

Annexure C
Study Schema of Bachelor of
Science in Artificial Intelligence

Introduction

The objective of the bachelor's degree in Artificial Intelligence program is to produce well-rounded graduates, having a strong foundation in theoretical concepts and skills to design and implement complex intelligent software using multiple programming technologies under different operating systems and backend technologies. Also, strong academic preparation to pursue careers in local and international IT industry where they can communicate effectively and to continue seeking education through formal or informal methods.

Eligibility Criteria

The minimum requirements for admission in the program are any of the following:

(a) At least 50% marks in Intermediate (HSSC) examination with Mathematics or equivalent qualification with Mathematics, certified by IBCC.

OR

(a) At least 50% marks in Intermediate (HSSC) examination with Pre-Engineering, Pre-Medical or equivalent qualification, certified by IBCC.

Deficiency:

“Students with pre-medical, must have to pass deficiency courses of Mathematics of 6 credit hours in first two semesters.”

Duration

The minimum duration for completion of the degree is four years. The HEC allows a maximum period of seven years to complete BS degree requirements.

Degree Completion Requirements

To become eligible for award of BS degree, a student must satisfy the following requirements:

- a) Must have studied and passed the prescribed courses, totaling at least 134 credit hours.
- b) Must have earned CGPA (Cumulative Grade Point Average) of at least 2.0 on a scale of 4.0.

Graduate Attributes (GAs) / Program Learning Outcome (PLOs)

This degree program prepares students to attain educational objectives by ensuring that students demonstrate achievement of the following outcomes (derived from Graduate Attributes defined by Seoul Accord www.seoulaccord.org).

S. No.	Graduate Attributes (GAs)	Computing Professional Graduate Outcomes
1	Academic Education	To prepare graduates as AI professionals
2	Knowledge for Solving Computing Problems	Apply knowledge of AI, knowledge of an AI specialization, and mathematics, science, and domain knowledge appropriate for the AI specialization to the abstraction and conceptualization of AI models from defined problems and requirements
3	Problem Analysis	Identify, formulate, research literature, and solve complex AI-related 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 AI 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 AI 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	AI 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 AI practice
9	Ethics	Understand and commit to professional ethics, responsibilities, and norms of professional AI practice
10	Life-long Learning	Recognize the need, and have the ability, to engage in independent learning for continual development as a AI professional

Program Educational Objectives (PEOs)

1. **Proficiency in Computing and Artificial Intelligence Fundamentals** - A graduate capable of applying foundational knowledge in computing and artificial intelligence to excel in professional endeavors.
2. **Critical Analysis**- The program aims to cultivate graduates equipped with the ability to conduct thorough critical analysis of complex problems. They will demonstrate proficiency in identifying computing requirements essential for crafting effective computer-based solutions
3. **Ethical Awareness and Social Responsibility** - A graduate who integrates ethical considerations and societal implications, particularly in the realm of artificial intelligence and its implementations, into professional practice.
4. **Effective Communication Proficiency** - A graduate skilled in conveying technical and managerial information both verbally and in writing.
5. **Leadership Aptitude** - A graduate proficient in leading teams or navigating entrepreneurial environments effectively.
6. **Commitment to Continuous Learning and Innovation** - A graduate committed to exploring new domains within computing and artificial intelligence to benefit their organization or to engage in academic research.

Graduate Attributes (GAs) – Program Educational Outcomes (PEOs) Mapping

PEOs	Graduate Attributes (GAs)									
	GA 1	GA 2	GA 3	GA 4	GA 5	GA 6	GA 7	GA 8	GA 9	GA 10
PEO 1	*	*	*	*	-	-	-	-	-	-
PEO 2	-	-	*	*	-	-	-	-	-	-
PEO 3	-	-	-	-	-	-	-	*	*	-
PEO 4	-	-	-	-	-	*	*	-	-	-
PEO 5	-	-	-	-	-	*	-	*	-	-
PEO 6	-	-	-	-	*	-	-	-	-	*

Curriculum Design

The structure of BS in AI program is proposed to meet the needs of students through theory and practical experience. The students are expected to learn theoretical and practical understanding of AI and its sub-domains.

