REVISED CURRICULUM
OF
COMPUTER SCIENCE
AND
INFORMATION TECHNOLOGY

CURRICULUM DEVELOPMENT PROJECT
SPONSORED BY
**MINISTRY OF SCIENCE AND TECHNOLOGY
GOVERNMENT OF PAKISTAN
ISLAMABAD**

**UNIVERSITY GRANTS COMMISSION
H-9, ISLAMABAD
2001**

CURRICULUM DIVISION, UGC

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CONTENTS

PREFACE

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum of a subject, one can judge the state of intellectual development and the state of progress of a nation. The world has turned into a global village, new ideas and information are pouring in a constant stream. It is, therefore, imperative to update our curricula by introducing the recent developments in the relevant fields of knowledge.

In exercise of the powers conferred by Sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide Notification No.D773/76-JEA (Cur.), dated December 4, 1976, appointed University Grants Commission as the Competent Authority to look after the Curriculum Revision Work beyond Class XII at Bachelor level and onwards to all Degrees, Certificates and Diplomas awarded by Degree Colleges, Universities and other Institutions of higher education.

In pursuance of the above decisions and directives, the Commission is continually performing curriculum revision in collaboration with the Universities. According to the decision of the 44th Vice-Chancellors' Committee, curriculum of a subject must be reviewed after every 3 years. For the purpose, various Committees are constituted at the national level comprising senior teachers nominated by the Universities. Teachers from local degree colleges and experts from user organizations, where required, are also included in these Committees.

The Curriculum Revision Committee on Information Technology in February, 2001 at the U.G.C., Islamabad finalized the draft curriculum after due consideration of the comments and suggestions received from the Universities and Colleges where the subject under consideration is taught.

The Final draft prepared by the Curriculum Revision Committee duly approved by competent authority is being circulated for implementation by the Universities.

(PROF. DR. ALTAF ALI G. SHAIKH)
DIRECTOR GENERAL (C&T)

May, 2001

INTRODUCTION

The Commission realizing very fast pace of knowledge in Computer Sciences and Information Technology, convened a meeting of experts from Universities in Public & Private Sector, R&D establishments and Computer & Information Technology experts at UGC Islamabad on February 20-22, 2001. The following attended the meeting:

1.   Dr. Khalid Rashid,   Convener
        Head, Department of Computer Sciences &
        Information Technology,
        International Islamic University, Islamabad.

2.   Prof. Dr. Muhammad Jamil Sawar,   Member/Secretary
        Director,
        Barani Institute of Information Technology,
        Arid Agriculture University, Rawalpindi.

3.   Dr. Mumtaz Hussain Mahar,   Member
        Chairman,
        Department of Computer Science,
        Shah Abdul Latif University, Khairpur.

4.   Mr. Ghulam Hussain,   Member
        Chairman,
        Department of Computer Science,
        University of Karachi, Karachi.

5.   Dr. Amanullah Khan,   Member
        Chairman,
        Department of Computer Science,
        Bahauddin Zakariya University, Multan.

6.   Dr. Haji Khan Soomro,   Member
        Director,
        Institute of Information Technology,
        University of Sindh, Jamshoro.

7.	Mr. Bashir Ahmad, Director, Computer Centre, Gomal Unviersity, D.I.Khan	Member
8.	Mr. Arshad Maluk, Network Administrator, NWFP Agriculture University, Peshawar.	Member
9.	Dr. Khawar Islam, Assistant professor, Department of Information Technology, University college of Engineering & Technology, Murpur Azad Kashmir.	Member
10.	Engr. Dr. Tariq Mahmood Jadoon, Assistant Professor, Department of Electrical & Electronics Engg., NWFP University of Engg. & Technology, Peshawar.	Member
11.	Dr. M.Afzal Bhatti Chairman, Department of Computer Sciences Quaid-e-Azam University Islamabad.	Member
12.	Dr. Abdul Qadeer Khan Rajput, Professor and Dean, Faculty of Engg., Mehran University of Engg. & Tech., Jamshoro.	Member
13.	Mr. Abdul Aziz Sabir, Department of Computer Science, University of Agriculture, Faisalabad.	Member

14.	Mr. Waqar Aslam, Department of Computer Science, Islamia University, Bahawalpur.	Member
15.	Prof. Dr. N.A. Sangi, Department of Information Technology, Allama Iqbal Open University, Islamabad	Member
16.	Mr. Wahabuddin Usmani, Department of Computer Science, NED University of Engg. & Tech., Karachi.	Member
17.	Dr.Syed M.H. Zaidi HOA NIIT, Department of Electronic Engineering National University of Science & Technology Tamiz-ud-Din Road, Rawalpindi.	Member
18.	Mr. Zahid Hussain Khan, Assistant Professor, Quaid-e-Awam University of Engg. Science & Tech., Nawabshah.	Member
19.	Dr. Arshad Ali, Director NIT, Department of Electronics Engineering, National University of Science & Technology, Tamiz-ud-Din Road, Rawalpindi.	Member
20.	Prof. Dr. Aftab Ahmad, Dean-FFIMCS, Institute of Management and Computer Sciences, Fauji Foundation, New Lalazar, Rawalpindi Cantt.	Member
21.	Dr. Arshad Ali Shahid Dean, Faculty of computer Studies M.A. Jinnah University Blue Area, Opposite Pak Saudi Tower Islamabad.	Member

22.	Dr. Abdul Sattar Director General MIS AGPR Near Supreme Court Building, Islamabad.	Member
23.	Dr. Mutawara Hussain Head, DICS Pakistan Institute of Engg. & Applied Scinces P.O. Nilore, Islamabad.	Member
24.	Dr. Shaftab Ahmad Senior Principal Officer ICCC, Islamabad.	Member
25.	Miss Naseem A. Bhatti, Director, Computer Training Centre, UGC Campus, Islamabad.	Member
26.	Dr. Sikandar Hayat Computer Training Centre, Islamabad.	Member
27.	Dr. M. Ashraf Iqbal, Head, Department of Computer Science, Lahore University of Management Sciences, Lahore.	Member
28.	Dr. Muhammad Afzal, Professor, FFIMCS, New Lalazar, Rawalpindi.	Member
29.	Mr. Ayyaz Mahmood, Assistant Professor, Bahria University, Islamabad.	Member

30.	Dr. Anwar Mahmood, Dean, Faculty of Information Technology, National University of Modern Languages, Islamabad.	Member
31.	Dr. M.Ayub Alvi Dean, Faculty of Computer Science National University of Computer & Engineering Sciences, Islamabad.	Member
32.	Prof. Dr. Altaf Ali G. Shaikh Adviser (C&T) University Grants Commission Islamabad.	Member

The meeting started with the recitation from Holy Quran by Prof. Dr. S. Altaf Husain, Member (W.T). He then welcomed the participants and informed them of constitutional obligations of the Commission with regard to review/revision and development of curricula of different subjects taught beyond class XII. He also spoke on uniformity of curricula and maintenance of educational standards at graduate and post-graduate levels. He briefed the participants of the hard facts and inputs which Commission is putting in to achieve the aforementioned goals.

Prof. Dr. S. Altaf Hussain specifically talked about the importance of Information Technology. He informed the members that Commission as a first step convened a meeting of experts to devise and develop the curricula, which in its Ist ever meeting held on December 23, 2000 had appointed a sub-committee comprising of the following members to identify the major core areas, which any future Information Technologist, Computer Scientist must be acquainted with to apply the same for storage and retrieval of information about any specific field by utilizing the modern tools like internet and E-mail etc.

