brands. Main purpose of the course is to teach students how marketing works in industrial life. Students must be aware of products, brands, and their pricing strategies, modes of transportation, logistics and types of communication for

marketing. Advertising is the key to marketing. This course is designed to serve as an introduction to the basic principles of marketing, practices, and the application of these practices. This course examines our present-day marketing system from a managerial point of view and has a current events component to help emphasize the marketing principles in today's business world. Subjects covered include consumers, market research and target markets, feasibility analysis, products, promotion, channels of distribution, pricing, international marketing and use of technology in marketing.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	To apply the basic principles and tools of marketing	C3
CLO-2	To Discuss concepts, tools, and skills necessary in developing an effective marketing plan	C1
CLO-3	To integrate theoretical concepts with practical marketing problems	C4

Course Outline:

1. Introduction: Marketing in Changing World: Creating Customer Value and Satisfaction.
2. Strategic Planning and the Marketing Process
3. Global Marketing Environment; Marketing
4. Research and Information Systems
5. Consumer Markets and Consumer Buyer Behavior,
6. Business Markets and Business Buyer Behavior
7. Marketing Segmentation, Targeting, and
8. Positioning for Competitive Advantage Product and Services strategy
9. New Products Development and Product Life-Cycle Strategies
10. Pricing Products: Pricing Considerations and Approaches
11. Pricing Strategies Distribution Channels and Logistics Management
12. Retailing
13. Wholesaling

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

Recommended Texts

1. Kotler. Philip, Armstrong, Gary, Opresnik, Marc Oliver. (2018). Principles of marketing 17th ed.(17th ed., Global Ed.).Harlow: Pearson.

Suggested Readings

1. W. D. Perreault, Jr., J.P Cannon, and E. J. McCarthy (2009).*Basic Marketing: A Marketing Strategy and Planning Approach.* (17thed). Irwin/McGraw Hill.

BUSB-6102 Human Resource Management	
Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	None

Course Introduction:

The principal objective of this course is to gain knowledge in the field of human resource management and enabling them to understand the human resource functions and practices in banks/organization for improved performance and help create a transparent organizational culture and maintain competitive advantage. The course also provides an overall understanding

of organizational behavior concepts to assist in recognizing organizational structure, culture and development concepts so that they are better equipped to perform in the organization, make informed decisions and effectively manage supervisors and subordinates for enhanced performance.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	To prepare students to gain knowledge in the field of human resource management	C2
CLO-2	To enabling them to understand the human resource functions	C2
CLO-3	To equip students with skills to make informed decisions and effectively manage supervisors and subordinates for enhanced performance	C3

Course Outline:

Concepts of human resource management
2. Human Resource Challenges
3. Human Resource Functions
4. Philosophical approaches to Human Resource Management Job Design and Analysis
5. An overview of Job design
6. Techniques of job design, Job analysis
7. Planning & Recruitment
8. Significance of Human Resource Planning, The planning process, the implementation of program
9. Recruitment & selection policy issues, Source of recruitment, Selection process & procedure
10. Evaluation of Human Resource Planning &Recruitment, Career
11. Planning & Development: Promotion, Anachronism, Demotion
12. Separation., Training and Development
13. Significance of training & development, Principles of training &development
14. Training & development methods, Evaluation of training & development

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

Recommended Text:

1. DeCenzo, David A. Fundamentals of human resource management / David A. DeCenzo, Stephen P. Robbins, Susan L. Verhulst.-- 12th edition.
2. Werther, W. B & Davis, K. Human Resource & Personnel. New York McGraw Hill.

Suggested Readings:

1. Bazerman, M. H., & Gino, F. (2012).Behavioral ethics: Toward a deeper understanding of moral judgment and dishonesty. Annual Review of Law and Social Science, 8(1), 85-104.

BUSB-5102 Financial Accounting-I	
Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	None

Course Introduction:

Bookkeeping is important for helping you maintain accurate financial records. Yet still, many businesses fail to implement this integral process. Without bookkeeping or accounting, you are blindly driving your business. The bookkeeping process primarily records the financial effects

of transactions. An important difference between a manual and an electronic accounting system is the former's latency between the recording of a financial transaction and it's posting in the relevant account.		
CLO No.	**Course Learning Outcomes**	**Bloom Taxonomy**
CLO-1	To introduce the students with basics of Book-keeping and Accounting.	C1
CLO-2	To create understanding of students' with cash book, purchase book and sales book.	C2
CLO-3	To prepare students to immediately documenting a financial transaction.	C3

Course Outline:

Introduction to the main concepts of accounting
2. Need, purpose and objectives of accounting
3. Types of transactions, Nature of transactions
4. Detail overview of accounting resources and Claims Against Resources
5. Detail overview of sources of funds
6. The Accounting Equation, Shortcomings of accounting equation
7. Business Entity Principle
8. Money measurement principle
9. Class Activity, The Accounting Process
10. Objectivity Principle
11. Time Period Principle
12. Going Concern Assumption
13. Rules of Recording and Debit & Credit
14. Preparation of Final Accounts from Trial Balance without Adjustments
15. Importance of trial balance

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

Recommended Text

1. Williams, J. R., Haka, S. F., Bettner, M. S., & Carcello V.J. (2020). Financial & Managerial *Accounting: the basis for business decisions.* (18thed). New York: Mcgraw-Hill College.

Suggested Readings

1. Larson, K. D., Wild, J. J., & Chiappetta, B. (2005).Financial Accounting. (18thed.). Irwin: McGraw.Hill.
2. Hall, A. James., (2009). Accounting Information System. (6thed). Thomson: South-Western.

