Institute of Space Technology

Program Specifications

Bachelor of Science in Computer Science

Department of Electrical Engineering

Document No: IST-EE-PS-04/00

Issue Date:

	Name	Designation	Signature	Date
Prepared by:	Engr. Muhammad Asad	Lecturer (EE)		
	Ch. Bilal Ahmad Khan	Assistant Professor (EE)		
Reviewed by:	Dr. Khurram Khurshid	Head of Department		
	Dr. Iqbal Rasool Memon	Dean		
	Col. Muhammad Sadiq Ur Rahman	Director-QEC		
Approved by	Major General Rehan Abdul Baqi (Retd)	Vice Chancellor		

Institute of Space Technology	Document No.	IST-EE-PS-04/00
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PROGRAM SPECIFICATIONS	Department	Electrical Engineering

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	Department	Electrical Engineering

AMMENDMENT SHEET

AMD. No.	DATE	INITIAT ED BY	PAGE No.	NATURE OF AMENDMENT	DONE BY	APPROV ED BY

BACHELOR OF SCIENCE IN COMPUTER SCIENCE (BS-CS)

1 AWARDING INSTITUTE/BODY

Institute of Space Technology (IST)

2 TEACHING INSTITUTION

Institute of Space Technology (IST), Islamabad campus

3 FINAL AWARD

Bachelor of Science in Computer Science

4 PROGRAM TITLE

Bachelor of Science in Computer Science (BS-CS)

5 STARTING TIME FOR PROGRAM

Fall-2020

6 ADMISSION CRITERIA

The candidates seeking admission in BS-Computer Science Program at IST must meet the following eligibility criterion:

- SSC/ Equivalent Certificate (Science)
- Minimum 50% Aggregate Marks in FSc Pre-Engineering/Pre-Medical/ ICS/ Equivalent Certificate with Mathematics & Physics
- No entry test required

7 THE PROGRAM

- The offered program is 4-years Bachelor's Program. Student must complete 124-credit-hours of course work and 6-credit-hours of final year project.
- Minimum duration of program is four (4) years and maximum is six (6) years.

8 PROGRAM DURATION

4 years to 6 years

9 CREDIT HOURS

Total 130 credit hours with 124 credit hours of course work and 6 credit hours of Final Year Project (FYP)

10 PROGRAM MISSION STATEMENT

To equip students with in-depth knowledge in the field of computing and related interdisciplinary areas thereby providing an opportunity to align themselves with new trends in the field so that they are able to contribute towards society through R&D innovations and entrepreneurship.

11 PROGRAM EDUCATIONAL OBJECTIVES

After graduation, our students will be equipped not only with advanced computer science tools. Moreover, our graduates will be able to:

PEO-01: Apply computing knowledge and skills to propose effective solutions.

PEO-02: Manage projects and become effective members of teams through inter-personal skills.

PEO-03: Demonstrate high moral and ethical values, life-long learning attitude and societal responsibilities.

12 PROGRAM LEARNING OUTCOMES

The curriculum for BS student is designed keeping in view the guidelines of National Computing Education Accreditation Council (NCEAC). Students of this department will have a chance to learn not only the fundamental courses of computer science but also advanced courses in different emerging areas. By the end of the of the program, upon successful completion of the courses taught by computer science faculty, students will be able to:

PLO 1.   Academic Education:

To prepare graduates as computing professionals

PLO 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.

PLO 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

PLO 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

PLO 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

PLO 6.   Individual and Team Work:

Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings

PLO 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

PLO 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

PLO 9.   Ethics:

Understand and commit to professional ethics, responsibilities, and norms of professional computing practice

PLO 10.   Life-long Learning:

Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional

13 PROGRAM EDUCATIONAL OBJECTIVE VS PROGRAM LEARNING OUTCOME

PLO No	Program Learning Outcome	PEO 1	PEO 2	PEO 3
1	Academic Education	✓	✓	✓
2	Knowledge for Solving Computing Problems	✓	✓	
3	Problem Analysis	✓	✓	

4	Design/ Development of Solutions	✓	✓	✓
5	Modern Tool Usage	✓	✓	
6	Individual and Team Work		✓	
7	Communication		✓	
8	Computing Professionalism and Society			✓
9	Ethics			✓
10	Life-long Learning			✓

14 SCOPE OF PROGRAM

The scope for BS-Computer Science graduates will be in:

i.   Institutions/organizations tackling computer problems/projects

ii.   Strategic organizations/industries of Pakistan and teaching institutions

iii.   Teaching and research

iv.   Banking & Finance

v.   Pursuing higher studies at national/international level.

vi.   Being entrepreneurs, starting new ventures

15 FACULTY BUILDUP PLAN

Year	PhD	MS	Total
Currently	4	2	6
2021-2022	6	2	8
2022-2023	8	2	10
2023-2024	11	2	13

16 TARGET STUDENT STRENGTH

Year	Fall-2020	Fall-2021	Fall-2022	Fall-2023	Total
Fall-2020	109	-	-	-	**109**
Fall-2021	100	100	-	-	**200**
Fall-2022	100	100	100	-	**300**
Fall-2023	100	100	100	100	**400**

17 IT TOOLS AND COMPUTER LAB

A lab on logic design is available. A computer lab equipped with modern IT-tools will be required so that at least sixty (60) students can work at a time.