1. Prof. Dr. Khalid Rashid
Chairman, Department of Computer Sciences
International Islamic University, Islamabad.

2.   Dr. Muhamamd Ayub Alvi
        Director FAST, Institute of Computer Sciences
        G-9 Markaz Islamabad.

3.   Dr. Jamil Sawar
        Director, Institute of Information Technology
        University of Arid Agriculture, Rawalpindi

4.   Dr. Nazir Ahmed Sangi
        Head, Department of Computer Sciences
        Allama Iqbal Open University, Islamabad.

5.   Dr. M. Afzal Bhatti
        Chairman Department of Computer Sciences,
        Quaid-e-Azam University, Islamabad

He stressed the participants to focus on developing Information Technology courses leading to degrees with uniform nomenclature to avoid any confusion. He also asked the member to review the curriculum of Computer Science as well as Computer Systems Engineering framed in 1998 by the Commission being offered by universities in Public Sectors.

The Member (WT) also pointed out various problems related to equivalence of degrees in the field of computer Sciences, Information Technology and Business Administration which have surfaced during past few years because of different levels of entrance to these degree programmes their duration of studies and ultimately different nomenclature of degrees being awarded.

Prof. Dr. Altaf Ali G. Shaikh, Adviser (C&T) during course of deliberation with regard to unification of existing nomenclature of degrees. Further he asked the participants of decide/recommend unanimously the future course as the existing scheme especially in private sector institutions is misleading and confusing the students and general public and is not in accordance with international standards. Prof. Shaikh also asked the members to carefully examine the issues of students perusing studies in old system of BCS which for all practical purposes is mixture of Computer Science and Information Technology.

The Committee took up the agenda and after discussion agreed to the following:-

i.   There shall be two distant branches of studies i.e. Information Technology and Computer Sciences and degrees will be awarded accordingly.

ii.   Entrance requirement for degree in Information Technology as well as Computer Science will be intermediate (F.Sc. in Pre-Engg. & Pre-Medical, Commerce, General Science with Computer Science).

iii.   The duration for BS (IT) will be four year (8 semester and minimum of 130 credit hrs) and for MS(IT), one & half year studies will be requirement including project of one semester duration (9 credit hrs).

iv.   The BS (Computer) will be awarded after 40year course (8 semester and minimum of 130 credit) and MS (Computer will require one and half year regular studies with a project to be part for fulfillment of degree comprising minimum of 9 credit hrs.)

v.   Present M.Sc. (Computer Science) being offered with B.Sc. degree as entrance requirement by some universities will continue. Studies having this master degree will be eligible for admission in MS (computer) and MS (Information Technology). These students will also clear the deficiency course as designed by respective universities before the commencement of actual programme.

vi.   Existing three year BCS and two year MCS courses will be discontinued from the next academic session.

vii.   The Committee also resolved to form a council in line with PMDC and PEC. The resolution is Attached at Annexure-A

The Committee after discussing the recommendations of the sub-committee and outlines of course on Information Technology and Computer Science prepared by the said sub-Committee, agree to the attached draft courses on BS (IT)., MS (IT), BS (Computer Science) Annex-B.

The meeting ended with a vote of thanks to the chair.

MINUTES OF THE MEETING NCRC TO FINALIZE THE DRAFT CURRICULUM FOR BS(IT), MS(IT), BS (CS)/MS(CS) AND M.C.S. CONVERSION COURSE

A meeting of National Curriculum Revision Committee to finalize the draft curricula for BS(IT)/MS(Information Technology), BS/MS (Computer Science) and M.C.S (conversion degree) programmes was held at University Grants Commission, Islamabad from April 23-25, 2001. Following attended the meeting:

1.   Dr. Khalid Rashid,   Convener
      Head,
      Department of Computer Sciences &
      Information Technology,
      International Islamic University, Islamabad.

2.   Prof. Dr. Muhammad Jamil Sawar,   Member/Secretary
      Director,
      Barani Institute of Information Technology,
      Arid Agriculture University,
      Rawalpindi.

3.   Dr. Mumtaz Hussain Mahar,   Member
      Chairman, Department of Computer Science,
      Shah Abdul Latif University, Khairpur.

4.   Mr. Ghulam Hussain,   Member
      Chairman, Department of Computer Science,
      University of Karachi,
      Karachi.

5.	Dr. Amanullah Khan, Chairman, Department of Computer Science, Bahauddin Zakariya University, Multan.	Member
6.	Dr. Haji Khan Soomro, Director, Institute of Information Technology, University of Sindh, Jamshoro.	Member
7.	Mr. Arshad Maluk, Network Administrator, NWFP Agriculture University, Peshawar.	Member
8.	Dr. Khawar Islam, Assistant professor, Department of Information Technology, University college of Engineering & Technology, Murpur Azad Kashmir.	Member
9.	Engr. Dr. Tariq Mahmood Jadoon, Assistant Professor, Department of Electrical & Electronics Engg., NWFP University of Engg. & Technology, Peshawar.	Member
10.	Dr. Abdul Qadeer Khan Rajput, Professor and Dean, Faculty of Engineering Mehran University of Engg. & Tech., Jamshoro.	Member
11.	Mr. Abdul Aziz Sabir, Department of Computer Science, University of Agriculture, Faisalabad.	Member
12.	Mr. Waqar Aslam, Department of Computer Science, Islamia University, Bahawalpur.	Member

13.	Mr. Muhammad Daud Khattak, Department of Information Technology, Allama Iqbal Open University, Islamabad.	Member
14.	Prof. Dr. N.A. Sangi, Department of Information Technology, Allama Iqbal Open University, Islamabad.	Member
15.	Mr. Wahabuddin Usmani, Department of Computer Science, NED University of Engg. & Tech., Karachi.	Member
16.	Mr. Zahid Hussain Khan, Assistant Professor, Quaid-e-Awam University of Engg. Science & Tech., Nawabshah.	Member
17.	Dr. Syed M.H. Zaidi, HOA NIIT, Department of Electronic Engineering, National University of Science & Technology, Tamiz-ud-Din Road, Rawalpindi.	Member
18.	Dr. Arshad Ali, Director NIT, Department of Electronics Engg., National University of Science & Technology, Tamiz-ud-Din Road, Rawalpindi.	Member
19.	Prof. Dr. Aftab Ahmad, Dean-FFIMCS, Institute of Management and Computer Sciences, Fauji Foundation, New Lalazar, Rawalpindi Cantt.	Member
20.	Dr. M. Ashraf Iqbal, Head, Department of Computer Science, Lahore University of Management Sciences, Lahore.	Member

21.	Mr. Haroon Rashid, Deputy Director, COMSATS University, Islamabad.	Member
22.	Mr. Saeed Ahmad, Director General, Pakistan Computer Bureau, H-8, Islamabad.	Member
23.	Miss Naseem A. Bhatti, Director, Computer Training Centre, UGC Campus, Islamabad.	Member
24.	Dr. Anwar Mahmood, Dean, Faculty of Information Technology, National University of Modern Languages, Islamabad.	Member
25.	Dr. Arshad Ali Shahid, Dean, Faculty of Computer Studies, M.A. Jinnah University, Blue Area, Opposite Pak Saudi Tower, Islamabad.	Member
26.	Dr. Muhammad Afzal, Professor, FFIMCS, New Lalazar, Rawalpindi.	Member
27.	Mr. Ayyaz Mahmood, Assistant Professor, Bahria University, Islamabad.	Member
28.	Ms. Dr. Anila Usman, Department of Informatics & Computer Sc., Pakistan Institute of Engg. & Applied Sciences, Nilore, Islamabad.	Member

Meeting started with recitation from Holy Quran by Dr. Khawar Islam.