BUSB-5104 Introductory Business Economics	
Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	None

Course Introduction:

Micro and Macro Business Economics examines how economic decisions are made by households and firms, and how they interact to determine the quantities and prices of goods and the allocation of resources under different market structures. It also studies the equilibrium in presence of externalities/public goods and information asymmetry. The course examines micro and macroeconomic policy and the role of government in allocating resources. It will develop

ability to apply the knowledge acquired to the analysis of specific economic cases, recognizing proper framework of analysis and constructing and analyzing adequate economic model within this framework.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	To clarify and extend the Microeconomic concepts and to develop analytical skills and solving petty problems.	C4
CLO-2	To enabling them to understand the Microeconomic functions.	C2
CLO-3	To equip students with advanced theoretical concepts and rigorous analysis with mathematical tools at hand.	C5

Course Outline:

1. Scope of Microeconomics and areas of its concern
2. Theory of Consumer Behavior, Cardinal and ordinal approach to indirect utility functions
3. Demand & Elasticity: Derivation of demand functions using indifference curves
4. Production Functions, Different production functions: Cobb Douglas and CES etc
5. Cost of Production, Different types of costs, Cost minimization subject to given output
6. Monopoly and Monopsony, bilateral monopoly, price discrimination
7. Monopolistic Competition and Oligopoly, Pricing of the Factors of Production
8. The introduction of Keynesian revolution and growth of Macroeconomics
9. Oken's Law and unemployment, Price Indices and Inflation
10. Exogenous and Endogenous variables and their functional relationships
11. Introduction to the Classical and Keynesian Schools of Thought
12. Measurement of National Income
13. Injections into and Leakages from the economy: Saving and Investment
14. The closed and open economy models
15. Real and Financial investment, Autonomous and Induced investment
16. Lags in Investment Demand, Volatility of Investment, Equilibrium in the goods market
17. The demand for money, The Quantity Theory of Money, The Liquidity Preference
18. The supply of money: M1, M2, M3 concepts
19. Derivation of LM Curve (graphic)
20. Aggregate supply and the labor market
21. Inflation and Unemployment

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

Recommended Texts

1. Koutsoyiannis, A. (1975). Modern Microeconomics. (2nded.). London: Macmillan. 2. Mankiw, G. N. (2018). Macroeconomics. (4th ed.). Worth Publishers.

Suggested Readings

1. Silberberg, E. (2000).The Structure of Economics: A Mathematical Analysis. (3rded.). NJ: McGraw Hill.

Content of General Education Courses

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

Course Introduction:

The course aims at providing understanding of a writer's goal of writing (i.e. clear, organized and effective content and to use that understanding and awareness for academic reading and writing. The objectives of the course are to make the students acquire and master the grammatical academic writing skills. The course would enable the students to develop argumentative writing techniques. The students would be able to logically add specific details on the topics such as facts, examples and statistical or numerical values. The course will also provide insight to convey the knowledge and ideas in an objective and persuasive manner. Furthermore, the course will also enhance the students' understanding of ethical considerations in writing academic assignments and topics including citation, plagiarism, formatting and referencing the sources as well as the technical aspects involved in referencing.

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

Course Outline:

1. Developing Analytical Skills
2. Transitional devices (word, phrase and expressions)
3. Development of ideas in writing
4. Reading Comprehension
5. Precis Writing
6. Developing argument
7. Sentence structure: Accuracy, variation, appropriateness, and conciseness
8. Appropriate use of active and passive voice
9. Organization and Structure of a Paragraph
10. Organization and structure of Essay
11. Types of Essays

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

Recommended Texts

1. Bailey, S. (2011). Academic writing: A handbook for international students (3rd ed.). New York: Routledge.
2. Eastwood, J. (2011). A Basic English grammar. Oxford: Oxford University Press.
3. Swales, J. M., & Feak, C. B. (2012). Academic writing for graduate students: Essential tasks and skills (3rd ed.). Ann Arbor: The University of Michigan Press.
4. Swan, M. (2018). Practical English usage (8th ed.). Oxford: Oxford University Press.

Suggested Readings

1. Biber, D., Johansson, S., Leech, G., Conrad, S., Finegan, E., & Quirk, R. (1999). Longman grammar of spoken and written English. Harlow Essex: MIT Press.
2. Cresswell, G. (2004). Writing for academic success. London: SAGE.
3. Johnson-Sheehan, R. (2019). Writing today. Don Mills: Pearson.
4. Silvia, P. J. (2019). How to write a lot: A practical guide to productive academic writing. Washington: American Psychological Association
5. Thomson, A. J., & Martinet, A. V. (1986). A Practical English Grammar. Oxford: Oxford University Press

URCG-5119 Expository Writing ✓	
Credit Hours:	3 (3-0)
Contact Hours:	3
Pre-requisites:	-

Course Introduction:

This course prepares undergraduates to become successful writers and readers of English. The course helps students develop their fundamental language skills with a focus on writing so that they can gain the confidence to communicate in oral and written English outside the classroom. The course is divided into five units and takes a Project-based Learning approach. Unit themes target the development of 21st century skills and focus on self-reflection and active community engagement. The course completion will enable the students to develop communication skills as reflective and self-directed learners. They will be able to intellectually engage with different stages of writing process, and develop analytical and problem-solving skills to address various community-specific challenges.

