

**Curriculum / Scheme of Studies**  
**of**  
**Bachelor of Science in Artificial Intelligence**  
**(BS Artificial Intelligence)**  
**(4 Years Program)**  
**(Applicable w.e.f. Fall 2025)**



**University of Education, Lahore**

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## 1. Introduction to BS in Artificial Intelligence Program

The BSAI program gives the students an in-depth knowledge they need to transform large and complex scenarios into actionable decisions. The program and its curriculum focus on how complex inputs — such as knowledge, vision, language and huge databases — can be used to make decisions to enhance human capabilities. The curriculum of the BS Artificial Intelligence program includes coursework in computing, mathematics, automated reasoning, statistics, computational modeling, introduction to classical artificial intelligence languages and case studies, knowledge representation and reasoning, artificial neural networks, machine learning, natural language processing, vision and symbolic computation. The program also encourages students to take courses in ethics and social responsibility, with the opportunity to participate in long term projects in which artificial intelligence can be applied to solve problems that can change the world for the better — in areas like agriculture, defense, healthcare, governance, transportation, e-commerce, finance and education.

## 2. Program Vision Statement

The BS Artificial Intelligence program aims to foster innovation, expand knowledge, publish research, and equip students with advanced Artificial Intelligence expertise, enabling them to actively participate and make valuable contributions in their field at the local, national, and global levels through academia, research, and practical applications.

## 3. Program Mission Statement

The mission of the program is to impart modern, quality, comprehensive and effective theoretical as well as applied education in various domains of Artificial Intelligences. Also, to instill high degree professionalism in student by developing their communication, problem solving and technical skills to meet modern and future challenges.

The program is designed to equip students with diverse professional knowledge and skills through a comprehensive degree program that enables them to face the future challenges of evolution in the field of Artificial Intelligences, technology professionals and Artificial Intelligence academics.

## 4. Program Objectives

The objective of the program is providing a learning experience that produces high quality professionals equipped with technological, research, communication, problem solving, managerial and leadership skills that contribute to their profession as managers, academics, innovators and planners in the field of Artificial Intelligences and its related fields. Some of the key objectives of the program are listed below:

- To provide a broad and in-depth latest knowledge of concepts, theory, techniques through intensive education/training in varying domains within the field of Artificial Intelligence as well

as supporting areas of science, mathematics and management.

- To impart problem solving and analytical thinking capabilities to propose and develop solution with practical applications in the industry and research.
- To encourage students to innovate and provide necessary communication skill and environment that enables them to present their proposed solution through well-organized reports, presentations and project utilizing latest tools and technologies.
- To develop awareness regarding state-of-the-art researches and the ever-changing technological environment in the industry.
- To provide formal foundations for higher learning and education while also preparing the students for industry.

## 5. Curricula Consideration

During the revision of the Computing Curricula two major guidelines have been considered (ACM and Seoul Accord). However, in some cases the main focus of these guidelines is mostly traditional Artificial Intelligence program. Association of Computing Machinery (ACM) - Guidelines

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

- AL -Algorithms and Complexity
- AR -Architecture and Organization
- CN -Computational Science
- DS -Discrete Structures
- GV -Graphics and Visual Computing
- HCI -Human-Computer Interaction
- IAS -Information Assurance and Security
- IM -Information Management
- IS -Intelligent Systems
- NC -Networking and Communications
- OS -Operating Systems
- PBD - Platform-based Development

- PD -Parallel and Distributed Computing
- PL -Programming Languages
- SDF -Software Development Fundamentals
- SE -Software Engineering
- SF -Systems Fundamentals
- SP -Social Issues and Professional Issues

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

## 5.2. Knowledge Areas in ACM CS Curriculum

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

11	OS-Operating Systems	4	11	Operating Systems	Operating Systems
12	PBD-Platform-based Development	0	0		(Electives: Web Technology (ASP, Javascript), Visual Prog (C#), Mobile App Dev (React/Flutter/Kotlin/Swift))
13	PD-Parallel and Distributed Computing	5	10	Parallel Programming Principle and Practice;	Parallel & Distributed Computing
14	PL-Programming Languages	8	20	Introduction to Compilers; Compilers; Introduction to Programming; Programming Languages	Programming Fundamentals, OOP, Compiler Construction
15	SDF-Software Development Fundamentals	43	0	Java Programming I; Introduction to Program Design: Introduction to Programming; OOP	Programming Fundamental, Object Oriented Programming, Data Structures
16	SE-Software Engineering	6	22	Software Engineering	Software Engineering
17	SF-Systems Fundamentals	18	9	Computer Systems and Networks; Great Ideas in Computer Architecture; System Programming	DLD, Computer Networks, Computer Architecture
18	SP-Social Issues and Professional Practice	11	5	Ethics in Technology; Technology Consulting in the Community	Professional Practices
	<b>Total Core Hours</b>	<b>165</b>	<b>143</b>		
		<b>308</b>			

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

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

S#	Program Learning Outcomes (PLOs)	Computing Professional Graduate
1	Academic Education	To prepare graduates as computing professionals
2	Knowledge for Solving Computing Problems	Apply knowledge of computing fundamentals, knowledge of a computing specialization, and mathematics, science, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and Requirements.
3	Problem Analysis	Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.
4	Design/Development of Solutions	Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
5	Modern Tool Usage	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
6	Individual and Team Work	Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings.
7	Communication	Communicate effectively with the computing community and with society at large about complex computing activities by being able to comprehend and write effective reports, Design documentation, make effective presentations, and give and understand clear instructions.
8	Computing Professionalism and Society	Understand and assess societal, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.
9	Ethics	Understand and commit to professional ethics, responsibilities, and norms of professional computing Practice.
10	Life-long Learning	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.

## 7. Curriculum Model for Bachelor of Science in Artificial Intelligence

The generic structure for computing degree program given before is mapped with the BS Artificial Intelligence program in the following tables.

### Generic Structure for Computing Disciplines:

Areas	Credit Hours	Courses
Computing Core	46	14
Domain Core	18	6
Domain Elective	21	7
Allied Courses	15	5
General Education Requirement	32	13
Internship	3	1
<b>Totals</b>	<b>135</b>	<b>46</b>

### Mapping of BS Artificial Intelligence Program on the Generic Structure:

#	Code	Pre-Reqs.	Course Title	Domain	Cr. Hr.
<b>Computing Core (46/135) 14 Courses</b>					
1	COMP1112		Programming Fundamentals	Core	4 (3+1)
2	COMP2111	Programming Fundamentals (COMP1112)	Object Oriented Programming	Core	4 (3+1)
3	COMP2114		Database Systems	Core	4 (3+1)
4	PHYS4129		Digital Logic and Design	Core	3 (2+1)
5	COMP2117	Programming Fundamentals (COMP1112)	Data Structures	Core	4 (3+1)
6	COMP2120		Information Security	Core	3 (2+1)
7	COMP2121		Artificial Intelligence	Core	3 (2+1)
8	COMP2119		Computer Networks	Core	3 (2+1)
9	COMP2112		Software Engineering	Core	3 (3+0)
10	COMP2118		Computer Organization and Assembly Language	Core	3 (2+1)
11	COMP3142		Operating Systems	Core	3 (2+1)
12	COMP4121	Data Structures	Analysis of Algorithms	Core	3 (3+0)
13	COMPXX XX		Final Year Project – I	Core	3 (0+3)
14	COMPXX XX	Final Year Project – I	Final Year Project – II	Core	3 (0+3)

<b>Domain Core (18/135) 6 Courses</b>					
15	COMPXXXX		Programming for Artificial Intelligence	Domain Core	3 (2+1)
16	COMP3124		Introduction to Machine Learning	Domain Core	3 (3+0)
17	COMP3126		Artificial Neural Networks	Domain Core	3 (3+0)
18	COMPXXXX		Knowledge Representation & Reasoning	Domain Core	3 (2+1)
19	COMPXXXX		Introduction to Computer Vision	Domain Core	3 (2+1)
20	COMP4122		Parallel & Distributed Computing	Domain Core	3 (2+1)
<b>Domain Elective (21/135) 7 Courses</b>					
21	COMP3131		Natural Language Processing	Domain Elective	3 (3+0)
22	COMPXXXX		Speech Processing	Domain Elective	3 (2+1)
23	COMP3116		Data Mining	Domain Elective	3 (3+0)
24	COMPXXXX		Advance Statistics	Domain Elective	3 (2+1)
25	COMPXXXX		Reinforcement Learning	Domain Elective	3 (2+1)
26	COMP3148		Theory of Automata	Domain Elective	3 (3+0)
27	COMP3145		HCI & Computer Graphics	Domain Elective	3(2+1)
28	COMPXXXX		Fuzzy Systems	Domain Elective	3 (2+1)
29	COMPXXXX		Swarm Intelligence	Domain Elective	3 (2+1)
30	COMPXXXX		Agent Based Modeling	Domain Elective	3 (2+1)
31	COMPXXXX		Knowledge Based Systems	Domain Elective	3 (2+1)
<b>Allied Courses (15/135) 5 Courses</b>					
31	MATH3122		Multivariable Calculus	Allied	3 (3+0)
32	MATH3114		Linear Algebra	Allied	3 (3+0)
33	STAT2115		Introduction to Statistics	Allied	3 (3+0)
34	ITEC4152		Technical and Business Writing	Allied	3 (3+0)
35	BUSA1113		Fundamentals of Accounting	Allied	3 (3+0)

**General Education Requirement as per HEC UG Education Policy  
(32/135) 13 Courses**

36	COMP1116		Applications of Information and Communication Technologies	GER	3 (2+1)
37	ENGL1114		Functional English	GER	3 (3+0)
38	ENGL1120		Expository Writing	GER	3 (3+0)
39	MATH2113		QR-1 (Discrete Mathematics)	GER	3 (3+0)
40	MATH1129		QR-2 (Calculus and Analytic Geometry)	GER	3 (3+0)
41	ISLA1111/HU MN1111		Islamic Studies/Ethics	GER	2 (2+0)
42	PAKS1119		Ideology and Constitution of Pakistan	GER	2 (2+0)
43	BUSA2118		Social Sciences (Foundations of Management)	GER	2 (2+0)
44	PHYS1124		Natural Sciences (Applied Physics)	GER	3 (2+1)
45	ITEC4112		Arts & Humanities (Professional Practices)	GER	2 (2+0)
46	POLS2111		Civics and Community Engagement	GER	2 (2+0)
47	BUSA1114		Introduction to Entrepreneurship	GER	2 (2+0)
48	PAKS1111		Pakistan Studies	GER	2(2+0)

**List of Courses for other disciplines to take Artificial Intelligence as Minor**

Sr . #	Code	Prerequisite	Course Title	Credit Hours (Contact Hours)
1	COMP3124		Introduction to Machine Learning	3 (3+0)
2	COMP3126		Artificial Neural Networks	3 (3+0)
3	COMPXXXX		Knowledge Representation & Reasoning	3 (2+1)
4	COMP2121		Artificial Intelligence	3 (2+1)
5	COMPXXXX		Introduction to Computer Vision	3 (2+1)
6	COMP3131		Natural Language Processing	3 (3+0)
7	COMPXXXX		Programming for Artificial Intelligence	3 (2+1)
8	COMP3116		Data Mining	3 (3+0)

Note: Students from other disciplines may take 12 credit hours from the list of Minor Courses

## 8. Semester/Study Plan for BS Artificial Intelligence

Course codes will be assigned based on the codes generated in the University of Education Lahore Information System (UE, Lahore). The course codes for the remaining courses will be generated after approval from the Academic Council.

<b>Semester – I</b>					
<b>Sr #</b>	<b>Code</b>	<b>Prerequisite</b>	<b>Course Title</b>	<b>Domain</b>	<b>Credit Hours</b>
1	COMP1112		Programming Fundamentals	Core	4(3+1)
2	COMP1116		Applications of Information and Communication Technologies	GER	3(2+1)
3	MATH2113		QR 1 (Discrete Mathematics)	GER	3(3+0)
4	ENGL1114		Functional English	GER	3(3+0)
5	PHYS1124		Applied Physics	GER	3(2+1)
6	ISLA1111/ HUMN1111		Islamic Studies / Ethics	GER	2(2+0)
	MATH1127		Pre-Calculus-I (Only for Pre-Medical Students)		Non-Credited
			<b>Total</b>		<b>18(15+3)</b>
<b>Semester – II</b>					
<b>Sr #</b>	<b>Code</b>	<b>Prerequisite</b>	<b>Course Title</b>	<b>Domain</b>	<b>Credit Hours</b>
7	COMP2111	Programming Fundamentals (COMP1112)	Object Oriented Programming	Core	4(3+1)
8	MATH3114		Linear Algebra	Allied	3(3+0)
9	ENGL1120		Expository Writing	GER	3(3+0)
10	COMP2119		Computer Networks	Core	3(2+1)
11	PAKS1119		Ideology and Constitution of Pakistan	GER	2 (2+0)
12	PHYS4129		Digital Logic and Design	Core	3(2+1)
	ISLA1120/ ISLA1121		ترجمہ قرآن کورس/ وحدت ادیان اور مذاہب عالم		Non-Credited
	MATH1128		Pre-Calculus-II (Only for Pre-Medical Students)		Non-Credited
			<b>Total</b>		<b>18(15+3)</b>

<b>Semester – III</b>					
<b>Sr #</b>	<b>Code</b>	<b>Prerequisite</b>	<b>Course Title</b>	<b>Domain</b>	<b>Credit Hours</b>
13	ITEC4112		Professional Practices	GER	2(2+0)
14	COMP2117	Programming Fundamentals (COMP1112)	Data Structures	Core	4(3+1)
15	COMP2118		Computer Organization and Assembly Language	Core	3 (2+1)
16	BUSA2118		Foundations of Management	GER	2 (2+0)
17	MATH1129		Calculus and Analytic Geometry	GER	3(3+0)
18	COMP2114		Database Systems	Core	4(3+1)
			<b>Total</b>		<b>18(15+3)</b>
<b>Semester – IV</b>					
<b>Sr #</b>	<b>Code</b>	<b>Prerequisite</b>	<b>Course Title</b>		<b>Credit Hours</b>
19	BUSA1114		Introduction to Entrepreneurship	GER	2(2+0)
20	POLS2111		Civics and Community Engagement	GER	2(2+0)
21	COMP2120		Information Security	Core	3(2+1)
22	COMP2121		Artificial Intelligence	Core	3(2+1)
23	MATH3122		Multivariable Calculus	Allied	3(3+0)
24	COMP2112		Software Engineering	Core	3(3+0)
25	PAKS1111		Pakistan Studies	GER	2 (2+0)
	ISLA1120/ ISLA1121		ترجمہ قرآن کورس / وحدت ادیان اور مذاہب عالم		Non-Credited
			<b>Total</b>		<b>18(16+2)</b>