Mr. Muhammad Javed Khan, Director Curriculum welcome the participants of the meeting. He informed the committee that first ever draft curricula for BS (IT), BS (CS) alongwith proposed scheme of studies spread over 8 semester or 4 year duration, outline of courses for MS (IT)/MS(CS) 4 semester or two year degree programme and M.C.S. (Conversion Degree) programme for students coming from main stream of BA/BSc/B.Com etc. was circulated amongst 40 University/Institutions and members of the committee. They were requested to discuss the draft with fellow members in their faculty and send their suggestions for improvement of the draft. Subsequently these comments were to be considered by the committee. Only three individual/universities responded to our request. Their comments mainly related to titles proposed in **management courses** included in the scheme of studies.

The Director Curriculum introduced the committee of different academic programmes run by the Commission aimed at facilitating the universities in effective implementation of curricula. He made special mention to the UGC programmes 'Short Course by Subject Experts' and Teachers Exchange Programme through which universities can utilize the services of qualified professionals working in other sister universities and R&D Institutions. To over come the shortage of locally produced reading material/s for students, he urged the experts to come up with proposals for writing of monographs on topics of syllabi. He suggested the senior and qualified professors to impart their valuable knowledge to younger generation of teachers by conducting In-service teachers training courses.

He informed the members that present exercise of revision of curricula for S&T subject is being carried out by the financial support of Ministry of Science & Technology. He assured the members of all possible assistance and cooperation. The members of the committee appreciated the efforts of Dr. Atta-ur-Rehman, Minister for Science & Technology for his efforts in promotion of Scientific and Technological Culture in the country and institution of indigenous Ph.D. Degree programmes.

Prof. Dr. Khalid Rashid, Convener of the committee appreciated the response of universities/institutions in public and private sector and

R&D institution by sending Professors and Experts to this national forum. He described the response on draft curricula as reposing confidence on the intellectual inputs and efforts of the committee while preparing the draft curricula in its preliminary meeting. Despite, prevalent uniformity of the opinion amongst members of the committee the Convener invited each of the participant of the meeting to comment on any aspect of the draft.

Dr. M. Ashraf Iqbal representing LUMS, Dr. Haroom Rashid COMSATS, Dr.Arshad Maluk, NWFP Engg. University Dr. A.Q. Rajput, Mehran University of Engg. & Tech, Prof. Dr. Haji Khan Soomro, University of Sindh, Jamshoro, Dr. Amanullah Khan, B.Z. University, Miss Naseem Bhatti, CSO, PAEC, Dr. Nazir Sangi from AIOU and Mr. Mumtaz Maher SAL University, Khairpur made valuable suggestions for improvement of the curriculum.

Dr. Jamil Sawar, Secretary of the Committee informed that the curricula has been thoroughly discussed at different forum and experts representing universities, private degree awarding institution and software industry. He made it a point that since Information Technology and Computer Science are relatively younger disciplines in Pakistan and the scheme of studies for graduate as well as post graduate degree are relatively new in Pakistani culture, curricula being recommended has been split up in **core courses,** Elective courses, Supporting courses, General Education Courses and Compulsory courses of Pakistan Studies and Islamic Studies. The committee unanimously recommended that the universities must teach core courses and may enhance the list of elective/optional subject to further their academic programmes depending upon the availability of teaching staff and allied infra-structure.

The committee after deliberating each one of the proposed Core, Elective, Optional courses and debating at length on re-requisites for pursuing the study of specific course/s as well as taking into the account the existent academic environment in universities/institutions, agreed to recommend curriculum for each of the five degree programmes as per following details.

Summary of Degrees
Proposed by
National Curriculum Revision Committee
For
Information Technology & Computer Science

BS (CS) 4 Years Degree Program {Bachelor of Science in Computer Science}

130+ credit hours spread over 8 semesters.

Eligibility: FSc Pre-Engineering, FSc Pre-Medical, Intermediate in General Science, Intermediate in Computer Science, Intermediate in Commerce.

Equivalent to MCS/M.Sc Computer Science (16 years education)

BS (IT) 4 Years Degree Program {Bachelor of Science in Information Technology}

130+ credit hours spread over 8 semesters.

Eligibility: FSc Pre-Engineering, FSc Pre-Medical, Intermediate in General Science, Intermediate in Computer Science, Intermediate in Commerce.

Equivalent to MIT/M.Sc Information Technology (16 years education)

MS (CS) Two Years Degree Program {Master of Science in Computer Science}

30+ credit hours spread over 4 semesters (2 Semesters Course work plus thesis).

Eligibility: BS (CS) 4 Years Degree Program (min 130 credit hours), or Computer Science Conversion Course 2 Years Degree Program (min 72 credit hours) referred to as "MCS" or "MSc CS".

Equivalent to M.Phil (18 years education)

MS (IT) Two Years Degree Program {Master of Science in Information

Technology}

30+ credit hours spread over 4 semesters (2 Semesters Course work plus thesis).

Eligibility: BS (IT) 4 Years Degree Program (min 130 credit hours), or Information Technology Conversion Course 2 Years Degree Program (min 72 credit hours) referred to as "MIT".

Equivalent to M.Phil (18 years education)

MCS Two Years Degree Program {Master of Computer Science – Conversion Course}

72 credit hours spread over 4 semesters.

Eligibility: BA/BSc Program in any of the following: Maths, Physics, Computer Science, Commerce, Stats, Economics, and Bachelors of Engineering.

Equivalent to BS (CS)/M.Sc (Computer Science) (i.e. 16 years education)

MIT Two Years Degree Program {Master of Information Technology – Conversion Course}

72 credit hours spread over 4 semesters.

Eligibility: BA/BSc Program in any of the following: Business Administration, Maths, Physics, Computer Science, Commerce, Stats, Economics, and Bachelors of Engineering

Equivalent to BS (IT) (i.e. 16 years education)
Bachelor of Science in Computer Science;BS (CS);131 credit hours

Required Computer Science Courses				(66/131)	
#	Code	Preq	Course Title	Credit hours	Sem-ester
1	CS		Introduction to Computers	3 (2-3)	1
2	CS		Fundamentals of Algorithms	3 (3-0)	1
3	CS	1,2	Introduction to Computer Programming	3 (2-3)	2
4	CS	29	Discrete Structures	3 (3-0)	2
5	CS	3	Object Oriented Programming	3 (2-3)	3
6	CS	1,2	Data Base Systems	3 (2-3)	3
7	CS	5	Data Structures	3 (2-3)	4
8	CS	4,33	Digital Logic Design	3 (2-3)	4
9	CS	3	Software Engineering - I	3 (2-3)	4
10	CS	2,7	Analysis of Algorithms	3 (3-0)	5
11	CS	1,8	Computer Organization & Assembly	3 (2-3)	5
12	CS	3	Numerical Analysis	3 (2-3)	5
13	CS	7,11	Operating System Concepts	3 (2-3)	6
14	CS	8,11	Computer Architecture	3 (3-0)	6
15	CS	4	Automata Theory	3 (3-0)	6
16	CS	3	Computer Graphics	3 (2-3)	6
17	CS		Data Communication	3 (3-0)	6
18	CS	15	Compiler Construction	3 (2-3)	7
19	CS	17	Computer Networks	3 (2-3)	7
20	CS	3	Artificial Intelligence	3 (2-3)	7
21	CS		Software Project	6(0-18)	8
Elective Computer Science Courses				(21/131)	
(The list of courses can be enhanced)					
22	CS	5	Modern Programming Languages	3 (2-3)	4
23	CS	22	Web Programming	3 (2-3)	5
24	CS	5,9	Software Engineering - II	3 (2-3)	5