The proposed structure is dynamic and provides basis for various options including Breadth-Based, Depth-Based, and Integrated Breadth & Depth Based specializations. Student may choose a particular option, which is most appropriate to their planned future career. The following are some relevant details:

- Minimum credit hours shall be 134 for BS (AI) program.
- The program comprises eight semesters spread over four years.
- The following table gives the distribution of credit hours in different domains of knowledge.

Generic Structure of Computing Discipline

Areas	Credit Hours	Courses
Computing Core	46	14
Domain Core	18	6
Domain Electives	21	7
Mathematics & Supporting Courses	12	4
Elective Supporting Courses	3	1
General Education Requirements	34	15
Total	134	47

Mapping of BSAI Program on the Generic Structure

S. No	Semester	Code	Pre-Req	Course Title	Domain	Credit Hours
Computing Core (46/134) 14 Courses						
1	1	CS102		Programming Fundamentals	Core	4(3-3)
2	2	CS150	PF	Object Oriented Programming	Core	4(3-3)
3	2	CS151		Database Systems	Core	4(3-3)
4	3	CS202		Digital Logic Design	Core	3(2-3)
5	3	CS201	PF	Data Structures	Core	4(3-3)
6	4	CS254		Information Security	Core	3(3-0)
7	4	CS253		Artificial Intelligence	Core	3(2-3)
8	3	CS203		Computer Networks	Core	3(2-3)
9	3	CS204		Software Engineering	Core	3(3-0)
10	4	CS250	DLD	Computer Organization & Assembly Language	Core	3(2-3)
11	5	CS301		Operating Systems	Core	3(2-3)
12	6	CS352	DS	Analysis of Algorithm	Core	3(3-0)
13	7	CS401		Final Year Project-I	Core	2(0-4)
14	8	CS450	FYP-I	Final Year Project-II	Core	4(0-12)
Domain Core (18/134) 6 Courses						
15	4	CS257		Programming for AI	Domain Core	3(2-3)
16	5	CS307		Machine Learning	Domain Core	3(2-3)
17	6	CS351		Artificial Neural Network & Deep Learning	Domain Core	3(2-3)
18	4	CS258		Knowledge Representation and Reasoning	Domain Core	3(2-3)
19	5	CS306		Computer Vision	Domain Core	3(2-3)
20	6	CS351		Parallel & Distributed Computing	Domain Core	3(2-3)
Mathematics & Supporting Courses (12/134) 4 Courses						
21	3	MT201	CAG	Multivariable Calculus	Maths	3(3-0)