<b>Semester – V</b>					
<b>Sr #</b>	<b>Code</b>	<b>Prerequisite</b>	<b>Course Title</b>		<b>Credit Hours</b>
26	COMP3142		Operating Systems	Core	3(2+1)
27	COMP3145		HCI & Computer Graphics	Domain Core	3(2+1)
28	COMP3124		Introduction to Machine Learning	Domain Core	3(3+0)
29	STAT2115		Introduction to Statistics	Allied	3(3+0)
30	COMP4121	Data Structures (COMP2117)	Analysis of Algorithms	Core	3 (3+0)
31	COMPXXXX		Programming for Artificial Intelligence	Domain Core	3(2+1)
			<b>Total</b>		<b>18 (15+3)</b>
<b>Semester – VI</b>					
<b>Sr #</b>	<b>Code</b>	<b>Prerequisite</b>	<b>Course Title</b>	<b>Domain</b>	<b>Credit Hours</b>
32	COMPXXXX		Introduction to Computer Vision	Domain Core	3(2+1)
33	COMPXXXX		Domain Elective-I	Domain Elective	3 (3+0)
34	COMPXXXX		Domain Elective-II	Domain Elective	3 (2+1)
35	COMPXXXX		Domain Elective-III	Domain Elective	3 (2+1)
36	COMPXXXX		Domain Elective-IV	Domain Elective	3 (2+1)
	ISLA1120/ ISLA1121		ترجمہ قرآن کورس/ وحدت ادیان اور مذاہب عالم		Non-Credited
			<b>Total</b>		<b>15(11+4)</b>

Semester – VII					
Sr #	Code	Prerequisite	Course Title	Domain	Credit Hours
37	COMPXXXX		Knowledge Representation & Reasoning	Domain Core	3(2+1)
38	COMPXXXX		Domain Elective-V	Domain Elective	3 (2+1)
38	COMPXXXX		Domain Elective-VI	Domain Elective	3 (2+1)
40	COMPXXXX		Final Year Project - I	Core	3 (0+3)
41	ITEC4152		Technical and Business Writing	Allied	3 (3+0)
42	INTN6112		Internship		3 (0+3)
			<b>Total</b>		<b>18(9+9)</b>
Semester – VIII					
Sr #	Code	Prerequisite	Course Title	Domain	Credit Hours
43	COMP4122		Parallel & Distributed Computing	Domain Core	3(2+1)
44	COMPXXXX		Domain Elective-VII	Domain Elective	3(2+1)
45	COMPXXXX	Final Year Project - I (COMPXXX)	Final Year Project – II	Core	3(0+3)
46	BUSA1113		Fundamentals of Accounting	GER	3(3+0)
	ISLA1120/ ISLA1121		ترجمہ قرآن کورس/ وحدت ادیان اور مذاہب عالم		Non-Credited
			<b>Total</b>		<b>12(7+5)</b>

\* The Internship of six to eight weeks is mandatory requirement for the award of degree. Students will take an Internship 3(0+3) course during summer vacations after sixth semester, and the result of this course will be added in the seventh semester.

**Note:** One credit of lab means 3 contact hours, which means students will spend three hours in the lab for each credit earned.

## University Mandatory Courses (Non-Credited)

Sr. No.	Course Code	Course Title	Credit Hours
1	**ISLA1121/ *ISLA1120	ترجمہ قرآن کورس / وحدت ادیان اور مذاہب عالم	4(4+0)
2	***ISLA1122	Seerat of the Holy Prophet Muhammad (SAW)	2(2+0)

\*For non-Muslim Students only

\*\*The courses will be evaluated in (8th semester) and taught in 2nd, 4th, 6th, and 8<sup>th</sup> semester. Course outline approved in the Notification No. UE/Syn/DD/2020/2158 Dated: December 31, 2020 will be followed.

\*\*\* The course “**Seerat of the Holy Prophet Muhammad (SAW)-ISLA1122**” bearing course code ISLA1122 with 2(2+0) Credit Hours is compulsory. Its lectures will be recorded in digital form and available to all students. Students may study (online) this course in any semester and will be examined online too. This course will be considered as Non-Credited.

## 9. Eligibility Criteria, Duration of the Program and Award of Degree:

- Minimum 50% marks in Intermediate/12 years schooling/A- Level (HSSC) or Equivalent with Mathematics are required for admission in BS Artificial Intelligence Program.
- *\*Equivalency certificate by IBCC will be required in case of education from some other country or system.*
- FSc pre-medical students are also eligible but the students have to pass deficiency course Pre-Calculus I and Pre-Calculus II. Additionally, the course will be considered as non-credited course.
- At minimum 135 credit hours are required for award of BS Artificial Intelligence degree.
- The minimum duration for completion of BS Artificial Intelligence degree is four years. The maximum period of degree completion will be followed as per University of Education Lahore policy.
- A minimum 2.0 CGPA (Cumulative Grade Point Average) on a scale of 4.0 is required for award of BS Artificial Intelligence Degree.
- After successfully completing 04 semesters in the BS Artificial Intelligence program, students may exit with an Associate Degree in Artificial Intelligence, subject to meeting all requirements for the award of the associate degree. These requirements include fulfilling the required Credit Hours, achieving a minimum CGPA, and completing compulsory courses or as per the approved university policy. However, students must complete a minimum of 72 credits to be eligible for the Associate Degree.

### Note:

- The Internship of six to eight weeks is mandatory requirement for the award of degree.
- Department offers the following options of minor/major from the available subjects at University of Education, Lahore subject to the approval of the concerned statutory body upon recommendation of the concerned department.

#### 1. Single Major

#### 2. Single Major with one Minor

#### 3. Single Major with two Minor

#### 4. Double Major\*

\*Additional semester(s) will be required to complete the degree requirements in case two majors are offered provided that the total duration to complete the undergraduate/ equivalent degree program does not go beyond the maximum duration prescribed in HEC semester guidelines. Where two majors have common courses, a student can get exemption for maximum of 30 credit hours for the second major.

## 10. Course Outlines

<b>Course Name:</b>	<b><i>Programming Fundamentals</i></b>
<b>Course Code:</b>	COMP1112
<b>Credit Hours:</b>	4 (3+1)
<b>Pre-requisites:</b>	None

### Course Introduction:

This course provides fundamental concepts of programming to freshmen. The course is pre-requisite 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.

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
CLO-1	Understand basic problem solving steps and logic constructs	C2 (Understand)
CLO-2	Apply basic programming 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, multi-dimensional lists, introduction to modular programming, function definition and calling, stack rolling and unrolling, string and string operations, pointers/references, static and dynamic memory allocation, File I/O operations.

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

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

<b>Course Name:</b>	<b><i>Object Oriented Programming</i></b>
<b>Course Code:</b>	COMP2111
<b>Credit Hours:</b>	4 (3+1)
<b>Contact Hours:</b>	3+1
<b>Pre-requisites:</b>	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.

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

**Course Outline:**

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

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

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

**Course Name:** *Data Structures*  
**Course Code:** COMP2117  
**Credit Hours:** 4 (3+1)  
**Contact Hours:** 3+1  
**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.

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
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 trees, 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

**Course Name:** *Computer Organization and Assembly Language*  
**Course Code:** COMP2118  
**Credit Hours:** 3 (2+1)  
**Pre-requisites:**

**Course Introduction:**

The main objective of this course is to introduce the organization of computer systems and usage of assembly language for optimization and control. Emphasis should be given to expose the low-level logic employed for problem solving while using assembly language as a tool. At the end of the course the students should be capable of writing moderately complex assembly language subroutines and interfacing them to any high level language.

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
CLO-1	Acquire the basic knowledge of computer organization computer architecture and assembly language	C2 (Understand)
CLO-2	Understand the concepts of basic computer organization, architecture, and assembly language techniques	C2 (Understand)
CLO-3	Solve the problems related to computer organization and assembly language	C3 (Apply)

**Course Outline:**

Introduction to computer systems: Information is bits + context, programs are translated by other programs into different forms, it pays to understand how compilation systems work, processors read and interpret instructions stored in memory, caches matter, storage devices form a hierarchy, the operating system manages the hardware, systems communicate with other systems using networks; Representing and manipulating information: information storage, integer representations, integer arithmetic, floating point; Machine-level representation of programs: a historical perspective, program encodings, data formats, accessing information, arithmetic and logical operations, control, procedures, array allocation and access, heterogeneous data structures, putting it together: understanding pointers, life in the real world: using the gdb debugger, out of- bounds memory references and buffer overflow, x86-64: extending ia32 to 64 bits, machine-level representations of floating-point programs; Processor architecture: the Y86 instruction set architecture, logic design and the Hardware Control Language (HCL), sequential Y86 implementations, general principles of pipelining, pipelined Y86 implementations

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

1. Computer System Architecture, M. Morris Mano, Latest Edition,
2. Assembly Language Programming for Intel- Computer, Latest Edition
3. Computer Systems: A Programmer's Perspective, 3/E (CS:APP3e), Randal E. Bryant and David R.O' Hallaron, Carnegie Mellon University
4. Robert Britton, MIPS Assembly Language Programming, Latest Edition,

<b>Course Name:</b>	<b><i>Digital Logic and Design</i></b>
<b>Course Code:</b>	PHYS4129
<b>Credit Hours:</b>	3 (2+1)
<b>Pre-requisites:</b>	None

**Objectives:**

The students will be able to understand:

- Digital circuits using Boolean algebra and to implement digital circuits with different logic gates and capable of designing both sequential and combinational circuits for microprocessor based systems.
- Design considerations for the telecommunication systems using analog integrated circuits.

**Course Outline:**

**Review of Number Systems:** Binary, octal and hexadecimal number system their inter conversion, basic logic gates, different codes (BCD, ASCII, Gray etc.), Parity in codes.

**Boolean Algebra:** Demorgan theorems, simplification of Boolean expression by Boolean postulates and theorem, SOP and POS conversions, K maps and their uses, don't care condition.

**Combinational Logic Circuit:** Logic circuits based on AND-OR, OR-AND, NAND, NOR Logic gates design, addition, subtraction, 2's compliments, half adder, full adder, half subtractor, full subtractor in coder, decoder, multiplexer and demultiplexer.

**Sequential Logic Circuit:** Latches, Flip-flop, S-R, J-K, T and D flip flops, Master-slave flips-flops.

**IC Logic Families:** Basic characteristics of a logic family. (Propagation delay time, dissipation, noise margins etc. Different logic based IC families (DTL, RTL, TTL, CMOS).

**List of Experiments**

1. To construct and understand an operation of arithmetic logic unit and study different operation of it.
2. Design and study the application of operational amplifier (current to voltage converter, voltage clamp, integrator and differentiator)

**Recommended Books:**

1. Nashelsky, L. (1972). *Introduction to digital computer technology*.
2. Debenham, M. J. (2013). *Microprocessors: principles and applications*. Elsevier.
3. Mano, M. M. (1988). *Computer engineering hardware design*. Prentice-Hall, Inc.
4. Tokheim, R. (2007). *Digital Electronics*. 7<sup>th</sup>Ed McGraw Hill. Instructor of respective course may add two books.

**Course Name:** *Operating Systems*  
**Course Code:** COMP3142  
**Credit Hours:** 3 (2+1)  
**Pre-requisites:**

**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.

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
CLO-1	Understand the characteristics of different structures of the Operating Systems and identify the core functions of the Operating Systems	C2 (Understand)
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, 9<sup>th</sup> edition by Abraham Silberschatz
2. Modern Operating Systems, 4<sup>th</sup> edition by Andrew S. Tanenbaum
3. Operating Systems, Internals and Design Principles, 9<sup>th</sup> edition by William StallingsWu

**Course Name:** *Database Systems*  
**Course Code:** COMP2114  
**Credit Hours:** 4 (3+1)  
**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

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
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 sub-queries 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, 6<sup>th</sup> Edition by Thomas Connolly and Carolyn Begg
2. Database Systems: The Complete Book, 2<sup>nd</sup> Edition by Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom
3. Database System Concepts, 6<sup>th</sup> Edition by Avi Silberschatz, Henry F. Korth and S. Sudarshan.
4. Database Management Systems, 3<sup>rd</sup> Edition by Raghu Ramakrishnan, Johannes Gehrke

**Course Name:** *Information Security*  
**Course Code:** COMP2120  
**Credit Hours:** 3 (2+1)  
**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, 3<sup>rd</sup> edition by William Stallings
2. Principles of Information Security, 6<sup>th</sup> edition by M. Whitman and H. Mattord
3. Computer Security, 3<sup>rd</sup> edition by Dieter Gollmann
4. Computer Security Fundamentals, 3<sup>rd</sup> edition by William Easttom
5. Official (ISC)2 Guide to the CISSP CBK, 3<sup>rd</sup> edition

**Course Name:** *Computer Networks*  
**Course Code:** COMP2119  
**Credit Hours:** 3 (2+1)  
**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.

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
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, 6<sup>th</sup> edition by James F. Kurose and Keith W. Ross
2. Computer Networks, 5<sup>th</sup> Edition by Andrew S. Tanenbaum
3. Data and Computer Communications, 10<sup>th</sup> Edition by William Stallings
4. Data Communication and Computer Networks, 5<sup>th</sup> Edition by Behrouz A. Forouzan

**Course Name:** *Software Engineering*  
**Course Code:** COMP2112  
**Credit Hours:** 3 (3+0)  
**Contact Hours:** 3+0  
**Pre-requisites:** None

**Course Introduction:**

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., 10<sup>th</sup> Edition, Pearson Inc., 2014
2. Software Engineering, A Practitioner's Approach, Pressman R. S.& Maxim B. R., 8<sup>th</sup> Edition, McGraw-Hill, 2015.

**Course Name:** *Analysis of Algorithms*  
**Course Code:** COMP4121  
**Credit Hours:** 3 (3+0)  
**Pre-requisites:** Data Structures

**Course Introduction:**

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

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
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-and-conquer, and dynamic programming) to solve an appropriate problem	
CLO-7	Solve problems using graph algorithms, including single-source and all-pairs shortest paths, and at least one minimum spanning tree algorithm	
CLO-8	Trace and/or implement a string-matching algorithm	

**Course Outline:**

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

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

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

**Course Name:** *Artificial Intelligence*  
**Course Code:** COMP2121  
**Credit Hours:** 3 (2+1)  
**Pre-requisites:**

**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.

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
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, Min-max algorithm, Alpha beta pruning, Game-playing); Case Studies: General Problem Solver, Eliza, Student, Macsymba; 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.

**Course Name:** *Theory of Automata*  
**Course Code:** COMP3148  
**Credit Hours:** 3 (3+0)  
**Pre-requisites:** None

### Course Introduction:

This course introduces the fundamental concepts of theory of automata and formal languages. It describes grammar, finite automaton, regular expressions, formal language, pushdown automaton and other concepts. It introduces the study of abstract machines and the computation problems that can be solved by using these machines.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Explain and manipulate the different concepts in automata theory and formal languages such as formal proofs, automata, regular expressions, Turing machines etc.	C2 (Understand)
CLO-2	Prove properties of languages, grammars and automata with rigorously formal mathematical methods	C2 (Understand)
CLO-3	Design of automata, RE and CFG	C3 (Apply)
CLO-4	Transform between equivalent NFAs, DFAs and REs	C3 (Apply)
CLO-5	Define Turing machines performing simple tasks	C2 (Understand)
CLO-6	Differentiate and manipulate formal descriptions of languages, automata and grammars with focus on regular and context-free languages, finite automata and regular expressions.	C3 (Apply)

### Course Outline:

Finite State Models: Language definitions preliminaries, Regular expressions/Regular languages, Finite automata (FAs), Transition graphs (TGs), NFAs, Kleene's theorem, Transducers (automata with output), Pumping lemma and non-regular language Grammars and PDA: CFGs, Derivations, derivation trees and ambiguity, Simplifying CFLs, Normal form grammars and parsing, Decidability, Context sensitive languages, grammars and linear bounded automata (LBA), Chomsky's hierarchy of grammars Turing Machines Theory: Turing machines, Post machine, Variations on TM, TM encoding, Universal Turing Machine, Defining Computers by TMs.