25	CS	5	Adv. Object Oriented Programming	3 (2-3)	6
26	CS	11,13	System Programming	3 (2-3)	7
27	CS	5,25	Visual Programming	3 (2-3)	7
28	CS	6	Distributed Database Systems	3 (2-3)	7

Required Supporting Courses   (21/131)

29	MT		Calculus and Analytical Geometry	3 (3-0)	1
30	MT	29	Multi Variable Calculus	3 (3-0)	2
31	MT	30	Differential Equations	3 (3-0)	3
32	MT	31	Linear Algebra	3 (3-0)	4
33	PH	29	Circuit Theory	3 (3-0)	3
34	PH	33	Electronics	3 (2-3)	4
35	ST	29	Statistics and Probability	3 (3-0)	5

Required General Education Courses   (23/131)

36	EG		English Comprehension	3 (3-0)	1
37	EG	36	Technical and Business Writing	3 (3-0)	2
38	EG	37	Communication Skills	3 (3-0)	3
39	MG		Financial Accounting	3 (3-0)	1
40	MG	39	Financial Management	3 (3-0)	2
41	MG		Human Resource Management	3 (3-0)	3
42	PS		Psychology	3 (3-0)	8
43	PK		Pakistan Studies	1 (1-0)	1
44	IS		Islamic Studies / Ethics	1 (1-0)	2

Sample Scheme of Study
BS (CS)

Semester 1 (16 credit hrs)

		Subjects	Credit Hrs
1	CS	Introduction to Computers	3
2	CS	Fundamentals of Algorithms	3
3	MG	Financial Accounting	3
4	MT	Calculus and Analytical Geometry	3
5	EG	English Comprehension	3
6	PK	Pakistan Studies	1

Total: 16

Semester 2 (16 credit hrs)

		Subjects	Credit Hrs
1	CS	Intro to Computer Programming	3
2	CS	Discrete Structures	3
3	MT	Multi Variable Calculus	3
4	EG	Technical and Business Writing	3
5	MG	Financial Management	3
6	IS	Islamic Studies	1

Total: 16

Semester 3 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Object Oriented Programming	3
2	CS	Data Base Systems	3
3	MT	Differential Equations	3
4	PH	Circuit Theory	3
5	MG	Human Resource Management	3
6	EG	Communication Skills	3

Total: 18

Semester 4 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Data Structures	3
2	CS	Digital Logic Design	3
3	CS	Software Engineering - I	3
4	CS	Modern Programming Languages	3
5	PH	Electronics	3
6	MT	Linear Algebra	3

Total: 18

Semester 5 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Software Engineering II	3
2	CS	Web Programming	3
3	CS	Analysis of Algorithms	3
4	CS	Computer Organization & Assembly	3
5	CS	Numerical Analysis	3
6	ST	Statistics and Probability	3

Total: 18

Semester 6 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Operating System Concepts	3
2	CS	Computer Architecture	3
3	CS	Data Communication	3
4	CS	Computer Graphics	3
5	CS	Advanced Object Oriented Prog	3
6	CS	Automata Theory	3

Total: 18

Semester 7 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	System Programming	3
2	CS	Compiler Construction	3
3	CS	Visual Programming	3
4	CS	Artificial Intelligence	3
5	CS	Computer Networks	3
6	CS	Distributed Database Systems	3

Total: 18

Semester 8 (9 credit hrs)

		Subjects	Credit Hrs
1	CS	Software Project	6
2	PS	Psychology	3

Total: 9

Master of Science in Computer Science; MS (CS) ; 30 credit hours

The students need to take 4 Core courses and 3 courses from any one of the specialization Areas plus Thesis of 9 credit hours.

#	Code	Preq	Course Title	Credit hours	
			Core Courses		
1	CS		Theory of Computation	3	
2	CS		Advanced Computer Architecture	3	
3	CS		Advanced Operating Systems	3	
4	CS		Theory of Programming Languages	3	
5	CS		**Thesis/Dissertation**	9	

(More specialization areas and/or courses can be added)

Code	Specialization Areas	C.Hrs		Code	Specialization Areas	
	Software Engineering				**Artificial Intelligence**	
CS	Advanced Software Engineering	3		CS	Design of Intelligent S	
CS	Topics in Software Engineering	3		CS	Machine Learning	
CS	Object Oriented Software Engg	3		CS	Neural Networks	
CS	Software Quality Assurance	3		CS	Mathematical Reason	
CS	Req Analysis and Specification	3		CS	Decision Support Sys	
				CS	Computer Vision	
	Data Bases					
CS	Advanced DBMS	3			**Multimedia & Graphi**	
CS	Object Oriented Databases	3		CS	Advanced Computer (	
CS	Web-Based DBMS	3		CS	Multimedia & Hyperme	
CS	Topics in DBMS	3		CS	Virtual Reality	
				CS	Human Computer Inte	
	System Engineering			CS	Geographical Informa	
CS	Advanced Computer Architecture	3		CS	Computer Animation	
CS	Digital Signal Processing	3				
CS	Switching and Fault Diagnosis	3			**Computer Science E**	
CS	Parallel & Distributed Computing	3		CS	Educational Technolo	

CS	Control Systems and Robotics	3		CS	Multimedia and Hyper	
CS	Real Time Operating Systems	3		CS	Computer Aided Instru	
				CS	Web Based Education	
	Computer Networks			CS	Measurement of Learr	
CS	Advanced Networking	3		CS	Topics in Comp Scien	
CS	Network security	3				
CS	Topics in Computer Networking	3				
CS	Network Transport Protocols	3				
CS	Network Administration	3				
CS	Network Performance Evaluation	3				

Sample Scheme of Study
MS (CS)

Semester 1 (12 credit hrs)

		Subjects	Credit Hrs
1	CS	Theory of Computation	3
2	CS	Advanced Computer Architecture	3
3	CS	Advanced Operating Systems	3
4	CS	Elective I	3

Total: 12

Semester 2 (9 credit hrs)

		Subjects	Credit Hrs
1	CS	Theory of Programming Languages	3
2	CS	Elective II	3
3	CS	Elective III	3

Total: 9

Semester 3 and 4 (9 credit hrs)

		Subjects	Credit Hrs
1	CS	Thesis	9

Total: 9

Master of Computer Science   (MCS) – Conversion Course; 72 Credit hours

			Required Computer Courses	(6:	
#	Code	Preq	Course Title	Cr ho	
1	CS		Fundamentals of Algorithms	3 (	
2	CS		Introduction to Computer Programming	3 (	
3	CS		Data Base Systems	3 (	
4	CS		Web Programming	3 (	
5	CS		Discrete Structures	3 (	
6	CS	5	Automata Theory	3 (	
7	CS	2	Object Oriented Programming	3 (	
8	CS	2,3	Software Engineering - I	3 (	
9	CS	2,5	Computer Organization & Assembly	3 (	
10	CS	2	Artificial Intelligence	3 (	
11	CS	1,7	Data Structures and Analysis of Algorithms	3 (	
12	CS	7,8	Advanced Object Oriented Programming	3 (	
13	CS	2,9,11	Operating Systems Concepts	3 (	
14	CS	9	Computer Architecture	3 (	
15	CS	6	Compiler Construction	3 (	
16	CS	8	Software Engineering - II	3 (	
17	CS	2,9	System Programming	3 (	
18	CS	7	Visual Programming	3 (	
19	CS	14	Computer Networks	3 (	
20	CS	3	Distributed Database Systems	3 (	
21	CS	7	Modern Programming Languages	3 (	
			(Select 9 Credit Hours)	(9/	
22	EG		English Comprehension	3 (	
23	EG	22	Technical and Business Writing	3 (	
24	EG	23	Communication Skills	3 (	
25	HM		Professional Ethics, Social Aspects of Computing	3 (	
26	CS		Software Project	6 (	

