

**CURRICULUM
OF
TELECOMMUNICATION SYSTEMS
BS/MS**

(Revised 2014)



**HIGHER EDUCATION COMMISSION
ISLAMABAD**

CURRICULUM DIVISION, HEC

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PREFACE

The curriculum, with varying definitions, is said to be a plan of the teaching-learning process that students of an academic programme are required to undergo. It includes objectives and learning outcomes, course contents, scheme of studies, teaching methodologies and methods of assessment of learning. Since knowledge in all disciplines and fields is expanding at a fast pace and new disciplines are also emerging; it is imperative that curricula be developed and revised accordingly.

University Grants Commission (UGC) was designated as the competent authority to develop, review and revise curricula beyond Class-XII vide Section 3, Sub-Section 2 (ii), Act of Parliament No. X of 1976 titled “**Supervision of Curricula and Textbooks and Maintenance of Standard of Education**”. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission (HEC) under its Ordinance of 2002, Section 10, Sub-Section 1 (v).

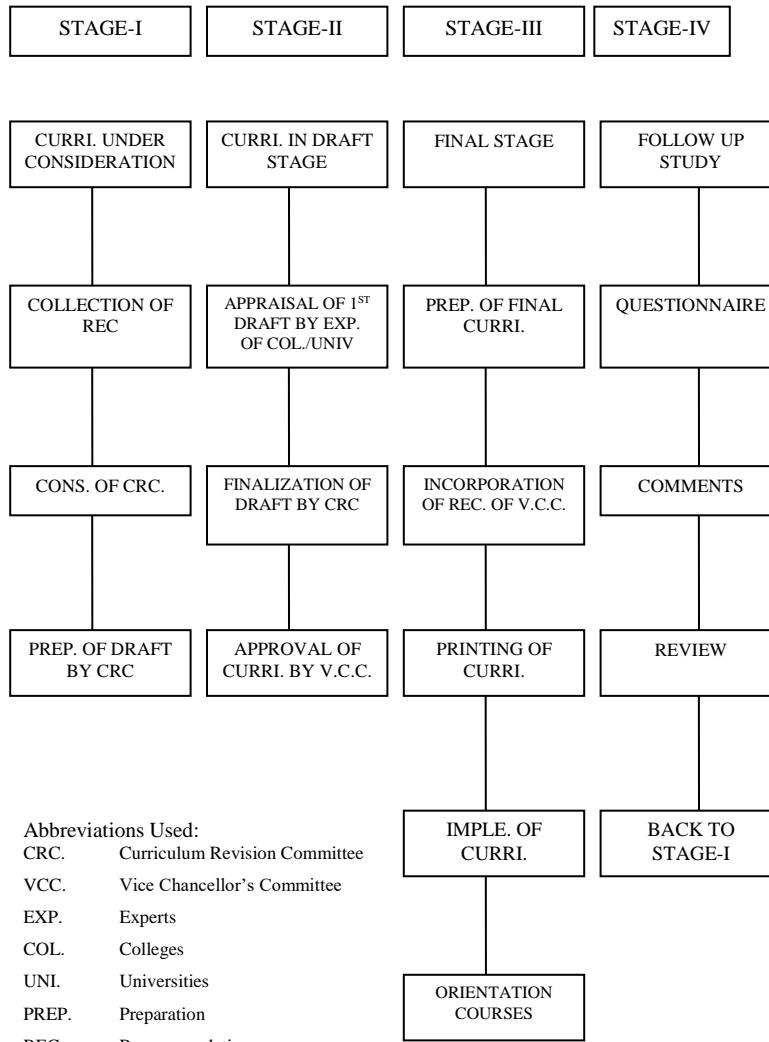
In compliance with the above provisions, the Curriculum Division of HEC undertakes the revision of curricula after every three years through respective National Curriculum Revision Committees (NCRCs) which consist of eminent professors and researchers of relevant fields from public and private sector universities, R&D organizations, councils, industry and civil society by seeking nominations from their organizations.

In order to impart quality education which is at par with international standards, HEC NCRCs have developed unified templates as guidelines for the development and revision of curricula in the disciplines of Basic Sciences, Applied Sciences, Social Sciences, Agriculture and Engineering in 2007 and 2009.

It is hoped that this curriculum document, prepared by the respective NCRC’s, would serve the purpose of meeting our national, social and economic needs, and it would also provide the level of competency specified in Pakistan Qualification Framework to make it compatible with international educational standards. The curriculum is also placed on the website of HEC (www.hec.gov.pk).

(Fida Hussain)
Director General (Academics)

CURRICULUM DEVELOPMENT PROCESS



INTRODUCTION

The final meeting of NCRC on Telecommunication Systems was held at HEC Regional Center, Peshawar from March 03 - 05, 2014 to finalize the draft curriculum of Telecommunication Systems at BS level. The first meeting on drafting the curriculum was held at the HEC Islamabad from September 02-04, 2013.

The meeting was attended by the following members:

1. **Prof. Dr. Muhammad Saleem Sheikh,**
Professor of Physics & Telecommunication,
Department of Electronics & Telecommunication,
Preston University, Islamabad. Convener
2. **Dr. Rashid Hussain,**
Associate Professor / Deputy Director,
Faculty of Engineering Science and Technology,
Department of Telecommunication Engineering,
Hamdard University, Madinat-al-Hikmah,
Muhammad Bin Qasim Avenue, Karachi. Secretary/
Member
3. **Dr. Qadeer Hasan,**
Principal Engineer,
Department of Electrical Engineering,
COMSATS Institute of Information Technology,
Islamabad. Member
4. **Engr. Muhammad Nadeem Iqbal,**
Associate Chairman,
Department of Telecommunication Engineering,
Sir Syed University of Engineering and
Technology, University Road, Karachi. Member
5. **Dr. Irfan Ahmed,**
Associate Professor,
Department of Electronic,
NED University of Engineering & Technology,
Karachi. Member
6. **Dr. Shahbaz Khan,**
Chairman,
Department of Telecommunication Engineering,
University of Engineering and Technology,
Peshawar, Mardan Campus. Member
7. **Dr. Asfandiyar Khan,**
Assistant Professor,
Chairman, Telecommunication Systems,
Institute of Engineering & Computing Science (IECS),
University of Science & Technology, Bannu. Member