### Reference Materials:

- 1 Introduction to computer theory, Daniel I. A. Cohen, 2<sup>nd</sup> Edition
- 2 Automata, Computability and Complexity: Theory and Applications, by Elaine Rich, 2011
- 3 An Introduction to Formal Languages and Automata, by Peter Linz, 4<sup>th</sup> edition, Jones & Bartlett Publishers, 2006
- 4 Theory of Automata, Formal Languages and Computation, by S. P. Eugene, Kavier, 2005, New Age Publishers

**Course Name:** Introduction to Machine Learning

**Course Code:** COMP3124

**Credit Hours:** 3 (3+0)

**Pre-requisites:**

**Course Introduction:**

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

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

**Course Outline:**

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

**Reference Materials:**

1. Machine Learning, Tom, M., McGraw Hill,
2. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press, 2012

**Course Name:** *Knowledge Representation and Reasoning*

**Course Code:**

**Credit Hours:** 3 (3-0)

**Contact Hours:** 3-0

**Pre-requisites:**

**Course Introduction:**

Knowledge representation is one of the fundamental areas of Artificial Intelligence. It is the study of how knowledge about the world can be represented and manipulated in an automated way to enable agents to make intelligent decisions. This course will provide an overview of existing knowledge representation frameworks developed within AI including but not limited to propositional and first-order logic, ontologies, planning, reasoning and decision making under uncertainty. The assignments component of the course would provide hands-on experience of software like Prolog, Protégé, probabilistic reasoning APIs and tools to support complex decision making. It is expected that after completing this course, students will understand (a) the foundations of Knowledge Representation & Reasoning and (b) which tools and techniques are appropriate for which tasks.

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
CLO-1	Understand the fundamentals of knowledge representation and reasoning in deterministic situations	C2 (Understand)
CLO-2	Understand the challenges in representing knowledge and reasoning under uncertainty	C2 (Understand)
CLO-3	Analyze different situations and apply appropriate knowledge representation frameworks	C4 (Analyze)
CLO-4	Development of hybrid approaches by synergizing the existing framework to solve complex decision-making problems.	C4 (Analyze)

**Course Outline:**

Propositional Logic, First-order Logic, Horn Clauses, Description Logic, Reasoning using Description Logic, Forward and Backward Chaining in Inference Engines, Semantic Networks, Ontologies and Ontology Languages, Logical Agents, Planning, Rule-based Knowledge Representation, Reasoning Under Uncertainty, Bayesian Networks Representation, Inference in Bayesian Networks, Fuzzy Logic, Inference using Fuzzy Rules, Markov Models, Commonsense Reasoning, Explainable AI.

**Reference Materials:**

1. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach* (3rd Ed.) (2015)
2. David Poole and Alan Mackworth, *Artificial Intelligence: Foundations of Computational Agents*, 2nd Ed, 2017
3. Ronald Brachman and Hector Levesque. *Knowledge Representation and Reasoning*, 2004

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**Course Name:** *Introduction to Computer Vision*

**Course Code:**

**Credit Hours:** 3 (2+1)

**Contact Hours:** 2+1

**Pre-requisites:**

### Course Introduction:

With a single glance a human interprets the entire scene. How many objects are present in the scene and where they are located. Which person is present in the scene. What will happen next. However, computers lack this capability. We have seen only face detectors so far working in our mobile phones? What is the challenge in understanding the 3D scene, i.e., the identity, the location and the size of the objects present in the scene. In this course we will introduce the basic concepts related to 3D scene modelling from single view and multiple views.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Understanding the single view geometry concepts	C2 (Understand)
CLO-2	Understanding the multiple view geometry concepts	C2 (Understand)
CLO-3	Apply concepts of CV for solving real world problems	C3 (Apply)

### Course Outline:

Introduction to Computer Vision (Problems faced, History and Modern Advancements). Image Processing, Image filtering, Image pyramids and Fourier transform, Hough transform. Camera models, Setting up a camera model from parameters, Camera looking at a plane, Relationship of plane and horizon line, Rotation about camera center. Concatenation, Decomposition and Estimation of transformation from point correspondences, Points and planes in 2D/3D, Transformations in 2D/3D, Rotations in 2D/3D. Edge detection, corner detection. Feature descriptors and matching (HoG features, SIFT, SURF). Applications of Computer Vision Traditional Methods: Image Stitching: Making a bigger picture from smaller pictures Single View Geometry: Converting a single image into a 3D model. Applications of CV using Deep Learning: Image Detection (Localization, Historical Techniques, RCNN, FRCNN, YOLO, Retina), Image Segmentation (UNet, SegNet, MaskRCNN), Image Generation (GANN)

### Reference Materials:

#### Text Book:

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

**Course Name:** *Parallel & Distributed Computing*  
**Course Code:** COMP4122  
**Credit Hours:** 3 (2+1)  
**Pre-requisites:**

**Course Introduction:**

This is a theory course directed at non-theory students with the standard undergrad background. The goal is to survey the key theory topics that every Artificial Intelligence graduate student should know. In about two weeks for each selected topic, we will gain insights into the basics and study one two example in depth.

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

**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:**

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

**Course Name:** *Natural Language Processing*  
**Course Code:** COMP3131  
**Credit Hours:** 3 (3+0)  
**Pre-requisites:**

**Course Introduction:**

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

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

**Course Outline:**

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

**Reference Materials:**

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

<b>Course Name:</b>	Speech Processing
<b>Course Code:</b>	COMP4XXXX
<b>Credit Hours:</b>	3 (2+1)
<b>Pre-requisites:</b>	

**Course Introduction:**

The course covers the following topics: Digital Speech Processing; Fundamentals of Digital Signal Processing; Human Speech Production; Sound Propagation in Human Vocal Tract; Time-Domain Methods for Speech Processing; Frequency-Domain Representations; Cepstrum & Homomorphic Speech Processing; Linear Predictive Analysis of Speech Signals; Algorithms for Estimating Speech Parameters; Digital Coding of Speech Signals; Frequency-Domain Coding of Speech & Audio; Text-to-Speech Synthesis Methods; and Automatic Speech Recognition & Natural Language Understanding.

- To discuss the concepts and applications of deep learning;
- To apply deep learning on a given dataset;
- To apply RNN and transformers on a given dataset;
- To build deep learning-based solutions for a given problem

**CLO No. Course Learning Outcomes****Bloom Taxonomy**

<b>CLO-1</b>	Express the concepts of digital speech processing	Understanding 2
<b>CLO-2</b>	Discuss the basic concepts of human speech production, perception and propagation.	Understanding 2
<b>CLO-3</b>	Apply speech transformation techniques.	Applying 2-5
<b>CLO-4</b>	Apply algorithms for speech parameter estimation, digital coding, and synthesis methods in speech processing and recognition systems	Applying 2-5
<b>CLO -5</b>	Develop a speech processing application by implementing key components of speech processing systems	Creating 2-5

**Course Outline:**

Digital Speech Processing: Introduction, Speech Signal, Speech Stack, and Applications; Fundamentals of Digital Signal Processing: Discrete-Time Signals & Systems, Transform Representation of Signals & Systems, Digital Filters, and Sampling.

Human Speech Production: Process of Speech Production, ShortTime Fourier Representation of Speech, and Acoustic Phonetics; Hearing, Auditory Model & Speech Perception; and Sound Propagation in the Human Vocal Tract.

Time-Domain Methods for Speech Processing: Short-Time Analysis of Speech, Short-Time Energy & Short-Time Magnitude, Short-Time & Modified Short-Time Autocorrelation Function, and Short-Time Average Magnitude Difference Function; Frequency Domain Representations: Discrete-Time Fourier Analysis, Short Time Fourier Analysis, Spectrographic Displays, Implementation of the FBS Method Using the FFT, and Modifications of the STFT.

Cepstrum & Homomorphic Speech Processing: Homomorphic

Systems for Convolution & Analysis of the Speech Model, Computing Short-Time Cepstrum & Complex Cepstrum of Speech, and Homomorphic Filtering of Natural Speech; Linear Predictive Analysis of Speech Signals: Basic Principles, Computation of the Gain for the Model, Frequency Domain Interpretations of Linear Predictive Analysis, Prediction Error Signal, and Relation of Linear Predictive Analysis to Lossless Tube Models.

Algorithms for Estimating Speech Parameters: Median Smoothing & Speech Processing, Speech-Background/Silence Discrimination, Bayesian Approach to Voiced/Unvoiced/Silence Detection. Pitch Period Estimation, and Formant Estimation.

Digital Coding of Speech Signals; Frequency-Domain Coding of Speech & Audio; Text-to-Speech Synthesis Methods; and Automatic Speech Recognition & Natural Language Understanding.

### **Reference Materials:**

1. Applied Speech Processing Algorithms and Case Studies, Nilanjan Dey, Academic Press, 2021.
2. Theory and Applications of Digital Speech Processing, Lawrence Rabiner, Ronald Schafer, Pearson, 2011.

### **Reference Book:**

3. Digital Signal Processing: Principles and Applications, Holton, T., Cambridge University Press, 2021.

**Course Name:** *Data Mining*  
**Credit Hours:** 3 (3+0)  
**Contact Code :** COMP3116  
**Pre-requisites:**

### Course Introduction:

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

- Expand on the student's understanding and awareness of the concepts of data mining basics, techniques, and application.
- Introduce the concepts of *Data Pre-processing and Summary Statistics*.
- Introduce the concepts of *Frequent Item Set Generation, Associations and Correlations measures*.
- Introduce the concepts of *Classification, Prediction, and Clustering algorithms*. Build on the programming and problem-solving skills developed in previous subjects studied by the student, to achieve an understanding of the development of Classification, Prediction, and Clustering applications.

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Apply preprocessing techniques on any given raw data.	C3 (Apply)
CLO-2	Select and apply proper data mining algorithm to discover interesting patterns	C3 (Apply)
CLO-3	Analyze and extract patterns to solve problems and point out how to deploy solution	C4 (Analyze)
CLO-4	Evaluate systematically supervised, semi supervised and unsupervised models and algorithms with respect to their accuracy	C4 (Analyze)

### Course Outline:

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

### Reference Materials:

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

**Course Name:** *Advance Statistics*

**Course Code:**

**Credit Hours:** 3 (3-0)

**Contact Hours:** 3-0

**Pre-requisites:**

**Course Introduction:**

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

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
CLO-1	Describe what part of statistics is meant for data scientist and what the applications of statistics in data science are.	C1 (Knowledge)
CLO-2	Apply Statistical techniques in real life problems.	C3(Apply)
CLO-3	Analyze, Correlate, Forecast data by using different statistical techniques	C2 (Understand)
CLO-4	Apply basic data science statistical techniques by using SPSS on real world datasets.	C3 (Apply)

**Course Outline:**

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

**Reference Materials:**

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

**Course Name:** *Reinforcement Learning*

**Course Code:** COMPXXXX

**Credit Hours:** 3 (2+1)

**Pre-requisites:**

**Course Introduction:**

This course provides an overview of reinforcement learning. The topics include: Fundamentals of Reinforcement Learning; Bellman Equation; Markov Decision Processes; Tabular Methods; Q-Networks; Policy Methods; Recent Advances & Applications, and Ethics in RL

- To discuss the concepts and applications of reinforcement learning;
- To apply Markov decision processes and tabular methods on practical problems;
- To discuss the current advanced techniques and applications in RL

**CLO No. Course Learning Outcomes**

**Bloom Taxonomy**

<b>CLO-1</b>	Describe core principals behind reinforcement learning and related tasks.	Understanding 2
<b>CLO-2</b>	Apply Markov decision processes and tabular methods to solve control problems	Applying 2-3
<b>CLO-3</b>	Demonstrate policy methods for optimization using case studies.	Applying 2-3
<b>CLO-4</b>	Recognize current advanced techniques, applications and ethical issues in RL.	Understanding 2
<b>CLO-5</b>	Develop a reinforcement learning application by using effective algorithms and strategies	Creating 2-5

**Course Outline:**

Reinforcement Learning (RL): Overview, Framework, Task Formulation, Environments, and Taxonomy of RL Approaches.

Bellman Equation: Value Function, Q function, Optimality Equation, and Relationship between Value & Q function.

Markov Decision Processes: Markov Property & Markov Chain, Markov Reward Process, and Markov Decision Process.

Tabular Methods & Q-Networks: Dynamic Programming, Monte Carlo, Temporal-Difference Learning Methods; and Deep QNetworks. Policy Methods: Gradient Methods, Entropy Methods, and ActorCritic Methods.

Recent Advances & Applications: Model-Based RL, Imitatio Learning, Meta-Learning, Multi-Agent RL, Partially Observable Markov Decision Process, and RL for Real-world Problems.

Ethics in RL

**Reference Materials:**

Textbook:

1. Reinforcement learning: An introduction, Richard S. Sutton and Andrew G. Barto, MIT Press, 2019.

Reference Books:

1. Reinforcement Learning: Industrial Applications of Intelligent Agents, Dr. Phil Winder, O'Reilly Media, 2020.

2. Deep Reinforcement Learning with Python, Sudharsan Ravichandiran, Packt Publishing, 2020

<b>Course Name:</b>	Programming for AI
<b>Course Code:</b>	COMPXXXX
<b>Credit Hours:</b>	3 (2+1)
<b>Pre-requisites:</b>	None

**Course Introduction:**

- To explain the fundamental constructs of programming language for data analysis and representation;
- To discuss and apply Solve and analyze programming and data analysis problems using standard libraries and/or toolboxes of the programming language

Introduction to Programming Language (Python): IDE for the Language, Variables, Expressions, Operands and Operators, Loops, Control Structures, Debugging, Error Messages, Functions, Strings, Lists, Object Oriented Constructs & Basic Graphics in the Language; Applied Mathematics for AI; Regression Analysis & Chain Rule; Version Control (Git and Subversion); Libraries/Toolboxes Necessary for Data Analysis; Analyzing & Plotting Numerical Data (E.G., Numpy, Matplotlib, Anaconda & Pandas for Python); and Case Studies

**CLO No. Course Learning Outcomes****Bloom Taxonomy**

<b>CLO-1</b>	Apply fundamental programming constructs to solve basic computational problems.	Understanding 2
<b>CLO-2</b>	Develop and use classes and objects, employing object oriented programming principles to create modular and scalable code.	Understanding 2
<b>CLO-3</b>	Clarify deep learning techniques for building AI applications.	Understanding 2,3
<b>CLO-4</b>	Implement AI based applications and optimization techniques using Python.	Applying 2-5

**Course Outline:**

Introduction to Programming Language (Python): Integrated Development Environments (IDEs) for Python; Variables; Expressions; Operands & Operators: Basic Syntax & Operations in Python, Data Types, Arithmetic, & Logical Operations, Regular Expression; Loops & Control Structures; Functions; File Handling; Exception Handling; and Debugging.