Sample Scheme of Study
Master of Computer Science (MCS) - Conversion Course

Semester 1 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Fundamentals of Algorithms	3
2	CS	Intro to Computer Programming	3
3	CS	Data Base Systems	3
4	CS	Web Programming	3
5	CS	Discrete Structures	3
6	EG	English Comprehension	3

Total: 18

Semester 2 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Object Oriented Programming	3
2	CS	Software Engineering - I	3
3	CS	Computer Organization & Assembly	3
4	CS	Artificial Intelligence	3
5	CS	Automata Theory	3
6	EG	Technical and Business Writing	3

Total: 18

Semester 3 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Data Structures & Analysis of Alg	3
2	CS	Advanced Object Oriented Prog	3
3	CS	Operating System Concepts	3
4	CS	Computer Architecture	3
5	CS	Compiler Construction	3

6	EG	Communication Skills	3

Total: 18

Semester 4 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Software Engineering - II	3
2	CS	System Programming	3
3	CS	Visual Programming	3
4	CS	Computer Networks	3
5	CS	Distributed Database Systems	3
6	CS	Modern Programming Languages	3

Total: 18

Bachelor of Science in Information Technology; BS (IT); 131 Credit hours

		Required Computer Science Courses		(6	
#	Code	Preq	Course Title	Cr ho	
1	CS		Introduction to Computers	3 (	
2	CS		Fundamentals of Algorithms	3 (	
3	CS	2	Introduction to Computer Programming	3 (	
4	CS	35	Discrete Structures	3 (	
5	CS	3	Data Structures	3 (	
6	CS	1	Introduction to Computer Architecture	3 (	
7	CS	6	Operating Systems Concepts	3 (	
8	CS	4	Data Base Systems	3 (	
9	CS	6	Data Communication	3 (	
10	CS	3	Software Engineering I	3 (	
11	CS	3	Object Oriented Programming	3 (	
12	CS	9	Telecommunication Systems	3 (	
13	CS	3	Multimedia Technologies	3 (	
14	CS	13	Web Design and Development	3 (	
15	CS	9	Computer Networks	3 (	
16	CS	10	Software Engineering II	3 (	
17	CS	8	Distributed Data Base Systems	3 (	
18	CS	14	Modern Programming Languages	3 (	
19	CS	14	E-Commerce	3 (	
20	CS	16	Software Project Management	3 (	
21	CS	16	Software Project	6 (	
		Elective Courses (More courses may be added)		(6	
	PH		Circuit Theory	3 (	
	PH		Electronics	3 (	
	CS		Computer Law	3 (	
	CS		Human Computer Interface	3 (	
	CS		Visual Programming	3 (	
	CS		Network Management	3 (	
	CS		Cellular Communication	3 (	
	CS		Client Server Technologies	3 (	

			Required Management Courses	(3:	
24	MG		Introduction to Economics	3 (	
25	MG		Financial Accounting	3 (	
26	MG		Fundamentals of Management	3 (	
27	MG		Introduction to Marketing	3 (	
28	MG	26	Organizational Behavior	3 (	
29	MG	27	Marketing Management	3 (	
30	MG	26	Human Resource Management	3 (	
31	MG	25	Business Finance	3 (	
32	MG		Entrepreneurship	3 (	
33	MG	25	Financial Management	3 (	
34	MG		Quantitative Business Analysis	3 (	
			Required Supporting Courses	(1:	
35	MT		Calculus and Analytic Geometry	3 (	
36	MT	35	Multivariable Calculus	3 (	
37	MT	36	Linear Algebra	3 (	
38	ST		Statistics and Probability	3 (	
			Required General Education Courses	(1	
39	EG		English Comprehension	3 (	
40	EG	39	Technical and Business Writing	3 (	
41	EG	40	Communication Skills	3 (	
42	PS		Psychology	3 (	
43	PK		Pakistan Studies	1 (	
44	IS		Islamic Studies / Ethics	1 (	

Sample Scheme of Study
BS (IT)

Semester 1 (16 credit hrs)

		Subjects	Credit Hrs
1	CS	Introduction to Computers	3
2	CS	Fundamentals of Algorithms	3
3	MG	Introduction to Economics	3

4	MT	Introduction to Calculus	3
5	EG	English Comprehension	3
6	PK	Pakistan Studies	1

Total: 16

Semester 2 (16 credit hrs)

		Subjects	Credit Hrs
1	CS	Introduction to Computer Programming	
2	CS	Discrete Mathematics	3
3	MT	Calculus and Analytic Geometry	3
4	EG	Technical and Business Writing	3
5	MG	Financial Accounting	3
6	IS	Islamic Studies	1

Total: 16

Semester 3 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Data Structures	3
2	CS	Introduction to Computer Architecture	
3	MG	Fundamentals of Management	3
4	MG	Introduction to Marketing	3
5	MT	Multivariable Calculus	3
6	EG	Communication Skills	3

Total: 18

Semester 4 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Operating Systems Concepts	3
2	CS	Data Communication	3
3	CS	Data Base Systems	3
4	MG	Organizational Behavior	3
5	MG	Marketing Management	3
6	MT	Statistics and Probability	3

<div align="right">Total: 18</div>

Semester 5 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Software Engineering I	3
2	CS	Object Oriented Programming	3
3	CS	Multimedia Technologies	3
4	CS	Telecommunication Systems	3
5	MG	Human Resource Management	3
6	MG	Business Finance	3

<div align="right">Total: 18</div>

Semester 6 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Web Design and Development	3
2	CS	Software Engineering II	3
3	CS	Computer Networks	3
4	CS	Distributed Data Base Systems	3
5	MG	Entrepreneurship	3
6	MG	Financial Management	3

<div align="right">Total: 18</div>

Semester 7 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Software Project Management	3
2	CS	Modern Programming Languages	3
3	CS	E-Commerce	3
4	CS	Elective I	3
5	CS	Elective II	3
6	MG	Quantitative Business Analysis	3

<div align="right">Total: 18</div>

Semester 8 (9 credit hrs)

		Subjects	Credit Hrs
1	CS	Project	6
2	PS	Psychology	3

Total: 9

Master of Science in Information Technology; MS (IT) ; 30 Credit hours

The students need to take 4 Core courses and 3 courses from IT Electives, plus Thesis of 9 credit hours.