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

Course Outline:

1. Self-Reflection
   - Introduction to the basics of the writing process
   - Introduction to the steps of essay writing
   - Prewriting activities: Brainstorming, listing, clustering and freewriting
   - Practicing Outlining of the essay
2. Personalized Learning
   - Learning Process, Learning Styles, Goal Setting and Learning Plan
3. Oral Presentation
   - Structure and Significance, Content Selection and Slide Presentation, Peer Review
4. Critical Reading Skills
   - Introducing Authentic Reading (Dawn and non-specialist academic books/texts)
   - Reading Strategies and Practice: Skimming, scanning, SQW3R, Annotating, Detailed reading and note-taking, Standard Test Practice: TOEFL and IELTS. Model Review Reports and Annotated Bibliographies
5. Community Engagement
   - Student-led brainstorming on local versus global issues, Identifying research problems
   - Drafting research questions, Drafting interview/survey questions for community research (in English or L1)
   - Engaging students in Critical reading, Presenting interview/ survey information. Field work
   - Writing Community Engagement Project
6. Letter to the Editor
   - Types of letters, Format and purpose of letter to the editor, Steps in writing letter-to-editor.

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

Recommended Texts

1. Bailey, S. (2011). Academic writing: A handbook for international students (3rd ed.). New York: Routledge.

2. Swales, J. M., & Feak, C. B. (2012). Academic writing for graduate students: Essential tasks and skills (3rd ed.). Ann Arbor: The University of Michigan Press.

Suggested Readings

1. Cresswell, G. (2004). Writing for academic success. London: SAGE.
2. Johnson-Sheehan, R. (2019). Writing today. Don Mills: Pearson.
1. Silvia, P. J. (2019). How to write a lot: A practical guide to productive academic writing. Washington: American Psychological Association

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

URCG-5105 Islamic Studies ✓	
Credit Hours:	2 (2-0)
Contact Hours:	2
Pre-requisites:	-

Course Introduction:

Islamic Studies engages in the study of Islam as a textual tradition inscribed in the fundamental sources of Islam; Qur'aan and Hadith, history and particular cultural contexts. The area seeks to provide an introduction to and a specialization in Islam through a large variety of expressions (literary, poetic, social, and political) and through a variety of methods (literary criticism, hermeneutics, history, sociology, and anthropology). It offers opportunities to get fully introductory foundational basis of Islam in fields that include Qur'aanic studies, Hadith and Seerah of Prophet Muhammad (PBUH), Islamic philosophy, and Islamic law, culture and theology through the textual study of Qur'aan and Sunnah.

- To make students understand the relevance and pragmatic significance of Islam in their lives.
- To make learners comprehend the true spirit of Islam with reference to modern world.
- To generate a sense of Islamic principles as a code of living that guarantee the effective solutions to the current challenges of being.
- To provide Basic information about Islamic Studies
- To enhance understanding of the students regarding Islamic Civilization
- To improve Students skill to perform prayers and other worships
- To enhance the skill of the students for understanding the issues related to faith and religious life.

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:

1. Introduction to Qur'aanic Studies — تعارف قرآن مجید

1) Basic Concepts of Qur'aan — قرآن مجید کا بنیادی تعارف
2) History of the compilation of Qur'aa — تاریخ جمع و تدوین قرآن مجید
3) Uloom-ul-Qur'aan — علوم القرآن

مطالعہ قرآن (تعارف قرآن مجید ، منتخب آیات کا ترجمہ و تفسیر سورۃ البقرہ آیات 1-5-284-286 سورۃ الحجرات آیات 1-18 - سورۃ الفرقان آیات 63-77؛ سورۃ المومنون ایات 1-11 سورۃ الاحزاب ایات 6، 21-32 33-5640 59 سورۃ

الانعام آیات 151-153، سورۃ الصف آیات 1 - 14: الحشر آیات 18 - 20 آل عمران آیات 190 - 192 النحل آیات 12-14 : لقمن آیت 20 ، حم السجدہ آیت 53

2Introduction to Hadith	تعارف حدیث
1) Legal Status of Hadith	حدیث کی قانونی
2) History of the compilation of Hadith	حیثیت ترین جمع وتدوین حدیث
3) Classifications of Hadith	حدیث کی اقسام

متن حدیث: درج ذیل موضوعات پر احادیث کا مطالعہ
1- اعمال کا اجر نیت پر منحصر ہے۔ 2- بہترین انسان قرآن کا طالب علم اور اس کا معلم ہے 3- کتاب وسنت گمراہی سے بچنے کا ذریعہ ہیں 4- ارکان اسلام 5- اسلام، ایمان، احسان اور قیامت کی نشانیاں 6- بچوں کو نماز کی تلقین 7- دین کا گہرا فہم اللہ کی خاص عنا یت ہے 8 حصول علم، تلاوت قرآن اور عمل کی اہمیت و فضیلت 9- روز محشر میں ہونے والا محاسبہ 10- حقوق اللہ کے ساتھ ساتھ حق العباد کالحاظ رکھنا بھی لازم ہے 11- حسن خلق کی عظمت اور فحش و بد گوئی کی مذمت 12 - دنیا و آخرت کی بھلائی کی ضامن چار چیزیں 13- ہلاک کر دینے والی سات چیزیں . 14- بے عمل مبلغ کا عبرت ناک انجام 15 - ہر شخص نگران ہے اور ہر شخص مسئول

Sirah of the Prophet (PBUH)	سیرت النبی ﷺ
1. Significance of Seerah Studies	مطالعہ سیرت کی ضرورت واہمیت
2. Prophetic principles of Character building	تعمیر سیرت و شخصیت کا نبوی منہاج

اقامت دین کا نبوی طریق کار ا قامت دین بعید خلافت را شدہ، میثاق مدینہ ، خطبہ حجۃ الوداع، اخلاقی تعلیمات، تشکیل اجتماعیت اور اسوہ حسنہ ، قرآن مجید میں سیرت سرور عالم کا بیان، غردات نبوی ﷺ کے مقاصد و حکمتیں