Python Data Structures: Strings; Lists; Tuples; and Dictionaries; Applied Mathematics for AI; and Regression Analysis & Chain Rule

Object-Oriented Programming in Python

Libraries/Toolboxes Necessary for Data Analysis: Overview of Essential Python Libraries (e.g., Numpy, Pandas, Matplotlib); Analyzing & Plotting Numerical Data: Techniques for Data analysis & Visualization

Object Detection and Tracking: OpenCV, Tracking Objects, Face & Eye Detection & Tracking; and AI Applications using Deep Learning

AI based Games; and Version Control (Git and Subversion)

**Reference Materials:**

Textbook:

1. Artificial Intelligence with Python: Your complete guide to building intelligent apps using Python 3.x,

Artasanchez, A. & Joshi, P., Packt Publishing, 2020.

Reference Books:

1. Introduction to Logic Programming (Synthesis Lectures on Artificial Intelligence and Machine Learning), Genesereth, M., et al., Morgan & Claypool, 2020.

2. AI for Games, Millington, I., CRC Press, 2019.

Course Name: *Artificial Neural Networks*  
 Credit Hours: 3 (3+0)  
 Course Code: COMP3126  
 Pre-requisites:

**Course Introduction:**

This course will introduce Artificial Neural Networks and Deep Learning. ANN's basic architecture and how they mimic the human brain using simple mathematical models. Many of the important concepts and techniques around brain computing and the major types of ANN will also be introduced. Emphasis is made on the mathematical models, understanding learning laws, selecting activation functions and how to train the networks to solve classification problems. Deep neural networks have achieved state of the art performance on several computer vision and speech recognition benchmarks. This course will further build on the fundamentals of Neural networks and artificial intelligence and will introduce advanced topics in neural networks, convolutional and recurrent network structures, deep unsupervised and reinforcement learning.

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
CLO-1	Understand the fundamentals of neural networks in AI	C2 (Understand)
CLO-2	Explain how simple ANNs can be designed	C2 (Understand)
CLO-3	Apply ANN for classification Problems	C3 (Apply)
CLO-4	Apply deep learning algorithms to real-world problems	C3 (Apply)
CLO-5	Analyze results from deep learning to select appropriate solutions	C4 (Analyze)

**Course Outline:**

Introduction and history of neural networks, Basic architecture of neural networks, Perceptron and Adaline (Minimum Error Learning) for classification. Basics of deep learning, learning networks, Shallow vs. Deep learning etc.; Machine learning theory – training and test sets, evaluation, etc. Selected topics from: Gradient descent (Delta) rule, Hebbian, Neo-Hebbian and Differential Hebbian Learning, Drive Reinforcement Theory, Kohonen Self Organizing Maps, Associative memory, Bi-directional associative memory (BAM), Energy surfaces, The Boltzmann machines, Backpropagation Networks, Feedforward Networks; Theory of Generalization; Multi-layer perceptrons, error backpropagation; 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:**

1. Neural Network Design, 2nd Edition, Martin T. Hagan, Howard, B. Demuth, Mark Hudson Beale and Orlando De Jesus, Publisher: Martin Hagan; 2 edition (September 1, 2014), ISBN-10: 0971732116
2. An Introduction to Neural Networks, James A Anderson, Publisher: A Bradford Book (March 16, 1995), ISBN-10: 0262011441

3. Fundamentals of Artificial Neural Networks, Mohammad Hassoun, Publisher: A Bradford Book (January 1, 2003), ISBN-10: 0262514672
4. Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville (<http://www.deeplearningbook.org/>)
5. Deep learning with python by Francoise Chollet, ISBN-10: 9781617294433, 2017

<b>Course Name:</b>	Fuzzy Systems
<b>Course Code:</b>	COMPXXXX
<b>Credit Hours:</b>	3 (2+1)
<b>Pre-requisites:</b>	None

### Course Introduction:

- To discuss the concepts and applications of fuzzy logic;
- To apply the concepts of fuzzy rule-based system on a computing problem;
- To design complete systems based on fuzzy logic.

This course covers the following concepts: Fuzzy Set Theory; Fuzzy Relations; Fuzzy Logic; Probability & Membership Functions; Fuzzification; Defuzzification; Fuzzy Systems with Rule Inferences; Fuzzy Control Systems; Automated Methods for Fuzzy Systems; Fuzzy Control Systems; Fuzzy Systems Simulations; Decision Making with Fuzzy Information; Fuzzy Clustering; and Application of Fuzzy Systems

### CLO No. Course Learning Outcomes

### Bloom Taxonomy

<b>CLO-1</b>	Formulate a membership function using fuzzy theory for a given computing problem	Applying 2,3
<b>CLO-2</b>	Design a fuzzy rule-based system for a computing problem.	Creating 3-5
<b>CLO-3</b>	Demonstrate fuzzy decision-making process with suitable examples	Applying 2,3
<b>CLO-4</b>	Develop a fuzzy system	Creating 3-5

### Course Outline:

Fuzzy Theory: Set, Relations, and Logic.

Membership Functions: Features, Fuzzification, Membership Value Assignments; Defuzzification Method

Fuzzy Rule-Based System: Formation, Decomposition & Aggregation of Fuzzy Rules, Properties of Set of Rules, and Fuzzy Inference System

Fuzzy Decision Making: Fuzzy Ordering, Individual Decision Making, Multi-Person Decision Making, Multi-Objective Decision Making, and Fuzzy Bayesian Decision Method.

Applications of Fuzzy Systems

### Reference Materials:

Textbook:

1. Fuzzy Sets and Fuzzy Logic with Engineering Applications, Timothy J. Ross, WILEY, 2017.

Reference Books:

1. Introduction to Fuzzy Sets, Fuzzy Logic, and Fuzzy Control Systems, Chen, Guanrong; Pham, Trung Tat, CRC Press; 1st edition, 2019.

2. Fuzzy Logic Theory and Applications: Part I And Part II, Lotfi A Zadeh, Rafik Aziz Aliev, World Scientific, 2018

**Course Name:** Agent Based Modeling

**Course Code:** COMPXXXX

**Credit Hours:** 3 (2+1)

**Pre-requisites:** None

### Course Introduction:

- To discuss the concepts and methodologies for agent-based modelling;
- To be able to create agent-based models to represent a complex system;
- To be able to perform a simulation for a complex system using modern tool and techniques

This course introduces the agent-based modeling to represent and analyze complex systems. Topics include: Agent Based Modeling Overview; Agent Oriented Methodologies; Agent Based Model (ABM) Creation; Components; Exploration & Extension; Analysis of ABM; Verification & Validation; Replication; and Applications of ABM.

<b>CLO-1</b>	Explain concepts and methodologies used for agent-based modeling.	Understanding 2
<b>CLO-2</b>	Create agent-based models to represent a complex system.	Creating 4
<b>CLO-3</b>	Analyze the usefulness of an agent-based model when applied to a real-world application	Applying 3
<b>CLO-4</b>	Perform a simulation for a complex system using modern tool and techniques	Applying 3,5

### Course Outline:

Agent Based Modeling(ABM): Overview, Complex Systems & Emergence; Multi-agent Systems; Ant Model; Agent Based Models (ABM): ABM vs. Other Modeling Forms, Randomness vs.

Determinism, and Trade-offs of ABM.

Agent Oriented Methodologies: Agent Oriented Development & Modeling Methodologies; and Agentology.

ABM Creation: Components, Designing Models, Agent Selection, Model Examination; Exploring & Extending ABMs: Fire Model, Diffusion-Limited Aggregation (DLA) Model, Segregation Model, and EI Farol Model.

Model Correctness: Verification & Validation, and Replication.

Analysis of ABM: Statistical Analysis, Graph Based Analysis, and Analyzing Networks within ABM.

Modern Tools for Constructing an ABM; and Real-World Applications of ABM.

### Reference Materials:

Textbooks:

1. An Introduction to Agent-Based Modeling: Modeling Natural, Social, and Engineered Complex Systems with NetLogo, Uri Wilensky & William Rand, The MIT Press, 2015.
2. Design of Agent-Based Model, Tomas Salamon, Tomas Bruckner Publishers, 2011.

Reference Books:

1. The Art of Agent-Oriented Modeling, Leon Sterling & Kuldar Taveter, The MIT Press, 2009.
2. AnyLogic 8 in Three Days: A Quick Course in Simulation Modeling, Ilya Grigoryev, 2018.

<b>Course Name:</b>	Knowledge Based Systems
<b>Course Code:</b>	COMPXXXX
<b>Credit Hours:</b>	3 (2+1)
<b>Pre-requisites:</b>	None

### Course Introduction:

#### Course Content

This course covers the following concepts: Knowledge Based Systems; Components of KBS; KBS Software Lifecycles; Knowledge Acquisition; Knowledge Representation; Knowledge Representations Schemes; Base Techniques of KBS; Productions & Rule Based Systems; Expert Systems; Case-Based Reasoning; and Evaluation of KBS

- To discuss the concepts and methodologies for knowledge based modelling;
- To design knowledge-based applications on a given problem

CLO No.	Course Learning Outcomes	Bloom Taxonomy
CLO-1	Discuss the architecture of knowledge-based systems	Understanding 1
CLO-2	Design knowledge-based applications for a given problem	Applying 1,2,3
CLO-3	Differentiate between different knowledge-based techniques.	Understanding 1,2
CLO-4	Develop an expert system.	Applying 3
CLO-5	Develop a case based reasoning system	Applying 2-4
CLO-6	Develop a knowledge-based system that effectively captures, organizes, and utilizes domain-specific knowledge to support decision-making and problem-solving	Creating 2-5

### Course Outline:

Knowledge Based Systems (KBS): Overview, Characteristics, Types of Knowledge, Types of KBS, Tools & Environments for KBS System Development, and Applications.

Components of KBS: Knowledge Base, Meta-Knowledge, Inference Engine, Search Techniques, User Interface & Dialog; and KBS Software Lifecycles.

Knowledge Acquisition: Sources of Knowledge, Categories of Knowledge Acquisition Methods, Top-Down & Bottom-Up Methods, and Knowledge Acquisition Modes.

Knowledge Representations Schemes: Logic Representation, Propositional Logic, Predicate Logic, and Logic Programming.

KBS Techniques: Rule-Based, Inductive, Hybrid, Symbol Manipulation, and Case-Based Techniques.

Rule Based Systems: Architecture, Execution, and Comparison of the Various Knowledge Schemes.

Expert Systems: Structure, Development Methodology, and Shells.

Case-Based Reasoning (CBR): Case, Case-Indexing, Main Components of Case-Based Systems, and Rule-based Inference Controls.

Evaluation of KBS: Test Cases, Refinement, and Performance.

**Reference Materials:**

Textbooks:

1. Artificial Intelligence and Expert Systems, I. Gupta G. Nagpal, Mercury Learning and Information, 2020.
2. Knowledge-Based Systems, Rajendra Akerkar, Priti Sajja, Jones & Bartlett Learning, 2009.

Reference Books:

3. Artificial Intelligence and Expert Systems, I. Gupta G. Nagpal, Mercury Learning and Information, 2020.
4. The Handbook of Applied Expert Systems, Jay Liebowitz, CRC Press, 20

**Course Name:** *Multivariable Calculus*  
**Course Code:** MATH3122  
**Credit Hours:** 3 (3+0)  
**Pre-requisites:**

**Course Introduction:**

This course has been designed to provide foundation and basic ground for multivariable calculus and analytical background with multi variables

**Course Outline:**

Functions of Several Variables and Partial Differentiation. Multiple Integrals, Line and Surface Integrals. Green's and Stoke's Theorem. Fourier Series: periodic functions, Functions of any period P-2L, Even & odd functions, Half Range expansions, Fourier Transform; Laplace Transform, Z-Transform.

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

- 1 Multivariable Calculus, 6th edition James, Stewart 2007 Cengage Learning publishers.
- 2 Calculus and Analytical Geometry, 6th edition. Swokowski, Olinick and Pence. 1994.Thomson Learning EMEA, Ltd.
- 3 Multivariable Calculus, 5th edition Howard, A. Albert, H. 1995, John Wiley.

**Course Name:** *Linear Algebra*  
**Course Code:** MATH3114  
**Credit Hours:** 3 (3+0)  
**Pre-requisites:**

**Course Description:** Linear algebra is the study of vector spaces and linear transformations. The main objective of this course is to help students learn in rigorous manner, the tools and methods essential for studying the solution spaces of problems in Mathematics, engineering, the natural sciences, and social sciences and develop mathematical skills needed to apply these to the problems arising within their field of study; and to various real-world problems.

**Course Content:**

**Vectors:** Vectors In  $R_n$  and  $C_n$ , Linear Combination of Vectors, Dot (Inner) Product, Angle between Vectors, Projections, Cauchy-Schwarz Inequality, Minkowski's Inequality, Hyperplanes, Lines, Vectors in (Spatial Vectors), Cross Product, Lagrange's Identity.

**Matrix Operations:** Matrices, Trace, Powers of Matrices, Polynomials in Matrices, Invertible Matrices, Orthogonal Matrices, Normal Matrices, Hermitian Matrices, Unitary Matrices, Block Matrices.

**Systems of Linear Equations:** Homogeneous and Non- Homogeneous System of Linear Equations and its Solutions, Equivalent Systems, Elementary Operations, Gaussian Elimination, Echelon and Reduced Echelon Forms, Row Equivalence, Elementary Matrices, Lu Decomposition.

**Determinants:** Determinants, Properties of Determinants, Minors and Cofactors, Classical Adjoint, Cramer's Rule, Principal Minors, Block Matrices and Determinants, Evaluation of Determinants and Inverses Using Row Operations

**Vector Spaces:** Introduction to Vector Spaces, Linear Combinations, Spanning Sets, Subspaces, Linear Dependence and Independence, Basis and Dimension, Rank of Matrices, Direct Sums, Coordinate Vectors.

**Eigenvalues and Eigenvectors:** Characteristic Polynomial, Cayley-Hamilton Theorem, Eigenvalues and Eigenvectors, Diagonalizable Matrices, Diagonalization, Symmetric Matrices, Minimal Polynomial.

**Linear Transformations:** Introduction to Linear Transformations, Kernel, and Image of a Linear Transformations, Rank and Nullity Theorem, Singular and Nonsingular Linear Mappings, Isomorphisms, Matrix Representations of a Linear Transformation, Change of Basis, Similar Matrices

**Inner Product Spaces:** Definition, Orthonormal Bases, The Concept of Length, Angle, and Distance. Some Inequalities Related to Inner Product Spaces, Gram Schmidt's Process of Normalization.

**Recommended Books**

- *Lipschutz, S. and Lipson, M. (2009). Linear Algebra. New York, McGraw-Hill*
- *Kolman, B. (2007). Elementary Linear Algebra with Applications. Toronto, Pearson.*
- *Anton, H. (2005). Elementary Linear Algebra. John Wiley & Sons*
- *Lay D.C. (2012) Linear Algebra and its Applications, 4th Edition*

<b>Course Name:</b>	<i>Introduction to Statistics</i>
<b>Course Code:</b>	STAT2115
<b>Credit Hours:</b>	3 (3+0)
<b>Pre-requisites:</b>	None

**Course Objectives:**

- To Develop Understanding for the Basic Concepts of Statistics.
- To Prepare the Students for the Advanced Courses in the Field of Statistics Like Statistical Inference, Sampling, Hypothesis Testing etc.
- At the End of Course, Students Should Have Capability of Critical Thinking about the Data and which Techniques Could be used for Analysis.