18 PROGRAM STRUCTURE AND FEATURES, CURRICULUM UNITS, CREDIT AND AWARD REQUIREMENTS

Department of Electrical Engineering is offering BS-Computer Science with following list of courses.

Course Code	Course Name	Course Cred Hr	Lab Cred Hr
Semester 1			
109101	Introduction to ICT	3	0
109102	Programming Fundamentals	3	0
109103	Programming Fundamentals Lab	0	1
100301	English Composition	3	0
123201	Calculus	3	0
117401	Applied Physics	3	0
	Total	**15**	**1**
Semester 2			
208412	Digital Logic Design	3	0
208413	Digital Logic Design Lab	0	1
109104	Object Oriented Programming	3	0
109105	Object Oriented Programming Lab	0	1
200302	Communication Skills	3	0
123403	Probability in Engineering	3	0
	University Elective – 1	3	0
	Total	**15**	**2**

Semester 3			
209106	Comp Organization & Assembly Lang	3	0
209107	Comp Organization & Assembly Lang Lab	0	1
209108	Data Structures & Algorithms	3	0
209109	Data Structures & Algorithms Lab	0	1
209110	Discrete Structures	3	0
400212	Professional Practices	3	0
	CS Supporting - 1	3	0
	Total	**15**	**2**
Semester 4			
209111	Design & Analysis of Algorithms	3	0
209112	Theory of Automata	3	0
209113	Database Systems	3	0
209114	Database Systems Lab	0	1
123204	Linear Algebra	3	0
	University Elective – 2	3	0
100102	Pakistan Studies	2	0
	Total	**17**	**1**
Semester 5			
309115	Compiler Construction	3	0
309116	Operating Systems	3	0
309117	Operating Systems Lab	0	1
309118	Software Engineering	3	0
100101	Religious Studies	2	0
	CS Supporting – 2	3	0

	CS Supporting - 3	3	0
	Total	**17**	**1**
Semester 6			
309119	Artificial Intelligence	3	0
309120	Artificial Intelligence Lab	0	1
308416	Computer Networks	3	0
308417	Computer Networks Lab	0	1
	CS Elective – 1	3	0
	CS Elective – 2	3	0
300303	Technical Writing	3	0
	Total	**15**	**2**
Semester 7			
	CS Elective – 3	3	0
	CS Elective – 4	3	0
499901	Final Year Project – I	0	3
	University Elective – 3	3	0
409121	Parallel & Distributed Computing	3	0
	Total	**12**	**3**
Semester 8			
	CS Elective – 5	3	0
	University Elective - 4	3	0
499901	Final Year Project – II	0	3
409122	Information Security	3	0
	Total	**9**	**3**

Total Courses: 39
Total credit hours: 130

Mandatory Courses (All 27)
Introduction to ICT
Programming Fundamentals
English Composition
Calculus
Applied Physics
Digital Logic Design
Object Oriented Programming
Communication Skills
Probability in Engineering
Computer Organization and Assembly Language
Data Structure and Algorithms
Discrete Structures
Professional Practices
Design & Analysis of Algorithms
Theory of Automata
Database Systems
Linear Algebra
Pakistan Studies
Compiler Construction
Operating Systems
Software Engineering
Religious Studies
Artificial Intelligence
Computer Networks
Technical Writing
Parallel & Distributed Computing
Information Security

Computer Science Electives (Any 5)
Data Warehousing and Data Mining
Big Data Analytics
Social Network Analysis
Mobile Application Development
Wireless Networks
Telecommunication Systems
System Modeling and Simulation
Concepts of Internet of Things
Digital Image Processing
Computer Vision
Computer Graphics
Machine Learning
Distributed Computing
Mobile Computing

Parallel Computing
Object Oriented Software Development
Software Quality Assurance
Software Project Management
Software Design and Testing
Network Security
Computer Forensics
Introduction to Cryptography
Introduction to Computer Security

University Electives (Any 4)
Sociology
Psychology
Engineering Management
Entrepreneurship

Supporting Courses (Any 3)
Graph Theory
Numerical Analysis
Differential Equations

19 DESCRIPTION OF COURSES

Introduction to ICT:

Books:

1. "Computers, Communications & information - A user's introduction" by Sarah, E. Hutchinson. Stacey, C. Swayer
2. "Introduction to Basic Information and Communication Technology (ICT): Basic ICT" by Emmanuel Kusi Achampong

Introduction to IT, Hardware, Computer Software, Internet and Web, Introduction to Data Communication and Computer Networks, Development, Introduction to Software Engineering

Programming Fundamentals:

Books:

1. "Programming Fundamentals - A Modular Structured Approach using C++" by Kenneth Leroy Busbee
2. "Introduction to C++ Programming" by Wan Anisha Wan Mohammad *et al.*

Introduction to programming languages, Introduction to C++, C/C++ Programming Basics, Loops and Decisions, Structures, Pointers, Functions, Arrays and Strings.