4. Islamic Culture & Civilization	اسلامی تہذیب و تمدن
1) Basic Concepts of Islamic Civilization	اسلامی تہذیب کا مفہوم
2) Historical evaluation of Islamic Civilization	اسلامی تہذیب کا تاریخی ارتقاء
3) Salient feature of Islamic Civilization	اسلامی تہذیب کی نمایاں خصوصیات
4) Islamic Civilization and Contemporary Issues	اسلامی تہذیب و تمد ن اور معاصر مسائل

اسلامی تہذیب کے عوامل و عناصر ، اسلامی تہذیب کے علمی، معاشرتی اور سماجی اثرات، تہذیبوں کے تصادم کے نظریے کا تنقیدی جائزہ، تہزیبی تصادم کے اثرات و نتائج ، طبیعی، حیاتیاتی اور معاشرتی علوم میں مسلمانوں کا کردار، نامور مسلمان سائنسدان

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

Hameed Ullah Muhammad, -Emergence of Islam, IRI, Islamabad
2) Hameed Ullah Muhammad, Muslim Conduct of State
3) Hameed Ullah Muhammad, Introduction to Islam
4) Ahmad Hasan, -Principles of Islamic Jurisprudence, Islamic Research Institute, International Islamic University, Islamabad (1993)
5) Dr. Muhammad Zia-ul-Haq,-Introduction to Al Sharia Al Islamia, Allama Iqbal Open University, Islamabad(2001)
6) Dr. Muhammad Shahbaz Manj, Teleecmat-e-Islam

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

Course Introduction:

This course focuses on ideological background of Pakistan. The course is designed to give a comprehensive insight about the constitutional developments of Pakistan. Starting from the Government of India Act, 1935 till to date, all important events leading to constitutional developments in Pakistan will be the focus of course. Failure of the constitutional machinery and leading constitutional cases on the subject. Moreover, students will study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan. It will also cover the entire Constitution of Pakistan 1973. However, emphasis would be on the fundamental rights, the nature of federalism under the constitution, distribution of powers, the rights and various remedies, the supremacy of parliament and the independence of judiciary.

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:

- **Ideology of Pakistan**
  - Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
  - Two Nation Theory and Factors leading to Muslim separatism.
- **Constitutional Developments**
  - Salient Feature of the Government of India Act 1935
  - Salient Feature of Indian Independence Act 1947
  - Objectives Resolution
  - Salient Feature of the 1956 Constitution
  - Developments leading to the abrogation of Constitution of 1956
  - Salient features of the 1962 Constitution
  - Causes of failure of the Constitution of 1962
  - Comparative study of significant features of the Constitution of 1956, 1962 and 1973
- **Fundamental rights**
- **Principles of policy**
- **Federation of Pakistan**
  - President
  - Parliament
  - The Federal Government
- **Provinces**
  - Governors
  - Provincial Assemblies
  - The Provincial Government
- **The Judicature**
  - Supreme Court

High Courts
Federal Shariat Courts
Supreme Judicial Council
Administrative Courts and tribunals

- **Islamic Provisions in Constitution**

Significant Amendments of Constitution of Pakistan 1973

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

1. Constitutional and Political History of Pakistan by Hamid Khan
2. Mahmood, Shaukat and Shaukat, Nadeem. Constitution of the Islamic Republic of Pakistan, 3rd re edn. Lahore: Legal Research Centre, 1996.
3. Munir, Muhammad. Constitution of the Islamic Republic of Pakistan: Being a Commentary on the Constitution of Pakistan, 1973. Lahore, Law Pub., 1975.
4. Rizvi, Syed Shabbar Raza. Constitutional Law of Pakistan: Text, Case Law and Analytical Commentary. 2nd re edn. Lahore: Vanguard, 2005.
5. The Text of the Constitution of the Islamic Republic of Pakistan, 1973 (as amended).
6. Fundamental Laws of Pakistan by A.K. Brohi

URCG-5126 Ethics ✓	
Credit Hours:	2 (2-0)
Contact Hours:	2
Pre-requisites:	-

Course Introduction:

CLO No.	Course Learning Outcomes	Bloom Taxonomy

Course Outline:

Meaning and Scope of Ethics.
2. Relation of Ethics with:
   (a) Religion
   (b) Science
   (c) Law
3. Historical Development of Morality:
   (a). Instinctive Moral Life.
   (b). Customary Morality.
   (c). Reflective Morality.
4. Moral Theories:
   (a). Hedonism (Mill)
   (b). Intuitionism (Butler)
   (c). Kant's Moral Theory.
5. Moral Ethics and Society.
   (a). Freedom and Responsibility.
   (b). Tolerance
   (c). Justice
   (d). Punishment (Theories of Punishment)
6. Moral Teachings of Major Religions:
   a). Judaism

b). Christianity
c). Islam
7. Professional Ethics:
a). Medical Ethics
b). Ethics of Students
c). Ethics of Teachers
d). Business Ethics

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

1. William Lille. An Introduction to Ethics., London Methuen & Co. latest edition.
2. Titus, H.H. Ethics for Today. New York: American Book, latest edition.
3. Hill, Thomas. Ethics in Theory and Practice. N.Y. Thomas Y. Crowel, latest edition
4. Ameer Ali, S. The Ethics of Islam. Calcutta: Noor Library Publishers, latest edition
5. Donaldson, D.M. Studies in Muslim Ethics. London: latest edition. 6. Sayeed. S.M.A.(Tr.) Ta'aruf-e-Akhlaqiat. Karachi: BCC&T, Karachi University of

