

Scheme of Study for Master of Science in Computer Science, MS(CS)
2-year programme (4 semesters)

#	Category	# of Courses	Credit Hours
1	Computer Science courses	8	24
	CS Core Courses (CS-Core)	4	12
	CS Elective Courses (CS-Elec)	4	12
2	SS Research Methodology	1	1
3	Thesis-I	1	3
	Thesis-II	1	3
	Total	11	31

Semester-I: (12 Credit Hours)

#	Course Code	Category	Course Title	Credit Hours	Prerequisites
1	CS 501	CS-Core	Advanced Algorithm Analysis	3 (3,0)	Data Structures and Algorithms
2	CS 503	CS-Core	Advanced Operating Systems	3 (3,0)	Operating Systems
3	CS 505	CS-Elec	CS Elective-1	3 (3,0)	
4	CS 507	CS-Elec	CS Elective-2	3 (3,0)	

Semester-II: (13 Credit Hours)

#	Course Code	Category	Course Title	Credit Hours	Prerequisites
1	EE 502	CS-Core	Advanced Computer Architecture	3 (3,0)	Computer Organization
2	CS 504	CS-Core	CS Core-4	3 (3,0)	
3	CS 506	CS-Elec	CS Elective-3	3 (3,0)	
4	CS 508	CS-Elec	CS Elective-4	3 (3,0)	
5	SS 301	SS	Research Methodology	1	

Semester-III: (3 Credit Hours)

#	Course Code	Category	Course Title	Credit Hours	Prerequisites
1	CS 601	Thesis	Thesis (partial registration)	3 (0,3)	

Semester-IV: (3 Credit Hours)

#	Course Code	Category	Course Title	Credit Hours	Prerequisites
1	CS 601	Thesis	Thesis (full registration)	3 (0,3)	

List of Electives for MS(CS)
(Extendable List)

#	Category	Course Title	Cr Hrs	Prerequisites
1	CS-Elec	Research Methods	3 (3,0)	Probability & Statistics
2	CS-Elec	Digital Signal Processing	3 (3,0)	Data Comm & Comp Networks
3	CS-Elec	Parallel and Distributed Computing	3 (3,0)	Data Comm & Comp Networks
4	CS-Elec	Control Systems and Robotics	3 (3,0)	Artificial Intelligence
5	CS-Elec	Real Time Operating Systems	3 (3,0)	Operating Systems
6	CS-Elec	Advanced Networking	3 (3,0)	Data Comm & Comp Networks
7	CS-Elec	Network Security	3 (3,0)	Data Comm & Comp Networks
8	CS-Elec	Topics in Computer Networking	3 (3,0)	Data Comm & Comp Networks
9	CS-Elec	Network Administration	3 (3,0)	Data Comm & Comp Networks
10	CS-Elec	Wireless Networks	3 (3,0)	Data Comm & Comp Networks
11	CS-Elec	Network Performance Evaluation	3 (3,0)	Data Comm & Comp Networks
12	CS-Elec	Advanced Compiler Design I	3 (3,0)	Compiler Construction
13	CS-Elec	Advanced Compiler Design II	3 (3,0)	Compiler Construction
14	CS-Elec	Intelligent User Interfaces	3 (3,0)	HCI
15	CS-Elec	Multimedia Databases	3 (3,0)	Database Systems
16	CS-Elec	Computer Vision	3 (3,0)	Data Structures & Algorithms
17	CS-Elec	Rich Internet Applications	3 (3,0)	Programming Fundamentals
18	CS-Elec	Machine Learning	3 (3,0)	Artificial Intelligence
19	CS-Elec	Advanced Optimization Methods	3 (3,0)	Discrete Structures
20	CS-Elec	Robotics	3 (3,0)	Artificial Intelligence
21	CS-Elec	Intelligent Planning	3 (3,0)	Artificial Intelligence
22	CS-Elec	Fuzzy Systems	3 (3,0)	Discrete Mathematics
23	CS-Elec	Intelligent Probabilistic Data Modeling	3 (3,0)	Probability & Statistics
24	CS-Elec	Logic Programming & Automated Reasoning	3 (3,0)	Discrete Structures
25	CS-Elec	Evolutionary Computations/Algorithms	3 (3,0)	Data Structures & Algo.
26	CS-Elec	Visualization in Medicine	3 (3,0)	Probability & Statistics, Graph Theory
27	CS-Elec	Advanced Database Systems	3 (3,0)	Intro to Database Systems
28	CS-Elec	Distributed Databases	3 (3,0)	Intro to Database Systems
29	CS-Elec	Web Mining	3 (3,0)	Intro to Database Systems
30	CS-Elec	Text Mining	3 (3,0)	Intro to Database Systems
31	CS-Elec	Virtual & Augmented Reality Systems	3 (3,0)	Data Structures & Algorithms
32	CS-Elec	Knowledge Management	3 (3,0)	Artificial Intelligence
33	CS-Elec	Decision Theory	3 (3,0)	Probability & Statistics
34	CS-Elec	Requirements Engineering	3 (3,0)	
35	CS-Elec	Software Quality Assurance	3 (3,0)	Software Engineering
36	CS-Elec	Software System Architecture	3 (3,0)	Software Engineering
37	CS-Elec	Software Risk Management	3 (3,0)	Software Engineering
38	CS-Elec	Software Measurement & Metrics	3 (3,0)	Software Engineering
39	CS-Elec	Software Configuration Management	3 (3,0)	Software Engineering