22	5	MT301	CAG	Linear Algebra	Maths	3(3-0)
23	4	MT250		Probability & Statistics	Maths	3(3-0)
24	5	EN350	FE	Technical & Business Writing	EN	3(3-0)
General Education Requirement as per HEC UG Education Policy (34/134) 15 Courses						
25	1	GE101		Application of Information & Communication Technologies	GER	3(2-3)
26	1	GE105		Functional English	GER	3(3-0)
27	2	GE152	FE	Expository Writing	GER	3(3-0)
28	1	GE104		Quantitative Reasoning – 1 (Discrete Structures)	GER	3(3-0)
29	2	GE151		Quantitative Reasoning – 2 (Calculus and Analytic Geometry)	GER	3(3-0)
30	1	GE102		Islamic Studies	GER	2(2-0)
31	1	GE106		Pakistan Studies	GER	2(2-0)
32	2	GE153		Understanding of Quran – I	GER	1 (0-1)
33	4	GE253		Understanding of Quran – II	GER	1 (0-1)
31	3	GE201		Ideology and Constitution of Pakistan	GER	2(2-0)
32	8	GE450		Social Sciences (Example: Introduction to Management)	GER	2(2-0)
33	2	GE150		Natural Sciences (Applied Physics)	GER	3(2-3)
34	8	GE451		Arts & Humanities (Professional Practices)	GER	2(2-0)
35	8	GE452		Civics and Community Engagement	GER	2(2-0)
36	7	GE401		Entrepreneurship	GER	2(2-0)
List of Elective Supporting Courses (3/134) 1 Course						
37	7	SS401		Social Science (Example: Introduction to Marketing)	SS	3(3-0)
38		SS4xx		Social Science (Example: Financial Accounting)	SS	3(3-0)
39		SS4xx		Research Methods	SS	3(3-0)
40		SS4xx		Organizational Behavior	SS	3(3-0)
41		SS4xx		International Relations	SS	3(3-0)
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Domain Elective (21/134) 7 Courses						
46	5	CS3xx		Natural Language Processing	Domain Elec	3(2-3)
47	5	CS3xx		Speech Processing	Domain Elec	3(2-3)
48	6	CS3xx		Data Mining	Domain Elec	3(2-3)
49	6	CS3xx		Advanced Statistics	Domain Elec	3(2-3)
50	6	CS3xx		Reinforcement Learning	Domain Elec	3(2-3)
51	6	CS3xx		Theory of Automata	Domain Elec	3(2-3)
52	7	CS4xx		HCI & Computer Graphics	Domain Elec	3(2-3)
53		CSxxx		Fuzzy Systems	Domain Elec	3(2-3)
54		CSxxx		Swarm Intelligence	Domain Elec	3(2-3)
55		CSxxx		Agent Based Modeling	Domain Elec	3(2-3)
56		CSxxx		Knowledge Based Systems	Domain Elec	3(2-3)
57		CSxxx		Web Engineering	Domain Elec	3(2-3)
58		CSxxx		Front-end Development Technologies	Domain Elec	3(2-3)
59		CSxxx		Back-end Technologies	Domain Elec	3(2-3)
60		CSxxx		Full Stack Development	Domain Elec	3(2-3)

61		CSxxx		MERN Stack Development	Domain Elec	3(2-3)
62		CSxxx		DevOps	Domain Elec	3(2-3)
63		CSxxx		Data Science	Domain Elec	3(2-3)
64		CSxxx		Computer Vision	Domain Elec	3(2-3)
65		CSxxx		Digital Image Processing	Domain Elec	3(2-3)
66		CSxxx		MLOPs	Domain Elec	3(2-3)
67		CSxxx		Business Intelligence	Domain Elec	3(2-3)
68		CSxxx		E-Commerce and Digital Marketing	Domain Elec	3(2-3)
69		CSxxx		Mobile Application Development	Domain Elec	3(2-3)
70		CSxxx		Large Language Models	Domain Elec	3(2-3)
71		CSxxx		MLOps	Domain Elec	3(2-3)
72		CSxxx		Robotics	Domain Elec	3(2-3)
73		CSxxx		Explainable AI	Domain Elec	3(2-3)
74		CSxxx		Generative AI	Domain Elec	3(2-3)
75		CSxxx		Human Robot Interaction	Domain Elec	3(2-3)
76		CSxxx		Graph Theory	Domain Elec	3(3-0)
77		CSxxx		Blockchain Technologies	Domain Elec	3(3-0)
7		CSxxx		Information Design	Domain Elec	3(2-3)
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Semester-wise Plan of BS in Artificial Intelligence (BS-AI) Program