PAKISTAN STUDIES

UGE POLICY V 1.1 : GENERAL EDUCATION COURSE

Credits:	02
Pre-Requisite:	Nil
Offering:	Undergraduate Degrees
Placement:	1 - 8 Semesters
Type:	General Education
Fields:	All

DESCRIPTION

This course is designed to provide students with a comprehensive exploration of Pakistan's identity, spanning geographical, historical, and cultural dimensions. It delves into the diverse landscapes, ancient civilizations, and rich cultural heritage that define Pakistan. Moreover, it examines the socio-cultural and political transformations in Pakistan over time including democratic transitions and military interventions. The aim of this course is to inculcate in students a nuanced understanding of Pakistan's past, present, and potential future trajectories, enabling them to critically evaluate the complex dynamics shaping the nation's development.

COURSE LEARNING OUTCOMES

By the end of this course, students will be able to:

1. Have enhanced knowledge of the geographical, historical, and political aspects of Pakistan.
2. Understand the society and culture of Pakistan.
3. Understand and explain the socio-economic developments in Pakistan.
4. Explore contemporary issues and challenges faced by Pakistan and their implications for the future.

SYLLABUS

1. **Introduction to Pakistan:**
   - Geographical location and significance.
   - Historical background: Ancient civilizations in the region.
   - Factors leading to the creation of Pakistan.
2. **Political History of Pakistan:**
   - Formative phase.
   - Military interventions and democratic transitions.
3. **Geography of Pakistan:**
   - Physiography: Mountains, plains, plateaus, deserts, valleys and coastal areas.
   - River systems: Indus River and its tributaries.
   - Climatic regions of Pakistan.
4. **Society and Culture of Pakistan:**
   - Socio-cultural diversity.
   - Languages and literature of Pakistan.
5. **Economic Development of Pakistan:**
   - Agriculture and industrial sectors of Pakistan.
   - Economic challenges of Pakistan.

URCG-5123 Application of Information & Communication Technologies	
Credit Hours:	3 (2-1)
Contact Hours:	2-3
Pre-requisites:	None

Course Introduction:

The course introduces students to information and communication technologies and their application in the workplace. Objectives include basic understanding of computer software, hardware, and associated technologies. How computers can be used in the workplace, how communications systems can help boost productivity, and how the Internet technologies can influence the workplace. Students will get basic understanding of computer software, hardware, and associated technologies. They will also learn how computers are used in the workplace, how communications systems can help to boost productivity, and how the Internet technologies can influence the workplace.

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:

1. Introduction, Overview of Information Technology.
2. Hardware: Computer Systems & Components, Storage Devices.
3. Software: Operating Systems, Programming and Application Software.
4. Databases and Information Systems Networks.
5. File Processing Versus Database Management Systems.
6. Data Communication and Networks.
7. Physical Transmission Media & Wireless Transmission Media.
8. Applications of smart phone and usage.
9. The Internet, Browsers and Search Engines.
10. Websites and their types.
11. Email Collaborative Computing and Social Networking.
12. E-Commerce.
13. IT Security and other issues.
14. Cyber Laws and Ethics of using Social media.
15. Use of Microsoft Office tools (Word, Power Point, Excel) or other similar tools depending on the operating system.
16. Other IT tools/software specific to field of study of the students if any.

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

Recommended Book

1. Discovering Computers 2022: Digital Technology, Data and Devices by Misty E. Vermaat. Susan L. sebok; 17th edition.

Suggested Books

1. Computing Essentials 2021 by Timothy J. O'Leary and Linda I. O'Leary, McGraw Hill Higher Education; 26th edition.
2. Computers: Understanding Technology by Fuller, Floyd; Larson, Brian: edition 2018.

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 Analytical 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 (3-0)
Contact Hours:	3-0
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.

URCG-5125 Civics and Community Engagement ✓

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

Course Introduction:

The Civics and Community Engagement course is designed to provide students with an understanding of the importance of civic participation, culture and cultural diversity, basic foundations of citizenship, group identities and the role of individuals in creating positive change within their communities. The course aims at developing students' knowledge, skills and attitudes necessary for active and responsible citizenship.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understand the concepts of civic engagement, community development, and social responsibility.	C1, 2 (Understand)
CLO-2	Understand rights and responsibilities of citizenship	C2 (Understand)
CLO-3	Understand cultural diversity in local and global context	C2 (Understand)
CLO-4	Analyze the significance of civic participation in promoting social justice, equity, and democracy.	C4
CLO-5	Examine the historical and contemporary examples of successful civic and community engagement initiatives.	C4
CLO-6	Identify and assess community needs, assets, and challenges to develop effective strategies for community improvement.	C5
CLO-7	Explore the ethical implications and dilemmas associated with civic and community engagement.	C5
CLO-8	Develop practical skills for effective community organizing, advocacy, and leadership.	C6

CLO-9	Foster intercultural competence and respect for diversity in community engagement efforts.	C6
CLO-10	Collaborate with community organizations, stakeholders, and fellow students to design and implement community-based projects.	C6
CLO-11	Reflect on personal growth and learning through self-assessment and critical analysis of community engagement experiences	C3,4

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

Active 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 citizens' 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-governmental organizations

Civic Engagement Strategies

- Grassroots organizing and community mobilization
- Advocacy and lobbying for policy change
- Volunteerism and service-learning opportunities

Social issues/Problems of Pakistan

- Overview of major social issues of Pakistani society

Social Action Project

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

Recommended Books:

1. Kennedy. J. K., & Brunold, A. (2016). Regional context and Citizenship education in Asia and Europe. New Yourk: Routledge, Falmer.
2. Henslin, James M. (2018). Essentials of Sociology: A Down to Earth Approach (13th ed.). New York: Pearson Education
3. Macionis, J. J., & Gerber, M.L. (2020). Sociology. New York: Pearson Education

Reference Books:

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

URCG-5124: Entrepreneurship ✓

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

Course Introduction:

This course addresses the unique entrepreneurial experience of conceiving, evaluating, creating, managing, and potentially selling a business idea. The goal is to provide a solid background with practical application of important concepts applicable to the entrepreneurial environment. Entrepreneurial discussions regarding the key business areas of finance, accounting, marketing and management include the creative aspects of entrepreneurship. The course relies on classroom discussion, participation, the creation of a feasibility plan, and building a business plan to develop a comprehensive strategy for launching and managing a new venture.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	To enhance the 'entrepreneurial intentions' of the students by improving their natural willingness to start a business.	C2 (Understand)
CLO-2	To understand the process of entrepreneurship and learn the ways to manage it by working individually in the class and in the form of groups outside the class to conduct field assignments.	C2 (Understand)

CLO-3	To educate the students about the practical underpinnings of the entrepreneurship with the aid of practical assignments and idea pitching.	C1, C6

Course Outline:

1. **Background:** What is an Organization, Organizational Resources, Management Functions, Kinds of Managers, Mintzberg's Managerial Roles.
2. **Forms of Business Ownership:** The Sole proprietorship, Partnership, Joint Stock Company
3. **Entrepreneurship:** The World of the Entrepreneur, what is an entrepreneur? The Benefits of Entrepreneurship, The Potential Drawbacks of Entrepreneurship, Behind the Boom: Feeding the Entrepreneurial Fire.
4. **The Challenges of Entrepreneurship:** The Cultural Diversity in Entrepreneurship, The Power of "Small" Business, Putting Failure into Perspective, The Ten Deadly Mistakes of Entrepreneurship, How to Avoid the Pitfalls, Idea Discussions & Selection of student Projects, Islamic Ethics of Entrepreneurship.
5. **Inside the Entrepreneurial Mind:** From Ideas to Reality: Creativity, Innovation, and Entrepreneurship, Creativity – Essential to Survival, Creative Thinking, Barriers to Creativity, How to Enhance Creativity, The Creative Process, Techniques for Improving the Creative Process, Protecting Your Ideas, Idea Discussions & Selection of student Projects.
6. **Products and technology, identification opportunities**
7. **Designing a Competitive Business Model and Building a Solid Strategic Plan:** Building a strategic plan, Building a Competitive Advantage, The Strategic Management Process, Formulate strategic options and select the appropriate strategies, Discussion about execution of Students' Project.
8. **Conducting a Feasibility Analysis and Crafting a Winning Business Plan:** Conducting a Feasibility Analysis, Industry and market feasibility, Porter's five forces model, Financial feasibility analysis, Why Develop a Business Plan, The Elements of a Business Plan, What Lenders and Investors Look for in a Business Plan, Making the Business Plan Presentation.
9. **Building a Powerful Marketing Plan:** Building a Guerrilla Marketing Plan, Pinpointing the Target Market, Determining Customer Needs and Wants Through Market Research, Plotting a Guerrilla Marketing Strategy: How to Build a Competitive Edge, Feed Back & Suggestions on Student Project, Islamic Ethics for Entrepreneurial Marketing
10. **E-Commerce and the Entrepreneur:** Factors to Consider before Launching into E-Commerce, Ten Myths of E-Commerce, Strategies for E-Success, Designing a Killer Web Site, Tracking Web Results, Ensuring Web Privacy and Security, Feed Back & Suggestions on Student Project.
11. **Pricing Strategies:** Three Potent Forces: Image, Competition, and Value, Pricing Strategies and Tactics, Pricing Strategies and Methods for Retailers, The Impact of Credit on Pricing
12. **Attracting Venture Capitalist:** Projected Financial Statements, Basic Financial Statements, Ratio Analysis, Interpreting Business Ratios, Breakeven Analysis, Feed Back &Suggestions on Student Project.
13. **Idea Pitching:** Formal presentation, 5-minutes pitch, funding negotiation and launching.

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

Recommended Texts:

1. Scarborough, N. M. (2011). Essentials of entrepreneurship and small business management. Publishing as Prentice Hall, One Lake Street, Upper Saddle River, New Jersey 07458..

Suggested Readings:

1. Burstiner, I. (1989). Small business handbook. Prentice Hall Press.

URCG-5129 Understanding of Holy Quran/Fehm-e-Quran-I	
Credit Hours: **Contact Hours:** **Pre-requisites:**	1 (0-3) 3 None

Course Learning Outcomes:

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Develop the ability to understand basic words of the Quran, phrases and sentences that do not contain verbs (unit 1 to 5 of Muallim ul Quran Book) and then sentences having present tense (first half of unit 6 of Muallim ul Quran Book).	C2 – Understanding
CLO-2	Acquire a strong foundation for understanding long verses of the Quran with clarity.	C3 – Applying
CLO-3	Comprehend Quranic vocabulary, particles (operative & non operative particles), compounds (Adjective & Possessive compound), pronouns (singular & plural) and types of plural through hundreds of Quranic sentences.	C4 – Analyzing
CLO-4	Recognize and understand different styles of Quranic sentences, including nominal sentence, emphatic sentence, double emphatic sentence, negative sentence, interrogative sentence, oath –based sentences.	C4 – Analyzing
CLO-5	Strengthen understanding of fundamental Quranic linguistic styles, expressions and idioms.	C5 – Evaluating
CLO-6	Understand at least 30 to 40 % of each page of the holy Quran.	C2/C3 – Understanding / Applying