40	CS-Elec	Component-Based Software Engineering	3 (3,0)	Software Engineering
41	CS-Elec	Decision Patterns	3 (3,0)	
42	CS-Elec	Complex Networks	3 (3,0)	Data Comm & Comp Networks
43	CS-Elec	Agent-Based Modeling	3 (3,0)	Data Comm & Comp Networks
44	CS-Elec	Information Security and Assurance	3 (3,0)	Data Comm & Comp Networks
45	CS-Elec	Mobile and Wireless Networks	3 (3,0)	Data Comm & Comp Networks
46	CS-Elec	Adv. Web Systems and Technologies	3 (3,0)	Web Engineering
47	CS-Elec	Information Technology Infrastructure	3 (3,0)	Data Comm & Comp Networks
48	CS-Elec	Telecommunications Management	3 (3,0)	Data Comm & Comp Networks
49	CS-Elec	Data Warehousing: Trends & Issues	3 (3,0)	Intro to Database Systems
50	CS-Elec	Data Mining: Trends & Issues	3 (3,0)	Intro to Database Systems
51	CS-Elec	Adv. Business Intelligence & Analytics	3 (3,0)	Data Mining
52	CS-Elec	Information Retrieval Systems	3 (3,0)	
53	CS-Elec	Cloud Computing	3 (3,0)	Operating Systems, Web Engg
54	CS-Elec	Mobile and Pervasive Computing	3 (3,0)	Operating Systems, Web Engg
55	CS-Elec	Enterprise Data Center: Design & Methodology	3 (3,0)	Intro to Database Systems
56	CS-Elec	Data Center Network Design, Implementation and Security	3 (3,0)	Intro to Database Systems
57	CS-Elec	Virtualized Data Center	3 (3,0)	Intro to Database Systems
58	CS-Elec	Integrated Services over Packet Networks	3 (3,0)	Data Comm & Comp Networks
59	CS-Elec	Stochastic Systems	3 (3,0)	Probability & Statistics
60	CS-Elec	Stochastic Processes	3 (3,0)	Probability & Statistics
61	CS-Elec	Knowledge-Based Systems	3 (3,0)	Artificial Intelligence
62	CS-Elec	Advanced Telecommunication Networks	3 (3,0)	Data Comm & Comp Networks
63	CS-Elec	Telecommunication Systems	3 (3,0)	Data Comm & Comp Networks
64	CS-Elec	Principles of Multimedia Systems	3 (3,0)	Data Comm & Comp Networks
65	CS-Elec	Advanced Multimedia Systems	3 (3,0)	Principles of Multimedia Sys.
66	CS-Elec	Principles of Soft Computing	3 (3,0)	Artificial Intelligence
67	CS-Elec	Web Semantics	3 (3,0)	Web Engineering
68	CS-Elec	Semantic Grid	3 (3,0)	Web Engineering
69	CS-Elec	Cryptography and Network Security	3 (3,0)	Data Comm & Comp Networks
70	CS-Elec	Digital Forensics	3 (3,0)	Data Comm & Comp Networks
71	CS-Elec	Ethical Hacking	3 (3,0)	Data Comm & Comp Networks
72	CS-Elec	Reverse Engineering/Malware Analysis	3 (3,0)	Data Comm & Comp Networks
73	CS-Elec	Digital Image Processing	3 (3,0)	Data Comm & Comp Networks
74	CS-Elec	Advanced Software Project Management	3 (3,0)	Software Engineering

The detailed course outline for the majority of the above courses is provided in the following (latest) document of the Higher Education Commission (HEC) of Pakistan.

“Curriculum of Computer Science, Information Technology, and Software Engineering”

List of Core Courses for MS(CS)

At least four courses must be taken from the following:

1. Advanced Analysis of Algorithms
2. Advanced Operating Systems
3. Theory of Programming Languages
4. Theory of Automata – II
5. Advanced Computer Architecture

Course Outline

Course: Theory of Automata – II

Course Structure: Lectures: 3, Labs: 0 **Credit Hours:** 3

Course Outline: Automata theory, formal languages, Turing Machines, computability theory and reducibility, computational complexity, determinism and non-determinism, time and space hierarchy, NP completeness, selected advanced topics.

Textbook/Reference Books:

1. “Introduction to the Theory of Computation”, Michael Sipser, PWS Publishing Co.
2. “Computational Complexity”, Christos Papadimitriou, Addison-Wesley.
3. “Introduction to Automata Theory, Languages, and Computation”, John Hopcroft and Jeffrey Ullman, Addison-Wesley.
4. “Formal Models and Computability”, Tao Jiang, Ming Li, and Bala Ravikumar, *in Handbook of Computer Science*, CRC Press.