8. **Dr. Bilal Shams,**
Assistant Professor,
Institute of Information Technology,
Kohat University of Science & Technology, Kohat. Member

The following members attended the preliminary meeting but unable to participate in the final meeting:

1. **Engr. Muhammad Afzal**
Associate Professor / Chairman,
Department of Electrical Engineering,
G.C. University, Faisalabad Member
2. **Dr. Faisal Karim Shaikh**
Associate Professor,
Department of Telecommunication Engineering,
Mehran University of Engg. & Technology,
Jamshoro. Member
3. **Prof. Dr. Qamarul Islam,**
Professor & HOD,
Department of Electrical Engineering,
Institute of Space Technology, Islamabad. Member
4. **Dr. Imran Rashid,**
Assistant Professor,
Department of Electrical Engineering,
Military College of Signals (NUST),
Humayun Road, Rawalpindi. Member
5. **Dr. Aftab Ahmed Memon,**
Professor & Chairman,
Department of Telecommunication Engineering,
Mehran University of Engg. & Technology,
Jamshoro. Member
6. **Dr. Syed Husnain A. Naqvi,**
Assistant Professor,
Department of Computer Science,
International Islamic University, Islamabad. Member

The Committee worked on suggestions given by the members of the Committee and incorporated their suggestions, where necessary in the final draft of BS & MS (Telecommunication System). Latest books were readily added through use of HEC internet facility. The committee also visited Sarhad University of Science & Information Technology and the University of Engineering & Technology, Peshawar. During the visits the committee exchanged their views with the management and faculty members regarding the process of curriculum development and its intended implementation.

The Committee also discussed and finalized scheme of study for MS in Telecommunication Systems.

Recommendations:

The purpose of this curriculum is to provide a uniform guideline to universities and institutions in Pakistan while developing their curriculum with an effort to have uniformity of standards in their programs.

- It is suggested that the credit hours for the proposed program should remain within the limits of 124 – 136 for BS in Telecommunication Systems.
- Higher Education Commission should support the institutions for the development of laboratories for Telecommunication Systems.
- The committee recommends that the intended candidates for this program must have sufficient background in **Physics** and **Mathematics** to perform well.

Mr. Riaz-ul-Haque, Assistant Director Curriculum, HEC, thanked the Convener and all the members of the committee for sparing their precious time and for their quality contribution towards finalization of the preliminary draft curriculum in the discipline of Telecommunication Systems. The committee appreciated the efforts made by Mr. Riaz-ul-Haque, for his facilitation, coordination and cooperation.

The committee lauded the efforts by Mr. Zaheer Ahmed Awan, Director HEC RC Peshawar for providing excellent facilities and warm hospitality. The meeting ended with vote of thanks to and from the chair.

PROGRAMME MISSION STATEMENT

Programme Title: BS Telecommunication Systems

The program is designed in accordance with the HEC stipulated Semester credit hour requirement and also takes into consideration the Quality Assurance aspect in curriculum development.

Mission Statement

To produce quality professionals with abilities to manage and operate telecommunication systems

PROGRAMME GRADUATE SKILLS (PGS)

The graduate of this program will be equipped with the following skills to demonstrate an understanding of key technologies applicable within the main areas of Telecommunications:

- (a) Basic knowledge of Telecommunications Public and private Network infrastructure, both land based and cellular in terms of architecture, operations, protocols and traffic planning.
- (b) Basic knowledge of Telecommunications standards, standard setting bodies and regulations.
- (c) Basic knowledge of support techniques, technologies and systems.
- (d) Abilities to systematically evaluate situations to cope with change and provide optimal solutions for particular applications.
- (e) Expertise in Telecommunication Business and market operations.
- (f) Ability to work effectively in real world Telecommunications setting, demonstrating team work and leadership skills.

Curriculum Review Basis – Undergraduate Degrees

The curriculum for the undergraduate BS degree programme is based on the following considerations:

Duration

Total duration:	Four (4) years
Total number of semesters:	Eight (8)
Duration of a semester:	Sixteen (16) – Eighteen (18)
weeks	Sixteen (16) weeks of instruction One (1) to two (2) weeks for examinations

Credit Hours

Total number of credit hours:	128 to 136
Contact hours:	One (1) contact hour per week for each credit hour of instruction Three (3) contact hours per week for each credit hour of laboratory work

Course Load

Course Load per Semester:	15-18 Credit Hours
Number of Courses per Semester: (courses)	4-6 (not more than 3 lab/practical courses)

CATEGORY-WISE FRAMEWORK BS IN TELECOMMUNICATION SYSTEMS

Duration:	4 years
Number of semesters:	8
Number of weeks per semester:	16-18 (16 weeks for instruction and 2 weeks for examination)
Total number of Credit Hours (CH):	128 to 136
Number of Credit Hours (CH) per semester:	15-18
Contact hours:	One (1) contact hour per week for each credit hour of instruction
	Three (3) contact hours per week for each credit hour of laboratory work

Category-based distribution of the courses:

Compulsory	:	21.37%
General Education	:	14.5%
Foundations	:	25.19%
Major	:	29.78%
Electives	:	9.16%