#	Code	Pre-Reqs	Course Title	Domain	Cr Hr (Cont Hr)
Semester 1					
1	CS102		Programming Fundamentals	Core	4 (3-3)
2	GE101		Application of Information & Communication Technologies	GER	3 (2-3)
3	GE104		QR 1 (Discrete Structures)	GER	3 (3-0)
4	GE102/103		Islamic Studies / Ethics	GER	2 (2-0)
5	GE106		Pakistan Studies	General	2 (2-0)
6	GE105		Functional English	GER	3 (3-0)
7	MT101		Additional Math Course 1 (for pre-medical students)	Non-Credit	0 (0-0)
				Total Cr Hrs	17 (15-6)
Semester 2					
1	CS150	PF-CS102	Object Oriented Programming	Core	4 (3-3)
2	CS151		Database Systems	Core	4 (3-3)
3	GE150		Natural Science (Applied Physics)	GER	3 (2-3)
4	GE151		QR 2 (Calculus and Analytic Geometry)	GER	3 (3-0)
5	GE152	FE GE-105	Expository Writing	GER	3 (3-0)
6	MT150		Additional Math Course 2 (for pre-medical students)	Non-Credit	0 (0-0)
7	GE153		Understanding of Quran – I	General	1 (0-1)
				Total Cr Hrs	18 (14-10)
Semester 3					
1	CS201	PF-CS102	Data Structures	Core	4 (3-3)
2	MT201	CAG GE-151	Multivariate Calculus	Maths	3 (3-0)
3	CS202		Digital Logic Design	Core	3 (2-3)
4	CS203		Computer Networks	Core	3 (2-3)
6	CS204		Software Engineering	Core	3 (3-0)
7	GE201		Ideology and Constitution of Pakistan	GER	2 (2-0)
				Total Cr Hrs	18 (15-9)
Semester 4					
1	CS250	DLD CS-202	Computer Organization & Assembly Language	Core	3 (2-3)
2	CS253		Artificial Intelligence	Core	3 (2-3)
3	MT250		Probability & Statistics	Maths	3 (3-0)
4	CS254		Information Security	Core	3 (3-0)
5	CS257		Domain Core 1 (Programming for AI)	Domain Core	3 (2-3)
6	CS258		Domain Core 2 (Knowledge Representation & Reasoning)	Domain Core	3 (2-3)
7	GE253		Understanding of Quran – II	General	1 (0-1)
				Total Cr Hrs	19 (15-10)

Semester 5					
1	CS301		Operating Systems	Core	3 (2-3)
2	CS306		Domain Core 3 (Computer Vision)	Domain Core	3 (2-3)
3	CS307		Domain Core 4 (Machine Learning)	Domain Core	3 (2-3)
4	CS3xx		Domain Elective 1	Domain Elec	3 (2-3)
5	CS3xx		Domain Elective 2	Domain Elec	3 (2-3)
6	MT301	CAG GE-151	Linear Algebra	Maths	3 (3-0)
				Total Cr Hrs	18 (12-15)
Semester 6					
1	CS354		Domain Core 5 (Artificial Neural Networks & Deep Learning)	Domain Core	3 (2-3)
2	CS351	OS CS-301	Domain Core 6 (Parallel & Distributed Computing)	Domain Core	3 (2-3)
3	CS3xx		Domain Elective 3	Domain Elec	3 (2-3)
4	CS3xx		Domain Elective 4	Domain Elec	3 (2-3)
5	CS352	DS CS-201	Analysis of Algorithm	Core	3 (3-0)
6	EN350	FE GE-105	Technical & Business Writing	EN	3 (3-0)
				Total Cr Hrs	18 (14-12)
Semester 7					
1	CS401		Final Year Project - I	Core	2 (0-6)
2	CS4xx		Domain Elective 5	Domain Elec	3 (2-3)
3	SS401		Elective Supporting Course (Example: Introduction to Marketing)	SS	3 (3-0)
4	CS4xx		Domain Elective 6	Domain Elective	3 (2-3)
5	CS4xx		Domain Elective 7	Domain Elective	3 (2-3)
6	GE401		Entrepreneurship	GER	2 (2-0)
				Total Cr Hrs	16 (11 -15)
Semester 8					
1	CS450	CS401 - FYP-I	Final Year Project – II	Core	4 (0-12)
2	GE450		Social Science (Example: Introduction to Management)	GER	2 (2-0)
3	GE451		Arts & Humanities (Professional Practices)	GER	2 (2-0)
4	GE452		Civics and Community Engagement	GER	2 (2-0)
				Total Cr Hrs	10 (6-12)