**Course Content:**

Scope of Statistics, Introduction to Basic Concepts of Statistics Like Descriptive and Inferential Statistics, Population, Sample, Parameter, Statistic, Types of Data and the Scales of Measurement, Frequency Distribution and Graphical Representation of Data (Bar Chart, Pie Chart, Histogram, Frequency Polygon and Frequency Curve, Cumulative Frequency Polygon), Measures of Central Tendency, Quantiles, Absolute and Relative Measures of Dispersion, Moments, Skewness and Kurtosis, Basic Concepts of Probability, Counting Rules (Multiplication Principle, Permutation and Combination), Probability Spaces, Laws of Probability, Conditional Probability, Bayes' Theorem, Discrete and Continuous Random Variables, Probability Distributions of Random Variables (Binomial Distribution, Poisson Distribution, Hypergeometric Distribution, Uniform Distribution, Exponential Distribution, Normal Distribution Etc.), Overview of Sampling Like Sample Design, Sampling Frame, Sampling and Non-Sampling Errors, Sampling Distributions for Mean, Proportion, Difference of Means and Difference of Proportions, Overview of Hypothesis Testing and Regression Analysis.

**Recommended Books**

1. Bluman, A. G. *Elementary Statistics: A Step-by-Step Approach*, McGraw-Hill, 2012.
2. Mood, A. M., Graybill, F. A. & Boes, D.C. *Introduction to The Theory of Statistics*, McGraw-Hill, New York (1997).

<b>Course Name:</b>	<i>Applications of Information and Communication Technologies</i>
<b>Course Code:</b>	COMP1116
<b>Credit Hours:</b>	3 (2+1)
<b>Pre-requisites:</b>	None

**Description:**

This course is designed to provide students with an exploration of the practical applications of Information and Communication Technologies (ICT) and software tools in various domains. Students will gain hands-on experience with a range of applications, learning how to leverage ICT to solve daily life problems, enhance productivity, and innovate in different fields. Through individual and interactive exercises and discussions, students will develop proficiency in utilizing software for communication, creativity, and more.

**Course Learning Outcomes:**

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

1. Explain the fundamental concepts, components, and scope of Information and Communication Technologies (ICT)
2. Identify uses of various ICT platforms and tools for different purposes.
3. Apply ICT platforms and tools for different purposes to address basic needs in different domains of daily, academics, and professional life.
4. Understand the ethical and legal considerations to use of ICT platforms and tools.

**Syllabus**

1. Introduction to Information and Communication Technologies
  - Components of Information and Communication Technologies (basis of hardware, software, ICT platforms, networks, local, and cloud data storage etc.)
  - Scope of Information and Communication Technologies (use of ICT in education, business, governance, health care, digital media and entertainment, etc.)
  - Emerging technologies and future trends.
2. Basic ICT Productivity Tools:
  - Effective use of popular search engines (e.g., Google, Bing, etc.) to explore World Wide Web.
  - Formal Communication Tools and etiquettes (Gmail, Microsoft Outlook, etc.).
  - Microsoft Office Suites (word, Excel, PowerPoint).
  - Google Workspace (Google Docs, Sheets, Slides).
  - Dropbox (Cloud Storage and file sharing), Google Drive (Cloud storage with Google Docs integration) and Microsoft OneDrive (Cloud storage with Microsoft Office Integration).
  - Evernote (Note-taking and organization applications) and OneNote (Microsoft's digital notebook for capturing and organizing ideas).
  - Video conferencing (Google Meet, Microsoft Teams, Zoom, etc.).
  - Social media applications (LinkedIn, Facebook, Instagram, etc.).
3. ICT in Education :
  - Working with learning management systems (Moodle, Canvas, Google Classrooms, etc.).
  - Sources of online education courses (Coursera, edX, Udemy, Khan Academy, etc.).
  - Interactive multimedia and virtual classrooms.

4. ICT in Health and Well-being:
  - Health and fitness tracking devices and applications (Google Fit, Samsung Health, Apple , Health Xiaomi, Mi Band, Runkeeper, etc.).
  - Telemedicine and online health consultations (OLADOC, Sehat Kahani, Marham, etc.)
5. ICT in Personal Finance and Shopping:
  - Online banking and financial management tools (.lazzCash, Easypaisa, Zong PayMax, 1LINK and MNET, keenu Wallet, etc.).
  - E-commerce platforms (Darazpk, Telemart, Shophive, etc.).
6. Digital Citizenship and Online Etiquette:
  - Digital identity and online reputation.
  - Netiquette and respectful online communication.
  - Cyberbullying and online harassment.
7. Ethical Considerations in Use of ICT Platforms and Tools:
  - Intellectual property and copyright issues.
  - Ensuring originality in content creation by avoiding plagiarism and unauthorized use of information sources.
  - Content accuracy and integrity (ensuring that the content shared through ICT platforms is free from misinformation, fake news, and manipulation).

### **Practical Requirements**

As part of the overall learning requirements, the course will include:

1. Guided tutorials and exercises to ensure that students are proficient in commonly used software applications such as word processing software (e.g., Microsoft Word), presentation software (e.g., Microsoft PowerPoint), and spreadsheet software (e.g., Microsoft Excel) among such other tools. Students may be assigned practical tasks that require them to create documents, presentations, and spreadsheets etc.
2. Assigning of tasks that involve creating, managing, and organizing files and folders on both local and cloud storage systems. Students will practice file naming conventions, creating directories, and using cloud storage solutions (e.g., Google Drive, OneDrive).
3. The use of online learning management systems (LMS) where students can access course materials, submit assignments, participate in discussion forums, and take quizzes or tests. This will provide students with the practical experience with online platforms commonly used in education and the workplace.

### **Suggested Instructional Reading Materials**

- "Discovering Computers" by Vermaat, Shaffer, and Freund.
- "GO! with Microsoft Office" Series by Gaskin, Vargas, and McLellan.
- "Exploring Microsoft Office" Series by Grauer and Poatsy.
- "Computing Essentials" by Morley and Parker.
- "Technology in Action" by Evans, Martin. and Poatsy

<b>Course Name:</b>	<b><i>Functional English</i></b>
<b>Course Code:</b>	ENGL1114
<b>Credit Hours:</b>	3 (3+0)
<b>Pre-requisites:</b>	None

**Course Description:**

This course is designed to equip students with essential language skills for effective communication in diverse real-world scenarios. It focuses on developing proficiency in English language usage: word choices, grammar and sentence structure. In addition, the course will enable students to grasp nuanced messages and tailor their communication effectively through application of comprehension and analytical skills in listening and reading. Moreover, the course encompasses a range of practical communication aspects including professional writing, public speaking, and everyday conversation, ensuring that students are equipped for both academic and professional spheres. An integral part of the course is fostering a deeper understanding of the impact of language on diverse audiences. Students will learn to communicate inclusively and display a strong commitment to cultural awareness in their language use. Additionally, the course will enable them to navigate the globalized world with ease and efficacy, making a positive impact in their functional interactions.

**Learning outcomes:**

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

1. Apply enhanced English communication skills through effective use of word choices, grammar and sentence structure.
2. Comprehend a variety of literary/non-literary written and spoken texts in English.
3. Effectively express information, ideas and opinions in written and spoken English.

**Syllabus:****1. Foundations of Functional English:**

- Vocabulary building (contextual usage, synonyms, antonyms and idiomatic expressions)
- Communicative grammar (subject-verb-agreement, verb tenses, fragments, run-ons, modifiers, articles, word classes, etc.)
- Word formation (affixation, compounding, clipping, back formation, etc.)
- Sentence structure (simple, compound, complex and compound-complex)
- Sound production and pronunciation

**2. Comprehension and Analysis:**

- Understanding purpose, audience and context
- Contextual interpretation (tones, biases, stereotypes, assumptions, inferences, etc.)
- Reading strategies (skimming, scanning, SQ4R, critical reading, etc.)
- Active listening (overcoming listening barriers, focused listening, etc.)

**3. Effective Communication:**

- Principles of communication (clarity, coherence, conciseness, courteousness, correctness, etc.)
- Structuring documents (introduction, body, conclusion and formatting)
- Inclusivity in communication (gender-neutral language, stereotypes, cross-cultural communication, etc.)
- Public speaking (overcoming stage fright, voice modulation and body language)
- Presentation skills (organization content, visual aids and engaging the audience)

- Informal communication (small talk, networking and conversational skills)
- Professional writing (business e-mails, memos, reports, formal letters, etc.)

### **PRACTICAL REQUIREMENT**

As part of the overall learning requirements, students will also be exposed to relevant simulations, role- plays and real-life scenarios and will be required to apply skills acquired throughout the course in the form of a final project.

### **SUGGESTED INSTRUCTIONAL/READING MATERIALS**

1. "Understanding and Using English Grammar" by Betty Schramper Azar.
2. "English Grammar in Use" by Raymond Murphy.
3. "The Blue Book of Grammar and Punctuation" by Jane Straus.
4. "English for Specific Purposes: A Learning-Centered Approach" by Tom Hutchinson and Alan Waters.
5. "Cambridge English for Job-hunting" by Colm Downes.
6. "Practical English Usage" by Michael Swan.
7. "Reading Literature and Writing Argument" by Missy James and Alan P. Merickel.
8. "Improving Reading: Strategies, Resources, and Common Core Connections" by Jerry Johns and Susan Lenski.
9. "Comprehension: A Paradigm for Cognition" by Walter Kintsch.
10. "Communication Skills for Business Professionals" by J.P. Verma and Meenakshi Raman.

<b>Course Name:</b>	<i>Discrete Mathematics</i>
<b>Course Code:</b>	MATH2113
<b>Credit Hours:</b>	3 (3+0)
<b>Pre-requisites:</b>	None

**Course Objectives:**

This course will help the students translate verbal statements into symbolic ones by using the elements of mathematical logics. Further, this course will also help develop better reasoning power, problem-solving skills and logical thinking.

**Course Content:**

**Mathematical Reasoning:** Sets, Subsets, Algebra of Sets, Propositions and Compound Statements, Basic Logical Operations, Propositional Logic and its Applications with Statement Problems (Including Propositions and Truth Tables, Tautologies and Contradictions, Conditional and Bi-conditional Statements, Arguments, Propositional Functions, Quantifiers, Negation of Quantified Statements Etc.), Relations, Equivalence Relations, Partial Ordering Relations, Functions, Recursively Defined Functions,

**Combinatorics:** Basics of Counting Methods, Combinations, Permutations, Pigeonhole Principle, Graphs and its Types, Graphs Isomorphism, Trees, Connectivity, Eulerian and Hamiltonian Paths, Spanning Trees and Shortest Path Problem, Revisiting the Graphs of Power Function, Floor Function, Increasing Function and Decreasing Function, Big O, Little O and Omega Notations, Orders of the Polynomial Functions

**Recommended Books:**

- *Rosen, K.H., 1999. Discrete Mathematics & Applications. McGraw-Hill.*
- *Susanna, S.E., 2018. Discrete Mathematics with Applications.*
- *Lipschutz, S., 2016. Schaum's Outlines of Theory and Problems of Discrete Mathematics*

<b>Course Name:</b>	<i>Calculus and Analytic Geometry</i>
<b>Course Code:</b>	MATH1129
<b>Credit Hours:</b>	3 (3+0)
<b>Pre-requisites:</b>	None

**Course Introduction:**

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

**Course Outline:**

Limits and Continuity; Introduction to functions, Introduction to limits, Techniques of finding 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  $R^3$ , 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

**Course Name:** *Islamic Studies*  
**Course Code:** ISLA1111  
**Credit Hours:** 2 (2+0)  
**Pre-requisites:** None

### **Introduction/Compulsory Foundation Course**

This course is designed to provide students with a comprehensive overview of the fundamental aspects of Islam, its beliefs, practices, history and influence on society. It will further familiarize the students with a solid foundation in understanding Islam from an academic and cultural perspective. Through this course, students will have an enhanced understanding of Islam's multifaceted dimensions which will enable them to navigate complex discussions about Islam's historical and contemporary role, fostering empathy, respect, and informed dialogue.

### **Course Learning Outcomes**

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

1. Demonstrate enhanced knowledge of Islamic foundational beliefs, practices, historical development, spiritual values and ethical principles.
2. Describe basic sources of Islamic law and their application in daily life.
3. Identify and discuss contemporary issues being faced by the Muslim world including social challenges, gender roles and interfaith interactions.

### **Syllabus**

1. Introduction to Islam:
  - Definition of Islam and its core beliefs.
  - The Holy Quran (introduction, revelation and compilation).
  - Hadith and Sunnah (compilation, classification, and significance).
  - Key theological concepts and themes (Tawhid, Prophethood, Akhirah etc.).
2. Sirah of the Holy Prophet (Peace Be Upon Him) as Uswa-i-Hasana:
  - Life and legacy of the Holy Prophet PBUH.
  - Diverse roles of the Holy Prophet PBUH (as an individual, educator, peace maker, leader etc.).
3. Islamic History and Civilization:
  - World before Islam.

- The Rashidun Caliphate and expansion of Islamic rule.
  - Contribution of Muslim scientists and philosophers in shaping world civilization.
4. Islamic Jurisprudence (Fiqh):
- Fundamental sources of Islamic jurisprudence.
  - Pillars of Islam and their significance.
  - Major schools of Islamic jurisprudence.
  - Significance and principles of Ijtihad.
5. Family and Society in Islam:
- Status and rights of women in Islamic teachings.
  - Marriage, family, and gender roles in Muslim society.
  - Family structure and values in Muslim society.
6. Islam and the Modern World:
- Relevance of Islam in the modern world (globalization, challenges and prospects).
  - Islamophobia, interfaith dialogue, and multiculturalism.
  - Islamic viewpoint towards socio-cultural and technological changes.

#### **Suggested Instructional/Reading Materials**

- *"The Five Pillars of Islam: A Journey Through the Divine Acts of Worship"* by Muhammad
- *Mustafa Al-Azami.*
- *"The Five Pillars of Islam: A Framework for Islamic Values and Character Building"* by Musharraf Hussain.
- *"Towards Understanding Islam"* by Abul A' la Mawdudi.
- *"Islami Nazria e Hayat"* by Khurshid Ahmad.
- *"An Introduction to Islamic Theology"* by John Renard.
- *"Islamic Civilization Foundations Belief & Principles"* by Abul A' la Mawdudi.
- *"Women and Social Justice: An Islamic Paradigm"* by Dr. Anis Ahmad.
- *"Islam: Its Meaning and Message"* by Khurshid Ahmad.

**Note:** This course is compulsory for Muslim and optional for non-Muslim undergraduate students. Non-Muslim students can opt for any course of at least the same or more credits in subjects such as religious studies, ethics, theology, comparative religion, Christian ethics, etc.

**Course Name:** *Ethics*  
**Course Code:** HUMN1111  
**Credit Hours:** 2 (2+0)  
**Pre-requisites:** None

**Course Objectives:**

- This course will serve as an introduction to religious ethics in general and to personal ethics in particular.
- You will consider the positions of historical thinkers as well as contemporary philosophers.
- You will gain understanding of specific topics in character building.