Category wise Framework for BS in Telecommunication Systems

Category	Course Title	LEC	CH	TOTAL CH	Pgs Of Each Course (Quality Check)	NCRC Proposal for Each Category			HEC Specifications for Each Category		
						Courses	CH	%age	Courses	CH	%age
Compulsory (by HEC)	Eng-I, English Composition and Comprehension	3	0	3	F	10	28	21.37 %	9	25	18.80 %
	Eng-II, Communication Skills	3	0	3	F						
	Islamic Studies/Ethics	2	0	2	F						
	Pakistan Studies	2	0	2	F						
	Calculus I	3	0	3	C						
	Linear Algebra	3	0	3	C						
	Calculus II	3	0	3	C						
	Probability & Statistics	3	0	3	C, D						
Introduction to Computing	2	1	3	C							
	Complex Variables and Transforms	3	0	3	C, D						
General Education	Applied Physics	3	1	4	C	6	19	14.50 %	8	21	15.79 %
	Object Oriented Programming	3	1	4	C						
	Organizational Behavior	3	0	3	E						
	Introduction to Business and Marketing	3	0	3	E						
	Eng-III, Technical Report Writing	2	0	2	F						
	Professional Ethics	3	0	3	E						
Foundation	Electric Circuits I	3	1	4	C	9	33	25.19 %	10	33	24.81 %
	Electronic Devices & Circuits	3	1	4	C						
	Digital Logic Design	3	1	4	C						
	Signals and Systems	3	1	4	C						
	Microcontrollers & Embedded Systems	3	1	4	A, C						

Category	Course Title	LEC	CH	TOTAL CH	Pgs Of Each Course (Quality Check)	NCRC Proposal for Each Category			HEC Specifications for Each Category		
						Courses	CH	%age	Courses	CH	%age
	Data Communications and Networking	3	1	4	A, C						
	Telecommunication Systems	3	0	3	A						
	Electric Circuit II	3	0	3	A,C						
	Electromagnetic Theory	3	0	3	A, C						
Major	Project Management	3	0	3	E, F	13	39	29.78 %	13	42	31.58 %
	Analogue & Digital Communications Systems	3	0/1	3/4	A, C						
	Antenna and Wave Propagation	3	0	3	A, C						
	Telecommunication Policies and Regulations	3	0	3	B						
	Economics	3	0	3	D, E						
	e-Business Management	3	0	3	D, E						
	Wireless and Mobile Communications	3	0	3	A, C						
	Optical Fiber Communication	3	0/1	3/4	A,B						
	Telecom Network Management	3	0	3	A, B, E						
	Transmission and Switching Systems	3	0	3	A, D						
	Information and Network Security	3	0	3	A,C						
	Project Part-I	3	0	3	A, E, F						
	Project Part-II	3	0	3	A, E, F						
Technical Electives	Technical Elective-I	3	0	3	All	4	12	9.16%	4	12	9.02%
	Technical Elective-II	3	0	3	All						
	Technical Elective-III	3	0	3	All						
	Technical Elective-IV	3	0	3	All						

Category	Course Title	LEC CH	TOTAL CH	Pgs Of Each Course (Quality Check)	NCRC Proposal for Each Category			HEC Specifications for Each Category		
					Courses	CH	%age	Courses	CH	%age
Program Total					42	131	100%	133	44	100%

AREA-WISE FRAMEWORK BS in Telecommunication Systems

Duration: 4 years
Number of semesters: 8
Number of weeks per semester: 16-18 (16 weeks for instruction and 2 weeks for examination)

Total number of Credit Hours (CH): 128-136
Number of Credit Hours (CH): 15-18
per semester
Contact hours: One (1) contact hour per week for each credit hour of instruction. Three (3) contact hours per week for each credit hour of laboratory work

Area-based distribution of the courses:

Humanities and Natural Sciences : 25.95%
Management Sciences : 16.04%
Technological Subjects and Project : 58.01%

Area-Wise Framework for BS in Telecommunication Systems

Main Area	Knowledge Area	Sub Area	Course Title	Lec CH	Lab CH	Total CH	Total Courses of Sub-Area	Total CH of Sub-Area	Total Courses of Main Area	Total CH of Main Area
Humanities and Natural Sciences	Humanities	English	Eng-I, English Composition and Comprehension	3	0	3	3	8	12	34 (25.95%)
			Eng-II, Communication Skills	3	0	3				
			Eng-III, Technical Report Writing	2	0	2				
		Cultural & Social Sciences	Islamic Studies/Ethics	2	0	2	3	7		
			Pakistan Studies	2	0	2				
			Professional Ethics	3	0	3				
	Natural Sciences	Mathematics	Calculus I	3	0	3	5	15		
			Calculus II	3	0	3				
			Linear Algebra	3	0	3				
			Complex Variables and Transforms	3	0	3				
			Probability & Statistics	3	0	3				
		Physics	Applied Physics	3	1	4	1	4		
	Management Sciences	Management (General)	Organizational Behavior	3	0	3	3	9		
			Economics	3	0	3				
			Introduction to Business and Marketing	3	0	3				
Management (Major)		Project Management	3	0	3	4	12			
		e-Business Management	3	0	3					
Technology-based Management Courses (Major)		Telecom Network Management	3	0	3	3	3			
		Telecommunication Policies and Regulations	3	0	3					

Main Area	Knowledge Area	Sub Area	Course Title	Lec CH	Lab CH	Total CH	Total Courses of Sub-Area	Total CH of Sub-Area	Total Courses of Main Area	Total CH of Main Area
Technological Subjects Area	Computing	Fundamentals	Introduction to Computing	3	0	3	2	7	23	76
		Programming & Applications	Object Oriented Programming	3	1	4				
	Technical	Technical (Foundation)	Electric Circuits I	3	1	4	9	33		
			Electric Circuits II	3	0	3				
			Electronic Devices & Circuits	3	1	4				
			Digital Logic Design	3	1	4				
			Signals and Systems	3	1	4				
			Microcontrollers & Embedded Systems	3	1	4				
			Data Communications and Networking	3	1	4				
			Telecommunication Systems	3	0	3				
			Electromagnetic Theory	3	0	3				
			Technical (Major)	Analog & Digital Communications Systems	3	0/1				
		Transmission and Switching Systems		3	0	3				
		Antenna and Wave Propagation		3	0	3				
		Optical Fiber Communication		3	0/1	3/4				
		Information and Network Security		3	0	3				
		Wireless and Mobile Communications		3	0	3				
		Technical Elective-I		3	0	3				
		Technical Elective-II		3	0	3				
		Technical	3	0	3					