#	Code	Preq	Course Title	Cr ho	
			Core Courses	**(2**	
1	CS		Information Systems	3	
2	CS		Advanced Software Engineering	3	
3	CS		Strategic Information Management	3	
4	CS		Advanced Computer Networks	3	
5	CS		**Thesis/Dissertation**	9	
			IT Electives **More elective courses may be added**	**(9/**	
1	CS		Object Oriented Software Engineering	3	
2	CS		Software Quality Assurance	3	
3	CS		Net Centric Computing	3	
4	CS		Web-Based DBMS	3	
5	CS		Topics in DBMS	3	
6	CS		Data Warehousing	3	
7	CS		Network Security	3	
8	CS		Topics in Computer Networking	3	
9	CS		Network Administration	3	
10	CS		Computer Graphics	3	
11	CS		Multimedia & Hypermedia System	3	
12	CS		Virtual Reality Applications	3	
13	CS		Human Computer Interface	3	
14	CS		Geographical Information Systems	3	
15	CS		Computer Animation	3	
16	CS		E-Commerce Technologies	3	
17	CS		E-Commerce Law and Regulations	3	
18	CS		Cyber Marketing	3	
19	CS		Advanced Topics in IT	3	

| 20 | CS | | IT Contracts Management | 3 | |
| 21 | CS | | IT Services Management | 3 | |

Sample Scheme of Study
MS (IT)

Semester 1 (12 credit hrs)

		Subjects	Credit Hrs
1	CS	Information Systems	3
2	CS	Advanced Software Engineering	3
3	CS	Information Technology Management	
4	CS	Elective I	3

Total: 12

Semester 2 (9 credit hrs)

		Subjects	Credit Hrs
1	CS	Advanced Computer Networks	3
2	CS	Elective II	3
3	CS	Elective III	3
4	CS	Thesis	

Total: 9

Semester 3 and 4 (9 credit hrs)

		Subjects	Credit Hrs
1	CS	Thesis	9

Total: 9

Master of Information Technology (MIT) – Conversion Course; 72 Credit hours

#	Code	Preq	Course Title	Credit hours	
			Required Computer Science Courses	(45	
1	CS		Fundamentals of Algorithms	3 (	
2	CS		Introduction to Computer Programming	3 (	
3	CS		Data Base Systems	3 (	
4	CS	2	Data Structures	3 (	
5	CS		Introduction to Computer Architecture	3 (	
7	CS	2	Software Engineering	3 (	
6	CS	5	Operating Systems Concepts	3 (	
8	CS	2	Object Oriented Programming	3 (	
9	CS		Web Design and Development	3 (	
10	CS		Data Communication	3 (	
11	CS		Telecommunication Systems	3 (	
12	CS	11	Computer Networks	3 (	
13	CS	9	E-Commerce	3 (	
14	CS	3	Distributed Data Base Systems	3 (	
15	CS	8	Visual Programming	3 (	
			Required Management Courses	(18	
16	MG		Fundamentals of Management	3 (	
17	MG		Introduction to Marketing	3 (	
18	MG		Introduction to Accounting	3 (	
19	MG	16	Organizational Behavior	3 (	
20	MG	16	Human Resource Management	3 (	
21	MG	18	Financial Management	3 (	
			(Select 9 Credit Hours)	(9	
22	EG		English Comprehension	3 (	
23	EG	22	Technical and Business Writing	3 (	
24	EG	23	Communication Skills	3 (	
26	CS		Software Project	6 (	

Sample Scheme of Study
Master of Information Technology (MIT) - Conversion Course

Semester 1 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Fundamentals of Algorithms	3
2	CS	Introduction to Computer Programming	
3	CS	Data Base Systems	3
4	MG	Fundamentals of Management	3
5	MG	Introduction to Marketing	3
6	EG	English Comprehension	3

Total: 18

Semester 2 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Data Structures	3
2	CS	Introduction to Computer Architecture	
3	CS	Software Engineering I	3
4	CS	Data Communication	3
5	MG	Organizational Behavior	3
6	MG	Introduction to Accounting	3

Total: 18

Semester 3 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Operating Systems Concepts	3
2	CS	Object Oriented Programming	3
3	CS	Web Design and Development	3
4	CS	Telecommunication Systems	3
5	MG	Financial Management	3

| 6 | EG | Technical and Business Writing | 3 |

Total: 18

Semester 4 (18 credit hrs)

		Subjects	Credit Hrs
1	CS	Distributed Data Base Systems	3
2	CS	Visual Programming	3
3	CS	Computer Networks	3
4	CS	E-Commerce	3
5	MG	Human Resource Management	3
6	EG	Communication Skills	3

Total: 18

Computer Science Courses

Introduction to Computers

Brief history of computers and their applications. Major components of a computer. Computer and Society. The social impact of computer age. Computers in offices, industry and education. Office automation tools; Word processing, Graphic packages, Databases and Spreadsheets. Current trends, research and future prospects. Legal and moral aspects of Computer Science. Using Internet.

Fundamentals of Algorithms

Using pseudo language as a base, introduction to algorithms, introduction to matrices and their manipulation, searching and sorting algorithm, graphs and related algorithms, trees and related algorithms. Introduction to concepts of iteration and recursion, tracing and timing. Introduction to order of magnitude and algorithm complexity.

Discrete Structures

Sets. Sequences and functions, Elementary logic. Propositional calculus, Methods of Proof, Mathematical induction, recurrence relation, loop invariants. Relations. Equivalence of Relations and Partitions. Partially ordered sets. Properties of General Relations, Introduction to combinatorics. Basic counting techniques. Elementary Probability, Inclusion-exclusion principle and binomial methods. Counting and partitions. Pigeon hole principle. Algebraic structures; groups and semi-groups.

Introduction to Computer Programming

Programming and problem analysis. Development of basic algorithms. Translation of algorithms into programs. Standard Data Types. Basic control structures. Functions. Structured data types; Arrays, Structures, Pointers and Files. Debugging and testing programmes.

Data Structures

Basic data structures. Static and dynamic data structures. Abstraction and Abstract Data Types (ADT's). Time and space requirements of various implementations of ADTs. Space/Time trade-Offs. Queues, stacks, trees and graphs. Implementations of tree and graph traversals. Height balanced trees. Heaps. Storage management. Hashing techniques.

Automata Theory

Regular languages, regular grammars, finite-state automate, transducers and relationships among them. Context-tree languages and grammars. Language recognition, parsers. Properties of formal languages. Turing computability and undesirability.

Compiler Construction

Compiler techniques and methodology. Organization of compilers. Lexical and syntax analysis. Parsing techniques. Object code generation and optimization, detection and recovery from errors. Contrast between compilers and interpreters.

Digital logic design

Fundamental of Boolean Algebra. Minimization techniques: algebraic, K-maps, QM methods, etc. Combinational logic circuits with MSI and LSI. Adders, Comparators, Encoders and decoders, multiplexers and demultiplexers, ROM and PLA and PAL implementation. Sequential logic circuits: flip flops, registers, counters, memory timing sequences. Moore and Mealy machine concepts.

Computer Organization and Assembly Language Programming

Computer organization. Data and instruction representation. ASCII code Assembler directives versus machine instructions. Keyboard input and screen output. Instruction formats and types. Conversion between ASCII strings and binary numbers. Stack operations. Debugging. Interrupts, Macros. Video output, Disk I/O.

Software Engineering-I

Software development life-cycles and models, System specification, Project control and development of team structures, Software Analysis and Design, Structured Analysis, Functional and object-oriented design, Programming, testing and debugging, validation, maintenance and modifications, Software development tools. Software quality. Process models. Report writing, Introduction to Case Tools.

Operating System Concepts

History and evolution of operating systems. Types of operating systems. Case histories of significant operating systems. Processes, inter-process communication, process co-ordination and synchronisation. Process scheduling. Memory management. File systems. Security and protection. Case operating systems.

Software Engineering-II

Software verification and validation: Techniques are introduced to evaluate software correctness, efficiency, performance and reliability, integration of these techniques into a verification and validation plan. Technical reviews, software testing, program verification, prototyping, and requirement tracing. Attitude of industry toward reliability and performance.