**Topics**

1. What is Ethics?
2. Religious Ethics: A Comparative Study
3. Ethical Values
  - i. Hinduism
  - ii. Buddhism
  - iii. Zoroasterianism
  - iv. Judaism
  - v. Christianity and Islam
4. Ethics: Philosophical Perspective
  - i. Ram ChanderJi
  - ii. Mahatma Gandhi
  - iii. Siddharta
  - iv. Amanual Kant
  - v. Saint Paul
  - vi. Flourence Nightingale
  - vii. Aurbindu Ghoos
  - viii. Imam Ghazali
5. Mannerism
  - i. Good Manners
  - ii. Bad Manners
6. Ethics: Social Perspective
  - i. Role of Family
  - ii. Role of Community
  - iii. Role of Educational Institutions
7. Defense Mechanism
  - i. Conscience
    - a. Sin
    - b. Self-Ego
      - ii. Law
        - a. Crime

iii. Character Building

8. Prejudice

9. Regionalism

10. Provincialism

**Recommended Books:**

- *Ethical Theory: An Anthology 5<sup>th</sup> ed. Russ Shafer -Landau. Wiley-Blackwell.2013*
- *The Fundamentals of Ethics 2nd ed. Russ Shafer-Landau. Oxford University Press. 2011.*

**Note:** In addition to the above, any other text or book referred by Instructor can also be included.

<b>Course Name:</b>	<i>Fundamentals of Accounting</i>
<b>Course Code:</b>	<i>BUSA1113</i>
<b>Credit Hours:</b>	3 (3+0)
<b>Pre-requisites:</b>	None

### **Learning Outcomes:**

After studying this course, the students will be able to:

- Understand the significance, objectives, scope and use of accounting information
- Explore conceptual issues related to accounting and ethics,
- Comprehend the basic accounting concepts and conventions and qualitative aspect of financial report
- Develop an understanding of what the basic financial reports communicate to its readers and how they are prepared in business

### **Course Outline:**

#### **Introduction to Accounting and Business:**

Nature of Business and Accounting, Types of Businesses, Types of Business Organization, Users of Accounting Information, Role of Ethics in Business, Role of Accounting in Business, Profession of Accounting

#### **Fundamental Accounting Concepts, Principles and Policies:**

The Business Entity Concept, The Reliability (or Objectivity) principle, Historical Cost Convention, Substance Over Form, The Fair Value Principle, The Going Concern Assumptions, The Realization Principle, The Matching Principle, Money Measurement (Stable Dollar Assumption), Materiality

#### **Financial Statements:**

Business Transactions and The Accounting Equation, Effects of Business Transactions on Accounting Elements, Set of Financial Statements, Definition of Income Statement, Components of Income Statement : Revenues, Expenses, Gains and Losses, Accounting for Revenues and Expenses, Statement of Owner's Equity, Definition of Balance Sheet, Components of Balance Sheet: Assets, Liabilities, Equity, Statement of Cash Flows, Operating, Investing and Financing Activities, Direct Method, Interrelationships Among Financial Statements

#### **The Recording Process:**

Accrual Basis and Cash Basis of Accounting, Chart of Accounts, Phases in Accounting Cycle, Account and its Recording Process, Types of Accounts – Permanent and Temporary, Double Entry Book Keeping System, Rules of Debit and Credit, Introduction to General Journal and Special Journals, T-Ledger, Posting Journal Entries to Accounts, Analyzing and Summarizing Transactions in Accounts, Normal Balances of Accounts, Need and Objective of Trial Balance, Preparing Trial Balance

**The Adjusting Process:**

Types of Adjusting Entries, Recording Adjusting Entries – Deferrals, Recording Adjusting Entries – Accruals, Depreciation Expense, Summary of Adjustment Process, Nature, Purpose and Preparation of Adjusted Trial Balance Completing the Accounting Cycle: Flow of Accounting Information, Journalizing and Posting, Closing Entries, PostClosing Trial Balance, Adequate Disclosure and Types of Information to be Disclosed, Income Statement, Statement of Owner's Equity, Balance Sheet, Illustrations and Questions

**Accounting for Merchandising Operations:**

Service Companies and Merchandising Companies, Operating Cycle of Merchandising Companies, Income Statement of Merchandising Companies, Perpetual Inventory System, Periodic Inventory System, Merchandising Transactions, Transactions related to Sales and Purchase, Evaluating the Performance of Merchandising Companies

**Reference Materials:**

Financial & Managerial Accounting, Williams , Haka , Bettner, Prentice Hall  
Business Accounting, I, Fank Woods  
Financial Accounting and Reporting, Barry Elliot ,Jame Elliot, Prentice Hall  
Financial Accounting, A. Mukherjee and M. Hanif

<b>Course Name:</b>	<b><i>Introduction to Entrepreneurship</i></b>
<b>Course Code:</b>	BUSA1114
<b>Credit Hours:</b>	2 (2+0)
<b>Pre-requisites:</b>	None

### **Description**

This course is designed to promote entrepreneurial spirit and outlook among students. Encouraging them to think critically, identify opportunities, and transform their ideas into successful ventures. It aims at imparting them with the requisite knowledge: skills and abilities, enabling them to seize the identified opportunities for initiating ventures and successfully navigating the challenges that come with starting a business and managing it. The course covers topics relevant to entrepreneurship including setting up and initiation of business (including requirements for registration and incorporation with regulators such as SECP and others), market research, opportunity identification. business planning. Financial literacy for managing finances and securing funding, marketing and I sales, team building and innovation. Overall, the course is geared towards personal growth and professional development for pursuing innovative ideas, availing opportunities and initiating start- ups.

### **Course Learning Outcomes**

By the end of this course, students shall have:

1. Knowledge of fundamental entrepreneurial concepts, skills and process:
2. Understanding of different personal, social and financial aspects associated with entrepreneurial activities;
3. Basic understanding of regulatory requirements to set up an enterprise in Pakistan, with special emphasis on exports;
4. Ability to apply knowledge, skills and abilities acquired in the course to develop a feasible

### **Course Content:**

- 1) Introduction to Entrepreneurship:
  - a) Definition and concept of entrepreneurship:
  - b) Why to become an entrepreneur?
  - c) Entrepreneurial process;
  - d) Role of entrepreneurship in economic development.
- 2) Entrepreneurial Skills:
  - a) Characteristics and qualities of successful entrepreneurs (including stories of successes and failures).
  - b) Areas of essential entrepreneurial skills and abilities such as creative and critical thinking innovation and risk taking.

- 3) Opportunity Recognition and Idea Generation:
  - a) Opportunity identification, evaluation and exploitation:
  - b) Innovative ideas generation techniques for entrepreneurial ventures.
- 4) Marketing and Sales
  - a) Target market identification and segmentation;
  - b) Four P's of Marketing;
  - c) Developing a marketing strategy;
  - d) Branding.
- 5) Financial Literacy:
  - a) Basic concepts of income, savings and investments;
  - b) Basic concepts of assets, liabilities and equity;
  - c) Basic concepts of revenue and expenses;
  - d) Overview of cash-flows;
  - e) Overview of banking products including Islamic modes of financing;
  - f) Sources of funding for startups (angel financing, debt financing, equity financing etc.)
- 6) Team Building for Startups:
  - a) Characteristics and features of effective teams
  - b) Team building and effective leadership for startups.
- 7) Regulatory Requirements to Establish Enterprises in Pakistan:
  - a) Types of enterprises (e.g., sole proprietorship; partnership; private limited companies etc.):
  - b) Intellectual property rights and protection;
  - c) Regulatory requirements to register an enterprise in Pakistan, with special emphasis on export firms:
  - d) Taxation and financial reporting obligation.

### **Practical Requirements:**

As part of the overall learning requirements, students shall be tasked with creating and presenting a comprehensive business plan at the end of the course for a hypothetical or real business idea. This practical exercise shall allow them to apply the knowledge, skills and abilities acquired in the course to develop a feasible business plan and where possible explore the possibility of implementing the plan with support and assistance from established business- persons and entrepreneurs.

### **Suggested Instructional/Reading Material:**

- *"Entrepreneurship: Successfully Launching New Ventures"* by Bruce R. Barringer and R.

*Duane Ireland.*

- *"Entrepreneurship: Theory, Process, and Practice" by Donald F. Kuratko.*
- *"New Venture Creation: Entrepreneurship for the 21st Century" by Jeffrey A. Timmons, Stephen Spinelli Jr., and Rob Adams.*
- *"Entrepreneurship: A Real-World Approach" by Rhonda Abrams.*
- *"The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" by Eric Ries.*
- *"Effectual Entrepreneurship" by Stuart Read, Saras Sarasvathy, Nick Dew, Robert Wiltbank, and Anne-Valérie Ohlsson*

<b>Course Name:</b>	<b><i>Civics and Community Engagement</i></b>
<b>Course Code:</b>	POLS2111
<b>Credit Hours:</b>	2 (2+0)
<b>Pre-requisites:</b>	None

**Course Description:**

This course is designed to provide students with fundamental knowledge about civics, citizenship, and community engagement. Students will learn about the essentials of civil society, government, civic responsibilities, inclusivity, and effective ways to participate in shaping the society which will help them apply theoretical knowledge to the real-world situations to make a positive impact on their communities.

**Course Objectives:**

The overall objectives of this course are to:

- Teach students about the significance and role of active citizenship for the promotion of a harmonious and developed society
- Educate students about the importance of skills and aptitude of community linkages in developing a sustainable society
- Highlight the importance of community involvement for a tolerant and productive citizenship and society
- Provide an opening to the students for developing their civic bond with the community

**Learning outcome:**

1. By the end of this course, students will be able to:
2. Demonstrate fundamental understanding of civics, government, citizenship and civil society.
3. Understand the concept of community and recognize the significance of community engagement for individuals and groups.
4. Recognize the importance of diversity and inclusivity for societal harmony and peaceful co-existence.

**Course Contents:**

## 1. Introduction to Civics and Citizenship

- Definition of civics, citizenship, and civic engagement.
- Historical evolution of civic participation.
- Types of citizenship: active, participatory, digital, etc.
- The relationship between democracy and citizenship.

## 2. Civics and Citizenship

- Concepts of civics, citizenship, and civic engagement.

- Foundations of modern society and citizenship.
- Types of citizenship: active, participatory, digital, etc.

### 3. State, Government and Civil Society

- Structure and functions of government in Pakistan.
- The relationship between democracy and civil society.
- Right to vote and importance of political participation and representation.

### 4. Rights and Responsibilities

- Overview of fundamental rights and liberties of citizens under Constitution of Pakistan 1973
- Civic responsibilities and duties.
- Ethical considerations in civic engagement (accountability, non-violence, peace dialogue, civility, etc.)

### 5. Community Engagement

- Concept, nature and characteristics of community
- Community development and social cohesion
- Approaches to effective community engagement.
- Case studies of successful community driven initiatives.

### 6. Advocacy and Activism

- Public discourse and public opinion
- Role of advocacy in addressing social issues.
- Social action movements.

### 7. Digital Citizenship and Technology

- The use of digital platforms for civic engagement.
- Cyber ethics and responsible use of social media.
- Digital divides and disparities (access, usage, socioeconomic, geographic, etc.) and their impacts on citizenship.

## 8. Diversity, Inclusion and Social Justice

- Understanding diversity in society (ethnic, cultural, economic, political etc.).
- Youth, women and minorities engagement in social development.
- Addressing social inequalities and injustices in Pakistan.
- Promoting inclusive citizenship and equal rights for societal harmony and peaceful co-existence.

### **SUGGESTED PRACTICAL ACTIVITIES (OPTIONAL)**

As part of the overall learning requirements, the course may have one or a combination of the following practical activities:

1. **Community Storytelling:** Students can collect and share stories from community members. This could be done through oral histories, interviews, or multimedia presentations that capture the lived experiences and perspectives of diverse individuals.
2. **Community Event Planning:** Students can organize a community event or workshop that addresses a specific issue or fosters community interaction. This could be a health fair, environmental cleanup, cultural festival, or educational workshop.
3. **Service-Learning:** Students can collaborate with a local nonprofit organization or community group. They can actively contribute by volunteering their time and skills to address a particular community need, such as tutoring, mentoring, or supporting vulnerable populations.
4. **Cultural Exchange Activities:** Students can organize a cultural exchange event that celebrates the diversity within the community. This could include food tastings, performances, and presentations that promote cross-cultural understanding.

### **SUGGESTED INSTRUCTIONAL / READING MATERIALS**

- "Civics Today: Citizenship, Economics, & You" by McGraw-Hill Education
- "Citizenship in Diverse Societies" by Will Kymlicka and Wayne Norman.
- "Engaging Youth in Civic Life" by James Youniss and Peter Levine.
- "Digital Citizenship in Action: Empowering Students to Engage in Online Communities" by Kristen Mattson.
- "Globalization and Citizenship: In the Pursuit of a Cosmopolitan Education" by Graham Pike and David Selby.
- "Community Engagement: Principles, Strategies, and Practices" by Becky J. Feldpausch and Susan M. Omilian.
- "Creating Social Change: A Blueprint for a Better World" by Matthew Clarke and Marie-Monique Steckel
- "Nationhood and the Nationalities in Pakistan, Economic and Political Weekly by Alavi, H. (1989).
- 'Imagined Communities: Reflections on the Origin and Spread of Nationalism by Anderson', B. R. O. (1991)
- 'The Idea of a Pakistani Nationhood', Polity by Syed, A. H. (1980)

<b>Course Name:</b>	Ideology and Constitution of Pakistan
<b>Course Code:</b>	PAKS1119
<b>Credit Hours:</b>	2 (2+0)
<b>Pre-requisites:</b>	None

**Specific Objectives of course:** This course is designed to provide students with a fundamental exploration of the ideology and the constitution of Pakistan. The course focuses on the underlying principles, beliefs, and aspirations that have been instrumental in shaping the creation and development of Pakistan as a sovereign state. Moreover, the course will enable students to understand the core provisions of the Constitution of the Islamic Republic of Pakistan concerning the fundamental rights and responsibilities of Pakistani citizens to enable them function in a socially responsible manner.

### **Course Outline:**

#### **Introduction to the Ideology of Pakistan:**

- Definition and significance of ideology.
- Historical context of the creation of Pakistan (with emphasis on socio-political, religious, and cultural dynamics of British India between 1857 till 1947).
- Contributions of founding fathers of Pakistan in the freedom movement including but not limited to Allama Muhammad Iqbal, Muhammad Ali Jinnah., etc.
- Contributions of women and students in the freedom movement for separate homeland for Muslims of British India

#### **Two-Nation Theory:**

- Evolution of the Two-Nation Theory (Urdu-Hindi controversy, Partition of Bengal, Simla Deputation 1906, Allama Iqbal's Presidential Address 1930, Congress Ministries 1937 Lahore Resolution 1940).
- Role of communalism and religious differences.

#### **Introduction to the Constitution of Pakistan:**

- Definition and importance of a constitution.
- Ideological factors that shaped the Constitution(s) of Pakistan (Objectives Resolution 1949).
- Overview of constitutional developments in Pakistan.

#### **Constitution and State Structure:**

- Structure of Government (executive, legislature, and judiciary).
- Distribution of powers between federal and provincial governments.
- 18th Amendment and its impact on federalism.

#### **Fundamental Rights, Principles of Policy and Responsibilities:**

- Overview of fundamental rights guaranteed to citizens by the Constitution of Pakistan 1973 (Articles 8-28).
- Overview of Principles of Policy (Articles 29-40).
- Responsibilities of the Pakistani citizens (Article 5).