Main Area	Knowledge Area	Sub Area	Course Title	Lec CH	Lab CH	Total CH	Total Courses of Sub-Area	Total CH of Sub-Area	Total Courses of Main Area	Total CH of Main Area
	Project (Final)	--	Elective-III							
			Technical Elective-IV	3	0	3				
			Project Part-I	3	0	3	2	6		
			Project Part-II	3	0	3				
Program Total									42	131

Scheme of Studies for BS in Telecommunication Systems

Semester	Course Title	Lec CH	Lab CH	Total CH	Total of Each Semester			
					Number of Courses	Lec CH	Lab CH	Total CH
Semester I	Eng-I, English Composition and Comprehension	3	0	3	5	14	3	17
	Introduction to Computing	2	1	3				
	Calculus I	3	0	3				
	Applied Physics	3	1	4				
	Electric Circuits I	3	1	4				
Semester II	Eng-II, Communication Skills	3	0	3	6	16	2	18
	Calculus II	3	0	3				
	Islamic Studies/Ethics	2	0	2				
	Pakistan Studies	2	0	2				
	Object Oriented Programming	3	1	4				
	Electronic Devices & Circuits	3	1	4				
Semester III	Digital Logic Design	3	1	4	5	15	2	17
	Data Communications and Networking	3	1	4				
	Linear Algebra	3	0	3				
	Professional Ethics	3	0	3				
	Electric Circuits II	3	0	3				
Semester IV	Eng-III, Technical Report Writing	2	0	2	5	14	1	15
	Organizational Behavior	3	0	3				
	Telecommunication Systems	3	0	3				
	Signals and Systems	3	1	4				
	Complex Variables and Transforms	3	0	3				
Semester V	Probability & Statistics	3	0	3	6	18	0	18
	Electromagnetic Theory	3	0	3				
	Information and Network Security	3	0	3				
	Economics	3	0	3				
	Introduction to Business and Marketing	3	0	3				
	Analog & Digital Communications Systems	3	0/1	3/4				
Semester VI	Antenna and Wave Propagation	3	0	3	5	15	1	16
	Transmission and Switching Systems	3	0	3				
	Telecommunication Policies and Regulations	3	0	3				

Semester	Course Title	Lec CH	Lab CH	Total CH	Total of Each Semester			
					Number of Courses	Lec CH	Lab CH	Total CH
	Microcontrollers & Embedded Systems	3	1	4				
	e-Business Management	3	0	3				
Semester VII	Wireless and Mobile Communications	3	0	3	5	15	0	15
	Telecommunication Network Management	3	0	3				
	Technical Elective-I	3	0	3				
	Technical Elective-II	3	0	3				
	Project Part-I	3	0	3				
Semester VIII	Project Management	3	0	3	5	15	0	15
	Optical Fiber Communication	3	0/1	3				
	Technical Elective-III	3	0	3				
	Technical Elective-IV	3	0	3				
	Project Part-II	3	0	3				
Program Total					42	122	9	131

List of Major-based Depth Electives

1. Ubiquitous Computing
2. Information Theory and Coding
3. Broadband Networks
4. Cyber Policies and Regulations
5. Software Define Radios
6. Mobile Operating Systems and Software Applications
7. Intelligent Networks
8. Tests & Measurements
9. Mobile and Pervasive Computing
10. Voice Over IP (VoIP)
11. Multimedia Networks
12. Satellite Communications
13. Broadcasting Systems
14. Reliability Assessment of Telecommunications Systems

DETAILS OF COMPULSORY COURSES

English Composition and Comprehension 3 + 0

Prerequisite: None

Course Outline:

- a. Grammar
- b. Writing
- c. Reading/Comprehension
- d. Speaking

Recommended Books:

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension

1. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

d) Speaking

Communication Skills 3 + 0

Prerequisite: None

Course Outline:

Paragraph writing

Practice in writing a good, unified and coherent paragraph

Essay writing

Introduction

CV and job application

Translation skills

Urdu to English

Study skills

Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills

Letter / memo writing and minutes of the meeting, use of library and internet **recourses**

Presentation skills

Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

Recommended Books:

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0194534030.
3. Reading and Study Skills by John Langan
4. 3. Study Skills by Richard Yorky.

Technical Report Writing 2+0

Prerequisite: None

Course Outline:

Presentation skills

Essay writing

Descriptive, narrative, discursive, argumentative

Academic writing

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended Books:

d) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
2. College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.
3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

e) Presentation Skills

Any available software

f) Reading

1. The Mercury Reader. A Custom Publication. Compiled by northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharon. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

Introduction to Computing 2+1

Prerequisite: None

Course Outline:

Introduction of basic components such as CPU, memory, peripheral devices, storage media and devices, physical and logical storage, data organization and file storage. Introduction to system software, and application software. Programming fundamentals, compilation and interpretation, problem specification, algorithms, flow chart, pseudo code, basic programming techniques, data types and declaration, header file and linkage, variables and constants, arrays, input/output, termination, remark, control structures, branching, conditional structures, repetition and loops, basic library functions.

Lab Outline:

Consistent with the course outline.