Digital Logic Design

Books:

1. "Digital Logic Design" by Mansaf Alam and Bashir Alam
2. "Digital Logic Design - A Rigorous Approach" by Guy Even, Moti Medina

Number systems, Logical Analysis, Combinational Logic, Sequential Logic, Data Processing, manipulation, data storage, logic families and logic design, FPGAs, Hardware description language like VERILOG

Object Oriented Programming

Books:

1. "Object Oriented Programming in C++" by Robert Lafore
2. "An Introduction to Object-Oriented Programming in C++ with Applications in Computer Graphics" by Graham M. Saeed

Evolution of Object Oriented (OO) programming, OO concepts and principles, problem solving in OO paradigm, OO program design process, classes, methods, objects and encapsulation, constructors and destructors, operator and function overloading, virtual functions, derived classes, inheritance and polymorphism, I/O and file processing, exception handling

Computer Organization and Assembly Language:

Books:

1. "Computer Organization and Architecture" by William Stallings
2. "Principles of Computer Organization and Assembly Language using Java Virtual Machine" by Patrick Juola

Introduction to microprocessors and computers, System Buses, Internal Memory, External Memory, Input/Output, Interrupts, DMA/IO Channels, Computer Arithmetic, Addressing Modes, CPU Structure and Functions, Control Unit Operations

Data Structure and Algorithms:

Books:

1. "Data Structures & Algorithms" by Alfred V. Aho *et al.*
2. "Data Structures & Algorithms in C++" by Adam Drozdek

Introduction to Data structures and types of data structures, Definition of algorithm, running time of algorithm, examples, role of efficient algorithms, Definition of Recursion, Direct and Indirect Recursion, Examples of Recursive Functions, Linear Queue & Its Features, Linear Queue Implementation, Circular Queue, Linked List & Its Features, Linked List Implementation, Doubly Linked List & its Implementation, Stack & Its Implementation, Postfix Notation Concept, Implementation Of Postfix Notation, Binary Trees, Strictly Binary Tree, Complete Binary Tree, Almost Complete Binary Tree, Binary Tree Applications, Traversing Trees, Pre-Order Traversing In-Order Traversing, Post-Order Traversing, Bubble Sort, Quick Sort, Binary Sort, Merge Sort, Insertion Sort, Heap, Heap Construction, Heap Sort, Heap Sort Implementation. Hashing & its Implementation, Linear and Binary Search, What Are Graphs, Representation Of Directed Graphs, GraphVocabulary, Graph Operations (Add Vertex, Add Edge), C++ Implementation, Hashing, dictionaries and hash tables, hashing function, hashing implementation using array and linked list.

Discrete Structures:

Books:

1. "Discrete Mathematics and Its Applications" by Kenneth H. Rosen
2. "Discrete Structures and Their Interactions" by Jason I. Brown

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

Design & Analysis of Algorithms

Books:

1. "Introduction to the design and Analysis of Algorithms" by Anany Levitin

2. "An Introduction to the Analysis of Algorithms" by Robert Sedgewick and Philippe Flajolet

Proof techniques, Induction, Summations, basic algorithms on numbers, complexity classes, Searching and Sorting, Asymptotic analysis , Divide-and-conquer: merge-sort, closest pair problems, collaborative filtering, Karatsuba algorithm, deterministic Selection, Greedy algorithms: Huffman codes, Minimum Spanning Tree, Interval Scheduling Dynamic programming: Weighted Independent Set in Paths, Weighted Interval Scheduling, Knapsack Problem, Sequence Alignment, Single Source Shortest Paths (Bellman-Ford Algorithm), BFS, DFS,

Topological Sort, Shortest paths, The Class P and NP, Decision, Optimization and Search problems, NP Complete Problems, Reduction, P vs NP Question, Ford Fulkerson Algorithm, Max Flow-Min Cut Algorithm, Edmond Karp Algorithm, Applications, Standard Form, Geometry of LP, Simplex Algorithm, Closest pair in linear-time, Universal and uniform hashing, Randomized Selection, Randomized Quicksort, Minimum Cut algorithm, Easy vs. hard problems, Approximation Algorithm with absolute approximation guarantees, Hardness of Approximation, Relative Approximation Algorithm, Max Cut , Set Cover, Vertex Cover, Parallel machine scheduling, PTAS and FPTAS for Knapsack problem, Approximation algorithms for TSP LP- rounding based Approximation Algorithms

Theory of Automata:

Books:

1. "Elements of Automata Theory" by Jacques Sakarovitch
2. "Introduction to Automata, Theory, Languages and Computation" by John E. Hopcroft *et al.*

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.