Software Project Management

Software Project management: Manage the development of software products, software estimation, planning, monitoring and controlling, metrics and measurement, process maturity, quality assurance, Software quality standards, human factors in people management, leadership and team building.

Introduction to Computer Architecture

Fundamental of Boolean Algebra. Minimization techniques: algebraic, K-maps, QM methods, etc. Combinational logic circuits with MSI and LSI. Adders, Comparators, Encoders and decoders, multiplexers and demultiplexers, ROM and PLA and PAL implementation. Computer organization: Control unit design, Instruction execution and sequencing of control signals. Hardwired and Micro programmed control. Arithmetic logic unit implementation. Memory organization, memory hierarchy,

cache memories - mapping functions and page replacement policies, memory management requirements and virtual memory hardware support.

Computer Architecture

Computer organization: Control unit design, Instruction execution and sequencing of control signals. Hardwired and Micro programmed control. Input-output – Programmed, Interrupt driven and DMA I/O and interface design. Arithmetic logic unit implementation, addition, subtraction, multiplication and division operations for Integer and Floating point numbers. Memory organization, memory hierarchy, cache memories - mapping functions and page replacement policies, memory management requirements and virtual memory hardware support. Fundamentals of computer communications and error control.

Object Oriented Programming

Introduction to Object Oriented Programming. Objects, Classes and inheritance. The concept of Encapsulation, Polymorphism. Early and late binding. Operator overloading and function overloading. Constructors and Destructors. Friend functions. In-line functions. Virtual functions. Class libraries. Object-oriented software development.

Data Communication

Time and frequency domain concepts, Fourier Transform. Introduction to Analogy and digital signals. A/D conversion, Nyquist sampling and quantization. Introduction to modulation and demodulation. Amplitude modulation, frequency modulation and phase modulation. ON-OFF keying, FSK and PSK. Binary codes for transmission (NRZ, RZ, HDB3, Manchester code), delta modulation. Serial and parallel communication, RS232. Modems.

Telecommunication Systems

Introduction to media, bandwidth and noise. Twisted pair (UTP, STP), coaxial cables (types and specifications), optical fibers (types and losses), Introduction to optical sources and detectors.

Microwave links, satellite communication and infrared links. Frequency Division Multiplexing (FDM), TDM, FDMA, TDMA and CDMA. Switching: circuit and packet switching. Introduction to mobile and cellular communications. Block diagram and current trends.

Numerical Analysis

Mathematical Preliminaries, Solution of Equations in one variable, Interpolation and Polynomial Approximation, Numerical Differentiation and Integration, Initial Value Problems for Ordinary Differential Equations, Direct Methods for Solving Linear Systems, Iterative Techniques in Matrix Algebra, Solution of non-linear equations. Approximation Theory. Eigenvalues and Eigenvector computation.

Artificial Intelligence

Introduction to Common Lisp. AI classical systems: General Problem Solver, rules, simple search, means-ends analysis. ELIZA, pattern matching, rule based translators, OPS-5. Knowledge Representation: Natural language, rules, productions, predicate logic, semantic networks, frames, objects, scripts. Search: Depth first search, breadth first search, best first search, hill climbing, min-max search, A* search. Symbolic Mathematics: student, solving algebra problems, translating English equations, solving algebraic equations, simplification rules, re-write rules, meta-rules, Macsyma, PRESS, ATLAS. Logic Programming: Resolution, unification, horn-clause logic, Prolog, Prolog programming. Sample case studies of shells and Knowledge Based Systems.

Computer Graphics

Graphics hardware. Fundamental algorithms. Applications of graphics. Interactive graphics programming - graph plotting, windows and clipping, and segmentation. Programming raster display systems, panning and zooming. Raster algorithms and software - Scan-Converting lines, characters and circles. Region filling and clipping. Two and three dimensional imaging geometry and transformations. Curve and surface design, rendering, shading, colour, and animation.

Data base systems

Basic database concepts. Conceptual modelling. Hierarchical, Network and Relational data models. Relational theory and languages. Database Design. Database security and integrity. Query languages: Relational Calculus, Relational Algebra, SQL. Introduction to query processing and optimization. Introduction to concurrency and recovery. Front- end and Back-end Databases.

Computer Networks

Introduction to Computer Networks, network requirements and layered architectures. ISO reference model. Data encoding/framing, error detection and correction, DLL protocols (stop wait & sliding windows), Ethernet and FDDI. Network layer and WANs, IP and routing, cell switching and ATM, bridges, internetworking – the global internet. End to End Protocols, UDP, TCP, and RPC. Application layer, security, the domain name system (DNS), and the WWW protocols.

Network Management

Introduction, Overview of Network operating system, Setting up a network server, Setting up network clients, Network design issues, Network client administration, Workgroup and Domain concepts. System Administration Basics, Network Services, Monitoring and logging of various operating system events, security applications and general system events, Monitoring wide variety of system objects, Diagnosing and Troubleshooting hardware, networking and various operating system services, System configuration including screen display, network services, bindings, protocols, servers, services and system devices, User and group management and services used to manage user access to resources, Remote administration, Management of key processes, Network services administration including e-mail, internet, web and ftp, Heterogeneous network environment, Firewall administration, Controlling access to the machines.

Distributed Database Systems

Advanced data models. Conceptual Database design. Concurrency control techniques. Recovery techniques. Query

processing and optimization. Integrity and security. Client-Server architecture. Distributed database systems. Current trends in database systems. Database machines.

Analysis of Algorithms

Advanced algorithms analysis and design techniques. Graph algorithm analysis, algebraic algorithms, NP-completeness, probabilistic and parallel algorithms, intractable problems.

Visual Programming

Introduction to Windows programming, Use of Windows API, MFC Class hierarchy, Class Wizard, Application Wizard and Application Studio, Graphics Device Interface, Menus, document view architecture, Multiple Views, files and achieving mechanisms, converting Windows programs to MFC, Sub-classing controls.

Systems Programming

System Programming overview : Application Vs System Programming, System Software, Operating system, Device Drivers, OS Calls. Window System Programming for Intel386 Architecture: 16 bit Vs 32 bit, Programming, 32 bit Flat memory model , Windows Architecture. Virtual Machine (VM)Basics, System Virtual Machine, Portable Executable Format, Ring O Computer, Linear Executable format, Virtual Device Driver (V + D), New Executable format, Module Management, COFF obi format 16 bit. (Unix) other 32-bit O.S Programming for I 386; Unix Binaryble format (ELF), Dynamic shared objects, Unix Kernel Programming (Ring O), Unix Device Architecture (Character & Block Devices), Device Driver Development, Enhancing Unix Kernel.

Multimedia Technologies

Introduction to Multimedia Programming, Scope of Multimedia Programming, convention and trends, Media types used in current applications (including digital video, audio, and graphics). System level issues of performance synchronization, storage and server schemes, dynamic interactivity, hyper linking, multimedia device control, distributed media development and delivery, non-

standard media and programming frame works. Introduction to Multi-media Networks.

Web Programming

Overview of Protocols:TCP/IP, HTTP, Overview of 3-tier Architecture, Web Based Applications Architecture. Developing Front End Applications : Front End Development Tools, HTML, DHTML, Scripting (Java Script, Jscript, Vbscript), Java Applets, ActiveX.

Modern Programming Languages

Developing Back End Applications: Java Servlets, CGI/Perl Programming, Cold Fusion, Gateway Interface. Database Connectivity: DBC, ODBC. Performance & Security Issues: E-Commerce Application Security, Presentations, Projects.