Recommended Books:

1. Brian Williams and Stacey Sawyer, Using Information Technology, Latest Edition, McGraw-Hill, ISBN: 0072260718
2. Robert Lafore "Thinking in C" Latest Edition

Pakistan Studies 2 + 0

Prerequisite: None

Course Outline:

1. Historical Perspective
 - a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
 - b. Factors leading to Muslim Separatism
 - c. People and Land
 - i. Indus Civilization
 - ii. Muslim advent
 - iii. Location and Geo-Physical features.
2. Government and Politics in Pakistan

Political and constitutional phases:

- a. 1947-58
- b. 1958-71
- c. 1971-77
- d. 1977-88
- e. 1988-99
- f. 1999 onward

3. Contemporary Pakistan

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1. Economic institutions and issues
2. Society and social structure
3. Ethnicity
4. Foreign policy of Pakistan and challenges
5. Futuristic outlook of Pakistan

Recommended Books:

1. Burki, Shahid Javed. State & Society in Pakistan, the Macmillan Press Ltd. 1980.
2. Akbar, S. Zaidi. Issue in Pakistan's Economy. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: A Historical analysis. Karachi: Oxford University Press, 1993.

4. Mehmood, Safdar. Pakistan Political Roots & Development. Lahore, 1994.
5. Wilcox, Wayne. The Emergence of Bangladesh., Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. Ethno - National Movement in Pakistan, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. Enigma of Political Development. Kent England: Wm Dawson & sons Ltd, 1980.
9. Zahid, Ansar. History & Culture of Sindh. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. The Political System of Pakistan. Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. Party, Politics in Pakistan, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, Pakistan under Martial Law, Lahore: Vanguard, 1987.
14. Haq, Noor ul. Making of Pakistan: The Military Perspective. Islamabad:
15. National Commission on Historical and Cultural Research, 1993.

Islamic Studies 2 + 0

Prerequisite: None

Course Objective:

This course is aimed:

1. To provide Basic information about Islamic Studies
2. To enhance understanding of the students regarding Islamic Civilization
3. To improve Students skill to perform prayers and other worships
4. To enhance the skill of the students for understanding of issues related to faith and religious life.

Course Outline:

UNIT NO. 1: INTRODUCTION TO QURANIC STUDIES

1. Basic Concepts of Quran

2. History of Quran
3. Uloom-ul-Quran

UNIT No. 2: STUDY OF SELECTED TEXT OF HOLLY QURAN

1. Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
2. Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
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3. Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4. Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
5. Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)

UNIT No. 3: STUDY OF SELECTED TEXT OF HOLY QURAN

1. Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6, 21, 40, 56, 57, 58.)
2. Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3. Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

UNIT NO. 4: SEERAT OF HOLY PROPHET (S.A.W)-I

1. Life of Muhammad Bin Abdullah (Before Prophet Hood)
2. Life of Holy Prophet (S.A.W) in Makkah
3. Important Lessons Derived from the life of Holy Prophet in Makkah

UNIT NO. 5: SEERAT OF HOLY PROPHET (S.A.W)-II

1. Life of Holy Prophet (S.A.W) in Madina
2. Important Events of Life Holy Prophet in Madina
3. Important Lessons Derived from the life of Holy Prophet in **Madina**

UNIT NO. 6: INTRODUCTION TO SUNNAH

1. Basic Concepts of Hadith
2. History of Hadith
3. Kinds of Hadith
4. Uloom –ul-Hadith
5. Sunnah & Hadith
6. Legal Position of Sunnah

UNIT NO. 7: SELECTED STUDY FROM TEXT OF HADITH

UNIT NO. 8: INTRODUCTION TO ISLAMIC LAW & JURISPRUDENCE

1. Basic Concepts of Islamic Law & Jurisprudence
2. History & Importance of Islamic Law & Jurisprudence
3. Sources of Islamic Law & Jurisprudence

4. Nature of Differences in Islamic Law
5. Islam and Sectarianism

UNIT NO. 9: ISLAMIC CULTURE & CIVILIZATION

1. Basic Concepts of Islamic Culture & Civilization
2. Historical Development of Islamic Culture & Civilization
3. Characteristics of Islamic Culture & Civilization
4. Islamic Culture & Civilization and Contemporary Issues

UNIT NO. 10: ISLAM & SCIENCE

1. Basic Concepts of Islam & Science
2. Contributions of Muslims in the Development of Science
3. Quran & Science

UNIT NO. 11: ISLAMIC ECONOMIC SYSTEM

1. Basic Concepts of Islamic Economic System
2. Means of Distribution of wealth in Islamic Economics
3. Islamic Concept of Riba
4. Islamic Ways of Trade & Commerce

UNIT NO. 12: POLITICAL SYSTEM OF ISLAM

1. Basic Concepts of Islamic Political System
2. Islamic Concept of Sovereignty
3. Basic Institutions of Govt. in Islam

UNIT NO. 13: ISLAMIC HISTORY

1. Period of khlaft-e-rashida
2. Period of Ummayyads
3. Period of Abbasids

UNIT NO. 14: SOCIAL SYSTEM OF ISLAM

1. Basic concepts of social system of Islam
2. Elements of family
3. Ethical values of Islam

Recommended Books:

1. Hameed Ullah Muhammad, "Emergence of Islam", IRI, Islamabad
2. Hameed Ullah Muhammad, "Muslim conduct of state"
3. Hameed Ullah Muhammad, "Introduction to Islam"
4. Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" Leaf Publication Islamabad, Pakistan.
5. Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, international Islamic University, Islamabad (1993)

6. Mir Waliullah, "Muslim Jurisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
7. H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
8. Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

Mathematics

Calculus I 3 + 0

Prerequisite: None

Course Outline:

Introduction to functions, introduction to limit, derivatives and their applications, integral calculus with applications, vector algebra, vector calculus, introduction to analytical geometry, straight line in R^3 , planes, cylindrical and spherical coordinates, surfaces, cylinders and cones, spheres, spherical trigonometry.

Complex numbers, Demoivers theorem, analytic function, elementary function, complex integration and Cauchy's theorem, Taylor and Laurent series, conformal mapping, Fourier and Laplace transform.