**Constitutional Amendments:**

- Procedures for amending the Constitution.
- Notable constitutional amendments and their implications.

**Recommended Readings:**

- Akbar S. Ahmed. Jinnah. Pakistan and Islamic Identity: The Search for Saladin
- Burki, Shahid Javed. (1980). State & Society in Pakistan. Macmillan Press Ltd.
- Chawla, M. Iqbal. (2011). Wavell and the dying days of the Raj: Britain's penultimate viceroy in India. OUP.
- G. W. Choudhury. (n.d.). Constitutional development in Pakistan, new edition, Peace Publication.
- G.W. Choudhury. Constitution-Making in Pakistan: The Dynamics of Political Order
- Hamid Khan. Constitutional and Political Development of Pakistan” by
- Ian Talbot. Pakistan: A New History
- Javed Iqbal. Ideology of Pakistan
- K.K. Aziz. The Making of Pakistan: A Study in Nationalism
- Khalid Bin Sayeed. Pakistan the Formative Phase
- Khan, H. (2001). Constitutional and political history of Pakistan. OUP.
- I.H. Qureshi. The Struggle for Pakistan
- Lawrence Ziring. Pakistan in the Twentieth Century: A Political History
- M.R Kazimi. (2023). Pakistan Studies. Karachi, OUP.
- Mahboob Hussain. The Parliament of Pakistan”
- Safdar Mahmood. Pakistan: Political Roots and Development
- Sharif-ul-Mujahid. Ideology of Pakistan
- Stephen P. Cohen. The Idea of Pakistan
- The Constitution of Pakistan 1973. Original.
- Zahid, Ansar. (1980). History & Culture of Sindh. Karachi: Royal Book Compan.

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<b>Course Name:</b>	Pakistan Studies
<b>Course Code:</b>	PAKS1111
<b>Credit Hours:</b>	2 (2+0)
<b>Pre-requisites:</b>	None

**Objectives:** The main objectives of this course are to:

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan, Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

**Course outline:**

Historical Perspective: Ideological rationale with special reference to Sir Syed Ahmad Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah, Factors leading to Muslim separation, Indus civilization, Muslim advent, Location and geo- physical features.

Government and Politics in Pakistan: Political and constitutional phases: 1947-58; 1958-71; 1971-77; 1977-88; 1988-99; 1999 onward.

Contemporary Pakistan: Economic institutions and issues, Society and social structure, Ethnicity, Foreign policy of Pakistan and challenges, Futuristic outlook of Pakistan.

**Recommended Books:**

1. Burki, Shahid Javed. State & Society in Pakistan, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. Issue in Pakistan's Economy. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. Pakistan Political Roots & Development. Lahore, 1994.
5. Wilcox, Wayne. The Emergence of Bangladesh., Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. Pakistan Kayyun Toota, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. Ethno - National Movement in Pakistan, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. Enigma of Political Development. Kent England: Wm Dawson & sons Ltd, 1980.
9. Zahid, Ansar. History & Culture of Sindh. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. The Political System of Pakistan. Boston: Houghton Mifflin, 1967.
12. Aziz, K. K. Party, Politics in Pakistan, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
14. Haq, Noor ul. Making of Pakistan: The Military Perspective. Islamabad: National Commission on Historical and Cultural Research.

<b>Course Name:</b>	<i>HCI &amp; Computer Graphics</i>
<b>Course Code:</b>	COMP3145
<b>Credit Hours:</b>	3 (2+1)
<b>Pre-requisites:</b>	None

### Course Introduction:

This course introduces the fundamental concepts of human computer interaction and computer graphics. It describes the implications of human understanding on the usability of computer systems and the importance of understanding the context of use. This course will also develop design and problem solving skills with applications to computer graphics.

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
CLO-1	Describe the concepts of human understanding on the usability of computer systems and the importance of understanding the context of use.	C2 (Describe)
CLO-2	Explain the basic principles of implementing computer graphics fundamentals	C2 (Explain)
CLO-3	Analyze and identify usability issues in User interfaces according to the standards.	C4 (Analysis)
CLO-4	Develop the design and problem solving skills with applications to computer graphics	C3(Develop)
CLO-5	Construct interactive computer graphics programs	C3 (Apply)

### Course Outline:

**The Human:** Input-output channels, Human memory, Thinking, Reasoning, Problem solving, Emotions, Individual differences, Psychology and design of interacting systems. **The Computer:** Introduction, 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 interfaces, Interactivity, Context of interaction, Experience. Usability Paradigm and Principles: Introduction, Paradigms for interaction. Interaction Design Basics: Introduction, What is design, Process of design, User focus, Navigation design, Screen design and layout, Iteration and prototyping. HCI in Software Process: Introduction, Software life cycle, Usability engineering, Iterative design and prototyping, Design rationale. Design rules, Prototyping, Evaluation techniques, Task analysis, Universal design and User support and Computer Supported Cooperative Work: Guidelines, Golden rules and heuristics, HCI patterns, Choosing an evaluation method, Requirements of user support, Applications, Design user support systems. Introduction to Groupware, Pervasive and Ubiquitous Applications: Introduction, Groupware systems, Implementation of synchronous groupware, Ubiquitous computing. History of **Computer Graphics**, Graphics architectures and software, Imaging, Pinhole camera, Human vision, Synthetic camera, Modeling vs. rendering. OpenGL: Architecture, Displaying simple two-dimensional geometric objects, Positioning systems, Working in a windowed environment. Color: Color perception, color models (RGB, CMY, HLS), color transformations. Color in OpenGL. RGB and indexed color. Input: Working in a network environment, client-server computing; input measure, event, sample and request input, using callbacks, picking. Geometric

transformations: Affine transformations (translation, rotation, scaling, shear), homogeneous coordinates, concatenation, current transformation and matrix stacks. Three Dimensional Graphics: Classical three dimensional viewing, Specifying views, Affine transformation in 3D, Projective transformations. Ray tracing. Shading: Illumination and surface modeling, Phong shading model, Polygon shading. Rasterization: Line drawing via Bresenham's algorithm, clipping, polygonal fill, BitBlt. Introduction to hidden surface removal (z buffer). Discrete Techniques: Buffers, reading and writing bitmaps and pixel maps, texture mapping, compositing.

### Reference Materials:

1. Janet E. Finlay, Leeds Metropolitan. (2000). Human-Computer Interaction, Alan Dix, Computing Dept, Lancaster University, Birmingham Publisher: PrenticeHall.
2. Ben Shneiderman, University of Maryland Catherine Plaisant. (2010). Designing the User Interface: Strategies for Effective Human-Computer Interaction, 4/E, University Maryland. Publisher: Addison-Wesley.
3. Computer Graphics with Open GL (4th Edition) by Donald D. Hearn, Prentice Hall, 2010, ISBN-10: 0136053580.
4. Foundations of 3D Computer Graphics by S. J. Gortler, The MIT press, 2012.
5. Fundamentals of Computer Graphics, 3rd Edition, A K Peters, 2009.
6. Computer Graphics: Principles and Practice, 3rd Edition

<b>Course Name:</b>	<b><i>Swarm Intelligence</i></b>
<b>Course Code:</b>	COMPXXXX
<b>Credit Hours:</b>	3 (2+1)
<b>Pre-requisites:</b>	None

### Course Introduction:

- To discuss the concepts and applications of swarm intelligence;
- To understand different swarm intelligence algorithms and their applications;
- To apply various swarm intelligence algorithms on practical problems

This course covers the following topics: Particle Swarm Optimization; Bacterial Foraging Optimization; Bat Algorithm; Cat Swarm Optimization; Chicken Swarm Optimization; Cockroach Swarm Optimization; Crow Search Algorithm; Cuckoo Search Algorithm; Dynamic Virtual Bats Algorithm; Dispersive Files Optimisation; Elephant Herding Optimization; Firefly Algorithm; Glowworm Swarm Optimization; Grasshopper Optimization Algorithm; Grey Wold Optimizer; Hunting Search Algorithm; Krill Herd Algorithm; Monarch Butterfly Optimization; Salp Swarm Algorithm; Social Spider Optimization; Stochastic Diffusion Search; and Whale Optimization Algorithm

<b>CLO No.</b>	<b>Course Learning Outcomes</b>	<b>Bloom Taxonomy</b>
CLO-1	Discuss the basic concepts and components of swarm intelligence	Understanding 2
CLO-2	Formulate and assess problems in evolutionary computation and swarm intelligence	Applying 2,3
CLO-3	Apply various Swarm Intelligence algorithms	Applying 2-4
CLO-4	Analyze the strengths and weaknesses of swarm-based algorithms	Analyzing 3,5
CLO-5	Develop a swarm intelligence-based system to solve complex optimization and decision-making problems.	Creation 2-5

### Course Outlines:

Particle Swarm Optimization: Overview, Original Algorithm, Source Code, and Global Version PSO; Ant Colony Optimization: Ant's Behaviour, Algorithm, and Source Code; Artificial Bee Colony Algorithm: The Original ABC Algorithm, and Source Code. Bacterial Foraging Optimization: Algorithm, Bacterial Forging Optimization, and Numerical Examples; Bat Algorithm: Algorithm, Source Code, and Example; Cat Swarm Optimization: Algorithm, Code, and Global Version. Chicken Swarm Optimization; Cockroach Swarm Optimization; Crow Search Algorithm. Cuckoo Search Algorithm; Dynamic Virtual Bats Algorithm; Dispersive Files Optimization; Elephant Herding Optimization; and Firefly Algorithm. Glowworm Swarm Optimization; Grasshopper Optimization Algorithm; Grey Wold Optimizer; Hunting Search Algorithm; Krill Herd Algorithm; Monarch Butterfly Optimization; and Salp Swarm Algorithm. Social Spider Optimization; Stochastic Diffusion Search; and Whale Optimization Algorithm

### Reference Material:

Textbooks:

1. Swarm Intelligence and Evolutionary Computation: Theory, Advances and Applications in Machine Learning and Deep Learning, Georgios N. Kouziokas, CRC Press, 2023.
2. Swarm Intelligence Algorithms: A Tutorial, Adam Solwik, CRC Press, 2020.

Reference Books:

1. Swarm Intelligence: The Biggest Ideas in Science, Izi K. Lann, 2021.
2. Swarm Intelligence: Why Our World Would End If Swarm Intelligence Disappeared? Fouad Sabry, 2021.

<b>Course Name:</b>	<i>Applied Physics</i>
<b>Course Code:</b>	PHYS1124
<b>Credit Hours:</b>	3 (2+1)
<b>Pre-requisites:</b>	None

**Objectives:**

The main objectives of this course is to provide knowledge of wide variety of electric and magnetic phenomena, their relevant mathematics, atomic level phenomena and their applications.

**Course Outlines:**

**Electrostatics and Magnetism:** Coulombs Law, Electrostatic potential energy of discrete charges, Continuous charge distribution, Gauss's Law, Electric field around conductors, Dielectric Magnetic fields, Magnetic force on current, Hall effect, Biot- Savart Law, Ampere's Law, Fields of rings and coils, Magnetic dipole, Diamagnetism, Para magnetism and Ferromagnetism.

**Waves and Oscillations:** Reflection and Refraction of light waves, Total internal reflection, Double slit interference, Interference from thin films, Diffraction, Polarization of electromagnetic waves.

**Semi-Conductors:** Semi-Conductors Energy levels in a semi-conductor, Hole concept, Intrinsic and Extrinsic regions, PNP, NPN junction Transistor, LEDs Modern Physics, Inadequacy of classical physics, Plank's explanations of black body radiation.

**Modern physics:** Photo electric effect, Compton effect, Bohr's theory of Hydrogen atom. Nuclear stability and radioactivity.

**Nuclear Physics:** Alpha decay, Beta decay, Gamma decay attenuation, Fission, Energy release, Nuclear Fusion

**List of Experiments:** (At least 3 experiments should be performed), Measuring moments of inertia of different bodies; disc, hollow and solid cylinders. The Harmonic Oscillation of Helical springs-parallel and series connection of spring Value of g using a compound pendulum or simple pendulum. Verification of Ohm's law. Determine the speed of sound using Sonometer/Air column. Determine the refractive index with help of prism/glass plate

**Recommended books:**

- Fundamentals of Physics (Extended), 10th edition, Resnick and Walker
- Narciso Garcia, Arthur Damask, Steven Schwarz, —Physics for Artificial Intelligence students, Springer Verlag, 199
- Instructor of respective course may add two books.

<b>Course Name:</b>	<b><i>Professional Practices</i></b>
<b>Course Code:</b>	ITEC4112
<b>Credit Hours:</b>	2 (2+0)
<b>Pre-requisites:</b>	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.

**Course Outline:**

Historical, social, and economic context of Computing (software engineering, Artificial Intelligence, Information Technology); Definitions of Computing (software engineering, Artificial Intelligence, 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.

<b>Course Name:</b>	<b>Foundations of Management</b>
<b>Course Code:</b>	BUSA2118
<b>Credit Hours:</b>	2(2+0)
<b>Prerequisite(s):</b>	None

### **Specific Objectives of course:**

This 2-credit hour course is designed to provide non-business students with a comprehensive introduction to management principles, with a focus on understanding organizations and businesses. The course will cover various aspects of management, including the roles and functions of managers, the historical development of management theories, the concept of the environment in which organizations operate, decision-making processes, and the core functions of planning, organizing, leading, and controlling. Additionally, students will be introduced to different types of businesses and their key characteristics.

### **Learning Outcomes:**

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

- Define the concept of management and explain the significance of managers in organizations.
- Describe the managerial functions of planning, organizing, leading, and controlling and their role in achieving organizational objectives.
- Understand the different roles and skills required of managers and how they contribute to effective leadership.
- Trace the historical development of management theories and identify their impact on modern management practices.
- Analyze the influence of the external environment on managerial decision-making and organizational performance.

### **Detailed outline**

#### **Introduction to Management**

- Definition and significance of management
- Overview of key management functions and roles

#### **Short History of Management**

- Classical management approaches (scientific management and administrative management)

- Contemporary management theories (systems theory, contingency theory)

#### **Managerial Functions - Planning**

- Importance of planning in management
- Types of plans: strategic, tactical, and operational
- Decision making: rational vs intuitive
- Goal-setting and decision-making in the planning process

#### **Managerial Functions - Organizing**

- Principles of organizational structure
- Delegation of authority and responsibility
- Departmentalization and coordination within organizations

#### **Organizational Structure and Design**

- Types of organizational structures
- Factors influencing organizational design
- Mechanistic vs. organic structures

#### **Managerial Functions – Leading**

- Theories of leadership and leadership styles
- Motivation and employee engagement
- Communication and effective leadership

#### **Managerial Functions – Controlling**

- The control process and its significance
- Types of control measures and their application
- Addressing deviations and corrective actions

#### **Introduction to Organizations and Types of Businesses**

- Overview of organizations and their characteristics
- Types of businesses: Sole proprietorship, partnership, corporation, and more
- Advantages and disadvantages of different business types

#### **Understanding the Organizational Environment**

- Internal and external environmental factors
- Environmental analysis and adaptation
- Strategic planning in a dynamic environment

#### **Recommended Books:**

1. Management by Courtland L. Bovee
2. Management by Stephen P. Robbins and Mary Coulter

Note: In addition to the above, any other text or book referred by Instructor can also be included.