Course Outline:

Weeks	Lectures (1.5 hrs)	Units	Lessons	Assignments/Home Task	Linguistic Rules
1.	1.	1	1-6	Writing the meaning of Quranic words Lesson 1-8	Proper Noun Masculine & Feminine
	2.	1	9-14	Writing the meaning of Quranic words 9-14	Two kinds of plural Concept of (و) "And" Common Noun
2.	1.	1	15-17	Writing the meaning of Quranic words, phrases & translation of Sentences 15-17	Demonstrative Noun (This & That for Masculine (هذا- هذه) Demonstrative Noun (This & That for Feminine) (ذلك- تلك)

	2.	1	18-19 & Revision (Unit 1)	Writing the meaning of Quranic words , phrases & translation of Sentences 17-19 Quiz	Laam for emphasis (لام التأكيد) Superlative Degree like أكبر Revision of all Quranic Sentences
3.	1.	Unit 2	1-3	Writing the meaning of Quranic words, phrases & translation of Sentences 1-3	Emphatic Particle ن ! Preposition "For" (اللام) Preposition (في)
	2.	2	4-6	Writing the meaning of Quranic words, phrases & translation of Sentences 4-6	Preposition (على- من- إلى)
4.	1.	2	7- 9	Writing the meaning of Quranic words & translation of Sentences 7-9	Preposition (الباء) Absolute Negation Particle لا النافية) Exceptive Particle (إلا) (ما النافية)(للجنس
	2.	2	10-13 & Revision (Unit 2)	Writing the meaning of Quranic words, phrases & translation of Sentences 10-13 Quiz	Subordinating Conjunction(أن), Was (كا ن), Vocative Particle(حرف النداء)
5.	1.	Unit 3	1-2	Writing the meaning of Quranic phrases 1-2	Quranic Adjective Compou nds (صفة وموصوف
	2.	3	3-5	Writing the meaning of Quranic phrases & translation of sentences 3-5	Quranic Possessive Construction (مضاف ومضاف إليه)
6.	1.	3	6 -7	Writing the meaning of Quranic phrase translation of sentences 6-7	Quranic Possessive Construction (مضاف ومضاف إليه)

	2.	3	8-10 & Revision (Unit 3)	Writing the meaning of Quranic phrase & translation of sentences 8-10 Quiz	Active Participle (اسم الفاعل), Passive Participle (اسم المفعول), Dual (مثنى)
7.	1.	Unit 4	1-2	Writing the meaning of Quranic phrase & translation of sentences 1-2	Personal Pronoun He(هو المنفصل) Possessive Pronoun His ـه المتصل)
	2.	4	3-4	Writing the meaning of Quranic phrase & translation of sentences 3 -4	Possessive Pronoun with prepositions like في بيته Pronoun "His" with prepositions like له، منه، فيه
8.	1.	4	5-8	Writing the meaning of Quranic sentences 5-8	Personal Pronoun You(أنت المنفصل) Possessive Pronoun Your ك المتصل) Possessive Pronoun with prepositions like في بيتك Pronoun "your" with prepositions like لك، منك، فيك
	2.	Mid Term			
9.	1.	4	9-12	Writing the meaning of Quranic phrases & sentences 9-12	Personal Pronoun She(هي المنفصل) Possessive Pronoun Her ها المتصل) Possessive Pronoun with prepositions like في بيتها Pronoun "Her" with prepositions like لها،

	2.	4	13-16	Writing the meaning of Quranic phrases & sentences 13-16	Personal Pronoun I (أنا المنفصل) Possessive Pronoun Her ي المتصل) Possessive Pronoun with prepositions like بيتي فيPronoun "My" with prepositions like لي
10.	1	4	17 & Revision Unit 4	Revision of all Quranic sentences of Unit 4 Quiz	Adverb (حال)
	2.	Unit 5	1-2	Writing the meaning of Quranic phrases & sentences 1-2	Masculine Pluralجمع المذكر السالم و جمع المذكر السالم المسبوق بحرف الج ر
11.	1.	5	3-4	Writing the meaning of Quranic phrases & sentences 3-4	Possessive Construction with Plurals جمع المذكر السالم المسبوق بالإضاف ة
	2.	5	5-6	Writing the meaning of Quranic phrases, sentences & verses 5-6	Personal Pronoun They (هم المنفصل) Possessive Pronoun Their هم المتصل)
12.	1.	5	7-8	Writing the meaning of Quranic phrases, sentences & verses 7-8	Possessive Pronoun with prepositions like بيتهم فيPronoun "Their" with prepositions like لهم
	2.	5	9-11	Writing the meaning of Quranic phrases, sentences & verses 9-11	Personal Pronoun You (أنتم المنفصل) Possessive Pronoun Your كم المتصل) Possessive Pronoun with prepositions
					like في بيتكم
13.	1.	5	12-14	Writing the meaning of Quranic phrases & sentences & verses 12-14	Pronoun "Your" with prepositions like لك م Personal Pronoun We (نحن المنفصل) Possessive Pronoun Our نا المتصل)