Recommended Books:

1. Advance engineering mathematics by Erwin Kreyzig
2. George B. Thomas and Ross L. Finney, "Calculus and Analytic Geometry," Latest Edition, Addison-Wesley, ISBN: 0201531747.
3. George F. Simmons, "Calculus with Analytic Geometry," Latest Edition, McGraw-Hill, ISBN: 0070576424.
4. Gerald B. Folland, "Advanced Calculus," Latest Edition, Prentice Hall, ISBN: 0130652652.
5. Monty J. Strauss, Gerald L. Bradley and Karl J. Smith, "Calculus", Latest Edition, Prentice Hall, ISBN: 0130918717.

Calculus II 3+0

Prerequisite: Calculus I

Course Outline:

Introduction to three dimensional geometry. Limits, continuity and Partial Derivatives of Multivariable Function. Vectors. Directional derivative. Tangent Planes and Normal Lines to the Surfaces. Maxima And Minima of Functions of two variables. Applications of Extrema of Functions. Double Integration in rectangular and polar coordinates. Vector Valued Functions.

Integration of Exact differentials. Line integrals. Greens Theorem and its application. Divergence and Curl of a vector. Scalar Fields, Vector fields, Volume and Surface integrals. Conservative Fields. Divergence Theorem. Fourier Series. Laplace Transforms.

Recommended Books:

1. Advance engineering mathematics by Erwin Kreyzig
2. George B. Thomas and Ross L. Finney, "Calculus and Analytic Geometry," Latest Edition, Addison-Wesley, ISBN: 0201531747.
3. George F. Simmons, "Calculus with Analytic Geometry," Latest Edition, McGraw-Hill, ISBN: 0070576424.
4. Gerald B. Folland, "Advanced Calculus," Latest Edition, Prentice Hall, ISBN: 0130652652.
5. Monty J. Strauss, Gerald L. Bradley and Karl J. Smith, "Calculus", Latest Edition, Prentice Hall, ISBN: 0130918717.

Complex Variables and Transforms 3 + 0

Prerequisites: Calculus II

Course Outline:

Complex numbers and functions. Complex integration. Power series, Taylor series. Laurent series, residue integration. Introduction to Fourier Transform and series. Laplace Transform. Use of Laplace transform in solving differential equations.

Recommended Book:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley. (latest Ed.).

Linear Algebra 3 + 0

Prerequisite: Calculus I

Course Outline:

The course is divided into two somewhat related parts.

Linear algebra: matrices and matrix operations, Linear System equations, Gaussian elimination, matrix inverses, determinants, vector spaces and subspaces, dependence, dimension, eigenvalues, eigenvectors, diagonalization.

Recommended Books:

1. Introduction to Linear Algebra, 4th Edition by Gilbert Strang, published by Wellesley-Cambridge Press
2. Linear Algebra and Its Applications, 4th Edition by David C. Lay published by Pearson

Probability & Statistics 3 + 0

Prerequisite: Calculus I

Course Outline:

1. Basic concept of probability, conditional probability, independent events, Baye's formula.
2. Concept of random variables, discrete and continuous one and two dimensional random
3. Variables, probability distributions, marginal and joint distributions and density functions.
4. Important probability distributions (Binomial, Poisson, Uniform, Normal, Exponentials and Hyper-geometric). Mean, variance, moments and moment generating functions, linear regression and curve fitting. Central limit theorem, autocorrelation and cross-correlations, power spectral density functions and stochastic processes.

Recommended Books:

- J. Devore, Probability and Statistics, Latest Edition, John Wiley & Sons.
- Ronal Walpole, Probability methods for engineering and scientists, Latest Edition, McGraw-Hill.
- A. Popoulis and U, Pillai, Probability, Random Variable and Stochastic Processes, Latest Edition, McGraw-Hill, ISBN: 0071199810

General Education

Organizational Behaviour 3 + 0

Prerequisite: None

Course Outline:

- **Introduction to Organizational Behaviour**
 - Organizational Disciplines and topics
 - Psychological Perspective
 - Social-Psychological Perspectives
- **Structure and Control in Organization**
 - Introduction
 - Bureaucracy
 - Managerial Work
 - Contingency theory
 - Organizational **Design**

- **Individual and Work Learning**
 - Learning Theories
 - Learning and Work
- **Stress**
 - Types of Stress and Work
 - Occupational Stress Management
- **Individual Differences**
 - Personality and its factors
 - Personality dimensions and social learning
 - Intelligence
- **Motivation and Job Satisfaction**
 - Needs at Work
 - Theories of Motivation and job satisfaction
 - Correlates of Job satisfaction
 - Correlates of **Job satisfaction**
- **Perception**
- **Communication**
- **Group and Work**
 - Social Interaction
 - Dramaturgy and impression Management
 - Social Skill
- **Group and Inter group Behavior**
 - Group Structure & Norms
 - Group Processes & Formation
 - Hawthorne Studies
- **Leadership**
 - Leadership as an attribute
 - Leadership Style
- **Patterns of Work**
 - Work-the classical approach
 - Marx, Weber, & The critique of labor
 - Foucault & Disciplinary Power
- **Conflict and Consent in Work**
 - The labor Process debate
 - Work place control and resistance
 - Industrial conflict and industrial relations
- **Organizational culture**
 - Organizational culture and strategic management
 - Exploring organizational culture

- Evaluating concept of culture
- **Human reliability**
- **Decision Making**
 - Decision making theories
 - Decision making models
- **Power and politics**
 - Types of power
 - Gender discrimination
 - Machiavellianism

Recommended Books:

1. Finchan, R., & Rhodes, P. (2003), Principles of Organizational Behaviour, 3rd Oxford.
2. Noe, R., Hollenbeck, J. Gerhart, B., & Wright, P. (2006), Human Resource Management, 5th ed., McGraw Hill.
3. Newstrom John W. (2007), Organizational Behaviour, (12th Ed), McGraw-Hill.
4. Luthan Fred, (2005), Organizational Behaviour, McGraw-Hill Inc.
5. Robins, Stephen, (2005), Organizational Behaviour, McGraw-Hill Inc.
6. Organizational behavior: An Introductory text by Buchanan & Huczynski

Applied Physics 3 + 1

Prerequisite: None

Course Outline:

Work & Energy:

Work done by a constant force, scalar product of two vectors, work done by a varying force, kinetic energy and work energy principle,

Conservation of Energy:

Conservative and non-conservative forces, potential energy, mechanical energy and its conservation, law of conservation energy, gravitational potential energy and escape velocity, power Oscillations & Waves
 Oscillation of a spring, simple harmonic motion, energy in the simple harmonic oscillator, simple harmonic motion related to uniform circular motion, the simple pendulum, damped harmonic motion and vibration resonance, characteristics of wave motion, waves types, energy transported by waves, wave equation, principle of super position, reflection, refraction, diffraction, and standing wave.

Sound waves and Acoustics:

Characteristics of sound, Mathematical Representation of Longitudinal waves, intensity of sound: Decibels, Sources of Sound: Vibration Strings and Air Columns, Quality of sound and Noise: superposition, Interference of Sound Waves: Beats, Doppler's Effect, Shock Waves and Sonic Boom, Applications: Sonar, Ultrasonic and medical imaging

Lab Outline

From course contents.

Recommended Books:

1. Physics for scientist and engineers by Douglas C. Giancoli, Prentice Hall, Latest edition.
2. Fundamentals of Physics [David Halliday, Robert Resnick, Jearl Walker],
3. Latest Edition

Introduction to Business & Marketing 3 + 0

Prerequisite: None

Course Outline:**Business**

Introduction, Overview and scope of business, the Evolution and emergence of management thoughts, management functions, planning concepts, objectives, strategies and policies, decision making, staffing, principles of selection, performance and career planning, leading, motivation, leadership and communication, controlling the system and technique of controlling, management and society, future perspectives in business and management.

Marketing

Introduction: Marketing in Changing World: Creating Customer Value and Satisfaction, Strategic Planning and the Marketing Process, Global Marketing Environment; Marketing Research and Information Systems, Consumer Markets and Consumer Buyer Behavior, Business Markets and Business Behavior; Marketing Segmentation, New Products Development and Product Life-Cycle Strategies; Pricing Products: Pricing Considerations and Approaches, Pricing Strategies Distribution Channels and Logistics Management, Retail and sales management, Advertising Fundamental, Direct and Online Marketing; Competitive Strategies: Building Lasting Customer Relationships

Recommended Books:

1. Philp, Kotler and Gary Armstrong: Principle of Marketing, McGraw Hill, Co.

2. William J. Stanton: Fundamental of Marketing, Etzel, and Walker McGraw-Hill
3. Stephen Robins, Mary Coulter: Management.
4. McFarland: Management : Foundation and practices
5. Robert M Fulmer: The New Management

Object Oriented Programming 3 + 1

Prerequisite: Introduction to Computing

Course Outline:

This subject introduces students to object oriented programming concepts. Students will learn to build reusable objects, making use of encapsulation, polymorphism and inheritance in the object oriented programming language. Throughout the subject, the emphasis will be on using object oriented approaches to solving problems.

Lab Outline:

Consistent with the course outline

Recommended Books:

1. An Object-Oriented Approach to Programming Logic and Design by Joyce Farrell 4th edition, Cengage Learning, 2012
2. Robert Lafore, "Object-Oriented Programming in C++," Fourth Edition, 2002, Prentice Hall, ISBN: 0672323087

FOUNDATION COURSES

Microcontrollers & Embedded Systems 3 + 1

Prerequisite: Digital Logic Design

Course Outline:

Introduction to Embedded Software and hardware, Meaning of Real-Time and Multitasking, application of embedded systems in telecommunication, data representation, C for embedded systems, a programmer's view of computer organization, Mixing C and Assembly, Input output programming, Concurrent software, Scheduling, Memory Management, Shared memory, System Initialization, RISC and SISC micro-controllers, Micro-controllers interfacing.

Recommended Books:

1. Fundamentals of Embedded Software, Latest edition by Daniel W. Lewis, Prentice Hall

2. 8051 Microcontroller and Embedded Systems, Latest edition By Mazidi & McKinley, published by Pearson

Reference Books:

1. Designing Embedded Systems with PIC Microcontrollers by Tim Wilmshurst, published by Newnes, 2009 /Latest edition

Electrical Circuits I 3 + 1

Prerequisite: None

Course Outline:

DC Circuits, KCL, KVL, Network Theorems, Mesh and Nodal Analysis, Step response and transients. RC, RL and RLC circuits,

Lab Outline

From course contents.

Recommended Books:

1. Fundamentals of Electric Circuits, 2nd Edition, Charles K. Alexander and Matthew N.O. Sadiku, 4th Edition, McGraw-Hill, 2009
2. Electrical Engineering: Principles and Applications, by Allan R. Hambley, Latest edition by Pearson

Electrical Circuits II 3+0

Prerequisite: Electrical Circuits I

Course Outline:

Sinusoidal, phasor, power, frequency, active passive filters, solution of AC circuits. Single and three phase AC circuits. Magnetic circuits.

Recommended Books:

1. Fundamentals of Electric Circuits, 2nd Edition, Charles K. Alexander and Matthew N.O. Sadiku, 4th Edition, McGraw-Hill, 2009
2. Electrical Engineering: Principles and Applications, by Allan R. Hambley, Latest edition by Pearson

Electronic Devices and Circuits 3 + 1

Prerequisite: Electrical Circuits I

Course Outline:

Diodes: reverse bias characteristics – Zeners and avalanche behavior
Diodes: rectification – ac to dc conversion, filtering, figures of merit
Diodes: I-V characteristics,

Diode circuits: clamps, doublers, Signals, conventions, amplification and biasing.