<b>Course Name:</b>	<i>Expository Writing</i>
<b>Course Code:</b>	ENGL1120
<b>Credit Hours:</b>	3 (3+0)
<b>Pre-requisites:</b>	None

**Course Description:**

Expository Writing is a sequential undergraduate course aimed at refining writing skills in various contexts. Building upon the foundation of the pre-requisite course, Functional English, this course will enhance students' abilities of producing clear, concise and coherent written texts in English. The course will also enable students to dissect intricate ideas, to amalgamate information and to express their views and opinions through well-organized essays. The students will further be able to refine their analytical skills to substantiate their viewpoints using credible sources while adhering to established ethical writing norms. Additionally, the course will highlight the significance of critical thinking enabling students to produce original and engaging written texts.

**Learning outcomes:**

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

1. Understand the essentials of the writing process integrating pre-writing, drafting, editing and proof reading to produce well-structured essays.
2. Demonstrate mastery of diverse expository types to address different purposes and audiences.
3. Uphold ethical practices to maintain originality in expository writing.

**Syllabus:**

1. Introduction to Expository Writing:
  - Understanding expository writing (definition, types, purpose and applications)
  - Characteristics of effective expository writing (clarity, coherence and organization)
  - Introduction to paragraph writing
2. The Writing Process:
  - Pre-writing techniques (brainstorming, free-writing, mind-mapping, listing, questioning and outlining etc.)
  - Drafting (three stage process of drafting techniques)
  - Revising and editing (ensuring correct grammar, clarity, coherence, conciseness etc.) Proof reading (fine-tuning of the draft)
  - Peer review and feedback (providing and receiving critique)
3. Essay Organization and Structure:
  - Introduction and hook (engaging readers and introducing the topic)
  - Thesis statement (crafting a clear and focused central idea)
  - Body Paragraphs (topic sentences, supporting evidence and transitional devices)
  - Conclusion (types of concluding paragraphs and leaving an impact)
  - Ensuring cohesion and coherence (creating seamless connections between paragraphs)
4. Essay Organization and Structure:
  - Description
  - Illustration
  - Classification
  - Cause and effect (exploring causal relationships and outcomes)
  - Process analysis (explaining step-by-step procedures)
  - Comparative analysis (analyzing similarities and differences)

5. Writing for Specific Purposes and Audiences:
  - Different types of purposes (to inform, to analyze, to persuade, to entertain etc.)
  - Writing for academic audiences (formality, objectivity, and academic conventions)
  - Writing for public audiences (engaging, informative and persuasive language)
  - Different tones and styles for specific purposes and audiences
6. Ethical Considerations:
  - Ensuring original writing (finding credible sources, evaluating information etc.)
  - Proper citation and referencing (APA, MLA, or other citation styles)
  - Integrating quotes and evidences (quoting, paraphrasing, and summarizing)
  - Avoiding plagiarism (ethical considerations and best practices)

### **PRACTICAL APPLICATIONS AND CAPSTONE PROJECT**

As part of the overall learning requirements, students will be required to build a writing portfolio having a variety of expository texts and present the same at the end of the course showcasing proficiency in expository writing.

### **SUGGESTED INSTRUCTIONAL/READING MATERIALS**

1. “The St. Martin Guide to Writing” by Rise B. Axelrod and Charles R. Cooper.
2. “They Say / I Say: The Moves That Matter in Academic Writing” by Gerald Graff and Cathy Birkenstein.
3. “Writing Analytically” by David Rosenwasser and Jill Stephen.
4. “Style: Lessons in Clarity and Grace” by Joseph M. Williams and Joseph Bizup.
5. “The Elements of Style” by William Strunk Jr. and E.B. White.
6. “Good Reasons with Contemporary Arguments” by Lester Faigley and Jack Selzer.
7. “Writing to Learn: How to Write - and Think - Clearly About Any Subject at All” by William Zinsser.
8. “The Norton Field Guide to Writing” by Richard Bullock, Maureen Daly Goggin, and Francine Weinberg.
9. “The Art of Styling Sentences” by Ann Longknife and K.D. Sullivan.
10. “Writing Today” by Richard Johnson-Sheehan and Charles Paine.

<b>Course Name:</b>	<b><i>Technical and Business Writing</i></b>
<b>Course Code:</b>	ITEC4152
<b>Credit Hours:</b>	3 (3+0)
<b>Pre-requisites:</b>	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.

### **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, cross referencing, 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 Material**

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

**Course Name:** *Pre-Calculus-I*

**Course Code:** MATH1127

**Credit Hours:** 3 (3+0)

**Aims & Objectives:**

This subject develops the concepts of Mathematics and its applications in daily life. The students are taught different mechanisms as well as issues at different levels are discussed.

**Course Content:**

**Introduction of Mathematics**

History, Applications of mathematics, Number systems

**SETS and Functions**

Set, All type of sets, Operations on sets, Complex Numbers and its methods of simplification, Polar form of complex number, Functions and their types, Inverse of function, Graphs, Relevant Problems and their solutions

**Matrices and Determinants**

Matrix, all types of matrices, Operations on matrices, Determinants of  $2 \times 2$  and  $3 \times 3$  matrix, Solution of simultaneous linear equations by using matrices, Elementary Row and Column operation on a matrix, Echelon and Reduced Echelon forms of Matrices, System of Linear equations, Homogeneous Linear equation, Cramer's rule, Relevant Problems and their solutions

**Quadratic Equations**

Introduction, Solution of Quadratic Equations, Polynomial Function, Remainder Theorem and its applications, Relevant Problems and their solutions

**Partial Fractions**

Rational fraction, Proper rational fraction, Improper rational fraction, Resolution of all types of fraction, Relevant Problems and their solutions

**Mathematical Induction and Binomial Theorem**

Binomial theorem and its application on different types of functions, Relevant Problems and their solutions

**Fundamentals of Trigonometry**

Introduction, Units of Measures of Angles, Angles in Standard Position, Trigonometric Functions, Trigonometric Functions of any angle, Fundamental Identities of Geometric Functions, Signs of Trigonometric Functions, The value of Trigonometric Functions of Acute Angles  $30^\circ$ ,  $45^\circ$  and  $60^\circ$ , The value of Trigonometric Functions of Angles  $0^\circ$ ,  $90^\circ$ ,  $180^\circ$ ,  $270^\circ$ ,  $360^\circ$ , Proves of Fundamental Identities with different types of functions, Half angle Identities, Sum, Difference and product of Sines and Cosines, Period of Trigonometric Functions, Relevant Problems and their solutions

**Reference Books & Material**

Complete solution in PDF form

**Recommended Text Book**

Thomas Calculus 12<sup>th</sup> Edition

<b>Course Name:</b>	<i>Pre-Calculus-II</i>
<b>Course Code:</b>	MATH1128
<b>Credit Hours:</b>	3 (3+0)
<b>Pre-requisites:</b>	None

**Aims & Objectives:**

This subject develops the concepts of Mathematics and its applications in daily life. The students are taught different mechanisms as well as issues at different levels are discussed.

**Course Content:****Introduction of Mathematics**

History, Applications of mathematics

**Functions, Limits and Continuity**

Definition of Functions, Graph of Algebraic Functions, Polynomial Functions, Linear Function, Identity Function, Constant Function, Rational Function, Explicit Function, Implicit Function, Exponential Function, Logarithmic Function, Trigonometric Functions, Inverse Trigonometric Functions, Parametric form of Function, Even Function, Odd Function, Composition of Functions, Definition of Limit, Limit Theorems, Application of Limit on Algebraic and Geometric Function, Continuity of a Function, Relevant Problems and their solutions

**Differentiation**

Independent and Dependent variables, Average rate of change, Derivative and slop, By Definition Derivative, Rules of Derivation, Derivation of Algebraic and Geometric Functions, Taylor's Theorem, Relevant Problems and their solutions

**Integration**

Introduction of Integration, Formulas of Integration, Simple problems related with Integration, Relevant Problems and their solutions

**Integration**

Integration by parts, Integration by substitution method, Integration involving limit, Area of region bounded by the curve, Relevant Problems and their solutions

**Introduction to Analytical Geometry**

Quadrants, The Distance Formula, Slope of straight line, Equation of a straight Line, Intercepts form, Translation and Rotation of axes, Relevant Problems and their solutions

**Conic Section**

Introduction, General form of an Equation of a Circle, Center, Radius and Diameter of a Circle, Relevant Problems and their solutions, The Equation of a Circle when end points of its diameter are given, Relevant Problems and their solutions

**Recommended Book**

1. Howard Anton 10th Edition

**Course Name:** *Internship*  
**Course Code:** INTN6112  
**Credit Hours:** 3 (0+3)  
**Pre-requisites:** None

### Internship Policy

Internship Requirement	UE includes an internship, as a mandatory part for BSAI/BSIT/BSAI Post ADP/ BSIT Post ADP programs. Students may need to complete a minimum duration of practical training in relevant field.
Internship Placement	UE has a Student Counseling Center (SCC) that assists students in finding Internship opportunities. The SCC may collaborate with local industries, Companies or organizations for the student's internship placements.
Internship Duration	Minimum duration is 6 weeks.
Academic Credit	Its mandatory for degree with credit hours 3(0+3)
Evaluation & Assessment	Upon completion of internship, students are required to submit internship report and completion certificate that reflects experiences in relevant field.
Eligibility Criteria	As per university policy.
Internship Supervision	Faculty members will be assigned a group of students and he/she will visit Internee students once during internship period and shall take written feedback from Industry regarding skill set of the students and submit a written report to the coordinator regarding his/her visit.

### Evaluation Criteria

Evaluation	Contribution
Site Supervisor Evaluations	40%
Students Reports	30%
Faculty Supervisor Evaluation (Student internship report and completion certificate)	25%
Student's activity log completion	05%

## Seerat of the Holy Prophet Muhammad (SAW)

Title	Description
Semester	Student can opt this course in any Semester
Nature of Course	Regular
Course Code	ISLA2211
No. of Cr. Hrs.	2 (2+0)
Total Teaching weeks	16 Weeks
Objectives of the Course	<p>۱. طلباء کو مطالعہ سیرت طیبہ کی ضرورت و اہمیت سے آگاہ کرنا</p> <p>۲. تعمیر شخصیت میں مطالعہ سیرت طیبہ کے کردار کو واضح کرنا ۳. بعثت نبوی کے موقع پر اقوام عالم کی عمومی صورت حال سے آگاہ کرنا ۴. طلباء کو عہد نبوی کی معاشرت، سیاست، معیشت سے آگاہ کرنا</p>

## Course Description

S.No.	Title	Description
1	پیغمبر اسلام صلی اللہ علیہ وسلم: تعارف و اہمیت	<p>۱. مطالعہ سیرت کی معاشرتی و سماجی اہمیت ۲. مطالعہ سیرت کی معاشرتی و سیاسی اہمیت</p> <p>۳. مطالعہ سیرت کی عقلی و منطقی اور استدلالی حوالے سے اہمیت</p> <p>۴. مطالعہ سیرت کے شخصیت و کردار پر اثرات</p>
2	پیغمبر اسلام صلی اللہ علیہ وسلم کی زندگی کا مطالعہ کیوں کیا جائے؟	<p>۱. مادی اور بنیادی ذرائع ۲. ماحول اور حالت</p> <p>۳. اعلیٰ خدائی مشن کے لیے محمد صلی اللہ علیہ وسلم کا انتخاب</p> <p>۴. حرب فجار اور حلف الفضول</p>
3	اللہ تعالیٰ کے پیغام کی تبلیغ و اشاعت	<p>۱. ہجرت حبشہ ۲. معاشرتی بائیکاٹ ۳. معراج اور معجزات</p>
4	اسلام میں خواتین کا کردار	<p>۱. اسلام میں خواتین کا کردار قبل از ہجرت ۲. اسلام میں خواتین کا کردار بعد از ہجرت ۳. قومی شیرازہ بندی میں عورت کا کردار</p>
5	ہجرت مدینہ اور انصار و یہود	<p>۱. مؤاخات مدینہ کی عصر حاضر میں اہمیت</p> <p>۲. میثاق مدینہ کے تناظر میں یہود و نصاریٰ کے ساتھ</p>

		معاشرتی تعلقات
6	غزوات نبوی کے اثرات	نبوی کے سیاسی اور دفاعی اثرات ۲۔ غزوات نبوی کے معاشی اثرات ۳۔ غزوات نبوی کے سماجی اور دعوتی اثرات
7	صلی اللہ علیہ وسلم کے داخلی سیاسی اقدامات	۱۔ یہود سے تعلقات ۲۔ مشرکین اور منافقین سے تعلقات ۳۔ قبائل عرب سے تعلقات
8	اللہ علیہ وسلم کے خارجی تعلقات	۱۔ غیر ملکی سربراہوں سے حضور صلی اللہ علیہ وسلم کی مراسلات ۲۔ غیر ملکیوں کے ساتھ وفود کا تبادلہ ۳۔ فتح مکہ۔ دعوتِ اسلامی کا فروغ ۴۔ حضور صلی اللہ علیہ وسلم کی خارجی سیاست کے اثرات
9	ت اور سیرت طیبہ: ایک مطالعہ	۱۔ غیر مسلم اقلیت کا تعارف ۲۔ اقلیتوں کے حقوق کا سیرتی مطالعہ ۳۔ اسلامی ریاست میں غیر مسلموں کے حقوق و فرائض ۴۔ اقلیتوں کے حقوق اور اسلاموفوبیا
01	عہد نبوی۔ تہذیبی مطالعہ	۱۔ عہد نبوی کا معاشرتی و معاشی نظام ۲۔ عہد نبوی کا مذہبی نظام ۳۔ عہد نبوی کا نظام حکومت
00	نبی کریم ﷺ کی تعلیمی جدوجہد	علم کے لیے ایک جماعت کا قیام ۲۔ خواتین کے لیے تعلیم کا اہتمام ۳۔ نسل نو کے لیے تعلیم کا انتظام ۴۔ تشکیل و فود برائے توسیع و استحکام تعلیم

## نصابی کتب

نمبر شمار	نام مؤلف	نام کتاب
0	ابن ہشام	السیرة النبویة
2	مولانا شبلی نعمانی، سید سلمان ندوی	سیرة النبی صلی اللہ علیہ وسلم
3	قاضی محمد سلیمان سلمان منصور پوری	رحمة العالمین
4	مولانا سید ابوالحسن علی ندوی	نبی رحمت صلی اللہ علیہ وسلم
5	ڈاکٹر یسین مظہر صدیقی	عہد نبوی کا نظام حکومت
6	ڈاکٹر خالد علوی	انسانِ کمال

## حوالہ جاتی کتب

نمبر شمار	نام مؤلف	نام کتاب
1	ڈاکٹر اکرم الضیاء العمری	السیرة النبویة الصحیحة
2	مولانا عبدالرؤف داناپوری	اصح السیر
3	مولانا صفی الرحمن مبارکپوری	الرحیق المختوم
4	پیر محمد کرم شاہ الزہری	ضیاء النبی صلی اللہ علیہ وسلم
5	سید ابوالعلیٰ مودودی	سیرت سرور عالم صلی اللہ علیہ وسلم
6	پروفیسر رب نواز	أنحضور ﷺ کی تعلیمی جدوجہد