Theory of Computation

Models of computations: partial recursive functions, Turing machines, alternative models of computing. Basic theory and limitations of computability. Undesirability. Resource-bounded computational complexity, non-determinism, NP-completeness

Theory of Programming Languages

Theory and practice of programming language translation. Languages, grammars and parsing. Lexical, syntactic and semantic analysis. Compile- time error handling. Code optimisation and code generation. Organisation of programming languages including language processors, syntax data types, sequence control, storage management. Comparison of language features from the functional, imperative, logical, and object-oriented paradigms.

Advanced Computer Architecture

Complex instruction set architectures, CISC and RISC Processor implementation, memory hierarchy, pipe-lining, Programming of high-performance supercomputers. Hardware, algorithms, numerical accuracy, compilers. Vector, multiple-instruction multiple-data-stream, and single-instruction single-data- stream machines. Benchmarking techniques. new developments related

to single CPU systems.

Advanced Operating Systems

Parallel and distributed operating systems. Load sharing, scheduling, reliability, recovery, memory management. Distributed file systems, distributed agreement, and object-oriented operating systems.

Advanced Computer Networks

Multi-access Communications, Introduction to Layered Network Architecture, Inter Networking, Advanced Topics in flow Control, Congestion Control and rooting, Protocol Performances in Lan and Wan Environment, Network Privacy and Security.

Advanced Software Engineering

System Development using Formal Techniques, Algebraic specification, Abstract model specification, Verification: Proof Systems, Proof Techniques, Proof obligations, Design: Data refinement, operation refinement, Design decomposition. Software Reliability and Metrics. Macro models: productivity, effort. Defect models: Software reliability, Failures and fault, Software reliability modelling. Simple model, Markove modelling, Parameter estimation, Comparison of models.

Supporting Courses

Calculus and Analytic Geometry

Complex Numbers, DeMoivre's Theorem and its Applications, Simple Cartesian Curves, Functions and Graphs, Symmetrical Properties, Curve Tracing, Limit and Continuity, Differentiation of Functions. Derivative as Slope of Tangent to a Curve and as Rate of Change, Application to Tangent and Normal, Linearization, Maxima/Minima and Point of Inflexion, Taylor and Maclaurin Expansions and their convergence. Integral as

Antiderivative, Indefinite Integration of Simple Functions. Methods of Integration: Integration by Substitution, by Parts, and by Partial Fractions, Definite Integral as Limit of a Sum, Application to Area, Arc Length, Volume and Surface of Revolution

Differential Equations

Ordinary Differential Equations of the First Order: Geometrical Considerations, Isoclines, Separable Equations, Equations Reducible to Separable Form, Exact Differential Equations, Integrating Factors, Linear First-Order Differential Equations, Variation of Parameters. Ordinary Linear Differential Equations; Homogeneous Linear Equations of the Second Order, Homogeneous Second-Order Equations with Constant Coefficients, General Solution, Real Roots, Complex Roots, Double Root of the Characteristic Equation, Differential Operators, Cauchy Equation, Homogeneous Linear Equations of Arbitrary Order, Homogeneous Linear Equations of Arbitrary Order with Constant Coefficients, No homogeneous Linear Equations. Modelling of Electrical Circuits. Systems of Differential Equations. Series Solutions of Differential Equations.
Partial Differential Equations: Method of Separation of variables, wave, Heat & lap lace equations and their solutions by Fourier series method.

Multivariable Calculus

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. Lap lace Transform, Z-Transform.

Linear Algebra

Vectors, Vector Spaces, Matirces & Determinants, Linear Transformations, Operations on matrices, Inner products, Eigenvalues & Eigenvectors. Applications to Systems of Equations and to Geometry

Statistics and Probability

Introduction to Statistics, Descriptive Statistics, Statistics in decision making, Graphical representation of Data Stem-and Lead plot, Box-Cox plots, Histograms and Ogive, measures of central tendencies, dispersion for grouped and ungrouped Data, Moments of frequency distribution; examples with real life, use of Elementary statistical packages for explanatory Data analysis. Counting techniques, definition of probability with classical and relative frequency and subjective approaches, sample space, events, laws of probability. Conditional probability and Bayes theorem with application to Random variable (Discrete and continuous) Binomial, Poisson, Geometric, Negative Binomial Distributions; Exponential Gamma and Normal distributions.

Circuit Theory

Ohm's law, Kirchoff`s laws, loop and node equations, Cramer`s rule, Network theorems. Introduction to materials (Conductor, Semiconductor, Insulator). Band theory of solids. Types of diode and its applications (Half wave, Full wave rectifier, Clipper, clamper and etc.). Introduction to Transistor. Different configurations of transistors (Common Emitter, Common Collector, Common Base).

Electronic

Amplifiers: Low frequency basic amplifiers using BJTs and FETs, biasing of single and multistage circuits. Linear analysis and frequency response of single and multistage amplifier circuits, feedback amplifiers. Class A, B, AB large signal amplifiers, thermal considerations. Small signal analysis. Low voltage Amplifier. Oscillators: Low frequency Oscillator, High frequency Oscillator. 555 timer and its application. Op - amplifier and its application.

Financial Accounting

Introduction to Accounting and its concepts. Recording Business Transactions: Journal, Ledger, Trial Balance. Preparation of Financial Statements: Balance Sheet, Income Statement, Completion of Accounting Cycle: Adjustments, Closing, Work Sheet Accounting for purchase and sales of merchandise. Receivable and payable, Inventories, Payroll Systems. Plant and

Equipment: Acquisition, Depreciation, Disposal. Corporations: Organization and stock-holders equity, Operations, Earning per share and dividends.

Financial Management

Introduction to Financial Management, Concepts and Models in Valuation, The time value of money, Fundamentals of risk and portfolio analysis, Valuation of stocks and bonds, The capital Asset Pricing Model, the Arbitrage Pricing Model and other valuation models. The Cost of Capital: Capital structure and Dividend Policy, The cost of capital, Capital structure theory, Capital structure policy and optimal capital structure, Internal financing and dividends policy Capital Budgeting: The basis of capital budgeting, The determination and use of cash flow, Mutually exclusive investments and capital rationing, Annual equivalent cost and replacement decisions, Risk analysis and the optimal capital budget, Islamic guidelines for financial management: The rational of prohibition of interest, Alternate capital structure, Capital Budgeting in an Interest free economy, working Capital Management in 100% equity capital structure.

Human Resource Management

An overview of Human Resource Management and Human Resource Manager. The Environment of Human Resource Management, external and Internal Environment. Equal Employment Opportunity and Affirmative Action. Job Analysis: A Basic Human Resource Tool. Human Resource Planning, Recruitment, and Selection. Organization Change and Human Resource Development . Corporate Culture and Organization Development. Career Planning Development. Performance Appraisal.

Organizational Behavior

Fundamentals of Organizational Behaviour, Behavioural Science and Organizational Behaviour, Individual Behaviour in Organizations, Personality, perception and attitudes, Learning and reinforcement, Motivation, Group Behaviour in Organizations, Group dimensions in organizations, Group dynamics, Leadership, Organizational Structure and

Organizational Behaviour, Organizational design, Job design, Stress and work, Organizational Processes, The decision-making process, The communication process, Performance appraisal process, Special Issues in Organizational Behaviour, Management of conflict and change, Organizational development, Impact of computer technology.

Technical and Business Writing

Writing technical reports, research reports, research papers, and memos. Drafting, revising, and editing compositions derived from science and technology to develop skills in narration, persuasion, analysis, and documentation.