Database Systems:

Books:

1. "Database Systems - A Practical Approach to Design, Implementation and Management" by Thomas Connolly and Carolyn Begg
2. "Fundamentals of Database Systems" by Ramez Elmasri

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.

Compiler Construction:

Books:

1. "Compiler Construction" by William M. Waite and Gerhard Goos
2. "A Practical Approach to Compiler Construction" by Des Watson

Introduction to interpreter and compiler. Compiler techniques and methodology; Organization of compilers; Lexical and syntax analysis; Parsing techniques. Types of parsers, top-down parsing, bottom-up parsing, Type checking, Semantic analyser, Object code generation and optimization, detection and recovery from errors.

Operating Systems:

Books:

1. "Operating Systems Concepts" by Abraham Silberschatz *et al.*
2. "Operating Systems" by Harvey M. Dietel

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

Software Engineering:

Books:

1. "Software Engineering" by Ian Sommerville
2. "Software Engineering - A Practitioner's Approach" by Roger S. Pressman

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.

Artificial Intelligence:

Books:

1. "Introduction to Artificial Intelligence" by Wolfgang Ertel
2. "Artificial Intelligence – When Do Machines Take Over?" by Klaus Mainzer

Introduction (Introduction, basic component of AI, Identifying AI systems, branches of AI, etc.); Reasoning and Knowledge Representation (Introduction to Reasoning and Knowledge Representation, Propositional Logic, First order Logic); Problem Solving by Searching (Informed searching, Uninformed searching, Local searching.); Constraint Satisfaction Problems; Adversarial Search (Min-max algorithm, Alpha beta pruning, Game-playing); Learning (Unsupervised learning, Supervised learning, Reinforcement learning) ;Uncertainty handling (Uncertainty in AI, Fuzzy logic); Recent trends in AI and applications of AI algorithms (trends, Case study of AI systems, Analysis of AI systems).

Computer Networks:

Books:

1. "Computer Networks – A Systems Approach" by Larry L. Peterson and Bruce S. Davie
2. "Computer Networks and Internets" by Douglas E. Comer

Introduction to Computer Networks, Network Hardware, LAN, MAN, WAN, Inter Networks and the Internet, End Systems, Client and Servers, Connectionless and Connection Oriented Services, The Network Core: Circuit Switching and Packet Switching, Network Access and Physical Media, ISPs and Internet Backbones, Delay and Loss in Packet Switched Networks, Protocol Layering, Design Issues for Layers, Service Models. OSI Reference Model, Principles of Application-Layer Protocols, The Web and HTTP, FTP, DNS, WWW, Electronic Mail, Multimedia, Transport Layer Introduction, Transport Protocols, UDP, TCP/IP, Network Layer Introduction, Routing Algorithms, Congestion and Congestion Control Algorithms, QoS, Tunneling, Inter-network Routing and Addressing, Introduction to MAC and Channel Allocation, MAC Protocols, Bridges, Spanning Tree, Remote Bridges, Repeaters, Hub, Bridges, Switches, Routers, and Gateways, Introduction to Data Link Layer, Framing, Error Control, Flow Control, Error Detection and Correction

Parallel & Distributed Computing:

Books:

1. "Parallel and Distributed Computing – Architectures and Algorithms" by S. K. Basu
2. "Parallel and Distributed Computing Applications" by Zoran Gacovski

Introduction, Parallel and Distributed Computing, Parallel and Distrubuted Architectures, Socket programming, Parallel Performance, Shared Memory and Threads, Parallel Algorithms, Parallel Algorithms, OpenMP, Scalable Algorithms, Message Passing, Distributed Systems, MapReduce, Clusters, Distributed Coordination, Security, Distributed File Systems, Security, Distributed Shared Memory, Peer-to-Peer, Cloud Computing

Information Security:

Books:

1. "Information Security – Principles and Practices" by Mark Merkow and Jim Breithaupt
2. "Elementary Information Security" by Richard E. Smith

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.

20 DETAIL OF THE CURRENT FACULTY

Sr. no.	Name	Designation
1	Dr. Khurram Khurshid	Head of Department (Professor)
2	Dr. Fazal Hameed	Assistant Professor
3	Dr. Benish Amin	Assistant Professor
4	Dr. Komal Nain Sukhia	Assistant Professor
5	Mr. Ch. Bilal Ahmad Khan	Assistant Professor
6	Mr. Muhammad Asad	Lecturer