	2.	5	15-16	Writing the meaning of Quranic sentences & verses 15-16	Possessive Pronoun with prepositions like في بيتنا Pronoun "Our" with prepositions like لنا
14.	1.	5	17-18	Writing the meaning of Quranic sentences & Verses 17-18	Demonstrative Pronoun These, Those (أولئك -هؤلاء)
	2.	5	19-23	Writing the meaning of Quranic sentences & Verses 19-23	ما / إلا ،إن / إلا، إنما، ليس، ما، (أ/أم، أن، بل،) كأن ألا، أليس، اليوم، يومئذ، سبحان، مابينهما، قل، إذن، بئس، نعم، كلا، ما أدراك، حسب، أعلم ب، مصير ، مرجع، دينا)تمييز (
15.	1.	5	Revision Unit 5	Quiz	
	2.	5	1-3 (till Page 16)	Writing the meaning of Quranic Verbs &Translation of Quranic Sentences & Verses (1-3)	Introduction of Present Tense(فعل مضارع) & Verbal Sentence (جملة فعلية) Present Tense الفعل المضارع صيغة المفرد يعلم
16.	1.	6	3 (From Page 17) & 4 -5	Translation of Quranic Sentences & Verses 3-5	Present Tense الفعل المضارع صيغة المفرد يعلم
	2.	6	6	Translation of Quranic Sentences & Verses	Present Tense الفعل المضارع صيغة الجمع يعلمون
Reference Materials (or use any other standard and latest books):					
Course Book: Muallim ul Quran (Volume 1, 2 & 3) by Dr Ubaid ur Rahman					

URCG-5130 Understanding of Holy Quran/Fehm-e-Quran-II	
Credit Hours:	1 (0-3)
Contact Hours:	3
Pre-requisites:	None

Course Learning Outcomes:

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Directly comprehend hundreds of Quranic sentences & verses.	C3 – Applying

CLO-2	Understand at least 80 to 85 % of each page of the holy Quran.	C3/C2 – Applying / Understanding
CLO-3	Understand common verses across different Quranic topics.	C2 – Understanding
CLO-4	Achieve proficiency in the basic and advance linguistic aspects of the Arabic language.	C4 – Analyzing
CLO-5	Understand the difference between Quranic verbs in various forms, such as present, past and imperative.	C2 – Understanding
CLO-6	Develop the ability to understand long verses of the holy Quran independently and then comprehend their interpretation.	C5 – Evaluating

Course Outline

Weeks	Lectures	Units	Lessons	Assignments/Home Task	
1	1	6	6	Understanding & Translation of Verses	Present Tense صيغة جمع مذكر غائب مثل يعبدون
	2	6	7-8	Understanding & Translation of Verses	Present Tense صيغة جمع مذكر غائب مثل يعبدون
2	1	6	9-10	Understanding & Translation of Verses	Present Tense صيغة مفرد مذكر مخاطب)تعبد(وجمع مذكر مخاطب) تعبدون(
	2	6	11-12	Understanding & Translation of Verses	Present Tense صيغة جمع مذكر مخاطب) تعبدون(صيغة المتكلم)أعبد(
3	1	6	13	Understanding & Translation of Verses	Present Tense صيغة جمع المتكلم)نعبد(
	2	6	14-15	Understanding & Translation of Verses	Negative Imperative صيغة المفرد وصيغة الجمع , لا تعبدْ، لا تعبدوا
4	1	6	16-17	Understanding & Translation of Verses	Conditional Sentences & masdar moawal (مصدر موول)
	2	6	18-19	Understanding & Translation of Verses	Laam uttaleel (لام التعليل) & Laam ul jhood(لام الجحود)
5	1	6	20-21	Understanding & Translation of Verses	Present with object pronouns & Passive Voice

	2	6	Revision (Unit 6)	Quiz	
6	1	Unit 7	1 (sec 1-3)	Understanding & Translation of Verses	Past Tense صيغة الماضي المفرد الغائب
	2	6	1 (Sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة الماضي المفرد للغائب
7	1	6	1 (Sec 5-6)	Understanding & Translation of Verses	Past Tense صيغة الماضي المفرد للغائب
	2	6	1 (Sec 7-9)	Understanding & Translation of Verses	Past Tense صيغة الماضي المفرد للغائب
				QUIZ	
	2	MID TERM			
9	1	7	2 (sec 1-2)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عبدو ا
	2	7	2 (sec 3)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عبدو ا
10	1	7	2 (sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عبدو ا
	2	7	2 (sec 6-7)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عبدو ا
11	1	7	3 (sec 1-2)	Understanding & Translation of Verses	Past Tense صيغة الجمع المتكلم عبدن ا
	2	7	3 (sec 2-3)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم عبدن ا
12	1	7	3 (sec 3-4)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم عبدن ا

	2	7	3 (sec 4-5)	Understanding & Translation of Verses	Past Tenseصيغة الجمع للمتكلم عبدن ا
13	1	7	4 (sec 1-2-3)	Understanding & Translation of Verses	Past Tenseصيغة الجمع للمخاطب عبدت م
	2	7	4 (sec 4-5)	Understanding & Translation of Verses	Past Tenseصيغة الجمع للمخاطب عبدت م
14	1	7	5-6	Understanding & Translation of Verses	صيغة المتكلم Past Tense ، عبد ت والمخاطب عبد ت
	2	7	7	Understanding & Translation of Verses	صيغة المؤنث Past Tense للغائب عب دتْ
15	1	7	8	Understanding & Translation of Verses	Passive Voice (Past Tense) فعل مجهول للمفرد
	2	7	9	Understanding & Translation of Verses	Passive Voice (Past Tense) فعل مجهول الجمع
16	1	8	1-4	Understanding & Translation of Verses	Imperative Verb for singular الأمر للمفرد فعل
	2	7	5-8	Understanding & Translation of Verses	Imperative Verb for plural فعل الأمر للجمع

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

Course Book: Muallim ul Quran (Volume 1, 2 & 3) by Dr Ubaid ur Rahman

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