Power supply design, linear and switching regulators.

BJT: structure, I-V characteristics, BJT: large and small signal models, biasing and amplifier stages, Models: regions of operation, large/small signal equivalent circuits, biasing, small and large signal behavior, temperature behavior, special purpose.

FET, JFET structure biasing etc.

MOSFET devices: four terminal devices, I-V characteristics

MOSFET structure and relation to regions of operation, I-V equations, channel modulation, substrate bias and sub threshold behavior.

MOSFET biasing for amplification, as a current source, use of 'active' loads.

MOSFET inverters, complementary MOSFETs.

MOSFET small signal operation, SS models, equivalent models, amplifier, operational

Amplifier and oscillators their application, structure, biasing using common source, Differential amplifier stage: configuration, biasing, SS models, extension to active

Lab Outline:

The emphasis is first on understanding the characteristics of basic circuits including resistors, capacitors, diodes, and bipolar and field effect transistors. The students then use this understanding to construct more complex circuits such as rectifier circuits and power supplies.

Recommended Books:

1. Principal of electronic devices by Floyd and Malvino

Data Communications and Networking 3 + 1

Prerequisite: None

Introduction

Introduction to Data Communications

The Internet communications model

OSI Reference Model

TCP/IP Protocol Architecture

Analog and Digital Transmission

Frequency Domain Concepts

Time Domain Concepts

Distinction between Data and Signals

Transmission Impairments

- **Transmission Media**

- Guided Transmission Media

- Wireless Transmission
- Wireless Propagation
- Line of Sight Propagation
- **Signal Encoding**
 - Digital Data, Digital Signals
 - Digital Data, Analog Signals
- **Signal Encoding**
 - Analog Data, Digital Signals
 - Analog Data, Analog Signals
- **Digital Data Communication Techniques**
 - Synchronous Communication & Asynchronous Communication
 - Error Correction
 - Error Detection
- **Data Link Control**
 - Flow Control
 - Stop and Wait Flow Control
 - Error Control
 - Stop and Wait ARQ
 - Go-back N ARQ
- **Data Link Control**
 - Error Control
 - Selective Reject ARQ
 - High Level Data Link Control (HDLC) protocol
- **Multiplexing**
 - Frequency Division Multiplexing
 - Synchronous Time Division Multiplexing
 - Statistical Time Division Multiplexing
- **Circuit Switching**
 - Circuit Switching Concepts
 - Circuit Switching Networks
 - Control Signaling in Circuit Switching Networks
- **Packet Switching**
 - Packet Switching Principles
 - Datagram
 - Virtual Circuits
 - Packet Size
 - Comparison of Circuit Switching and Packet Switching
- **Routing in Switched Networks**
 - Routing in Circuit Switching Networks

- Routing in Packet Switching Networks
- **Local Area networks**
- **Topologies and Transmission Media**
- **LAN Protocol Architecture**

Lab Outline:

From course contents

Recommended Books

Text book:

1. Data Communications and Networking, Behrouz A. Forouzan, Latest edition.
2. Reference Books:
3. Data Communications, 7th edition, William Stallings, Prentice Hall
4. Computer Networks, 4th Edition, Andrew Tanenbaum, ISBN: 0-13-038488-7

Digital Logic Design 3 + 1

Prerequisite: Electronic Device and Circuits

Course Outline:

Introductory concepts, number systems, Logic gates and Boolean algebra, Combinational logic circuits, Flip Flops and related devices, Digital arithmetic circuits, counter and registers, MSI Logic circuits

Lab Outline:

Basic logic gates; hardware implementation of combinational circuits, hardware implementation of sequential circuits such as flip-flops, registers, shift registers, counters: MUX/DEMUX, encoder/decoder, arithmetic logic unit (ALU), implementation of logic circuits using SPLDs; project solving a real-life problem.

Recommended Books:

1. Digital design 3rd/ latest edition by M. Mano, publish by prentice hall

Signals and Systems 3 + 1

Prerequisite: Calculus I

Course Outline:

Introduction, Time-Domain Representations for Linear Time-Invariant Systems, Fourier Representations for Signals and Linear Time-Invariant Systems, Applications of Fourier Representations and Mixed Signal Classes, Application to Communication Systems,

Representation of Signals Using Continuous-Time Complex Exponentials:
The Laplace Transform, Representation of Signals Using Discrete-Time
Complex Exponentials: the z-Transform, Application to Feedback Systems

Recommended Books:

1. Signals and Systems Latest Edition by Haykin and Van Veen,
published by Wiley

Electromagnetic Theory 3 + 0

Prerequisite: Applied Physics

Course Outline:

Vector Analysis, Co-ordinate systems, Transformations between
Coordinate Systems, Gradient of a Scalar Field, Divergence of a Vector
Field, Divergence Theorem, Curl of a Vector Field, Stokes's Theorem,
Laplacian Operator, Electrostatics- Maxwell's Equations, Coulomb's,
Gauss's Law, Poisson's Equation, Electric Boundary Conditions,
Magnetostatics- The Biot-Savart Law, Maxwell's Magnetostatic Equations,
Gauss's Law for Magnetism, Ampere's Law Magnetic Boundary
Conditions, Maxwell's Equations for Time-Varying Fields, Faraday's Law,
Boundary Conditions for Electromagnetics, Plane-Wave, General Relation
between E and H.

Recommended Books:

1. Fawwaz Ulaby, Fundamentals of Applied Electromagnetics, Prentice
Hall, 2006, Latest edition
2. Mathew Sadiku, "Elements of Electromagnetics", Oxford university
press, Latest edition

Telecommunication Systems 3 + 0

Prerequisite: None

Course Outline:

Comprehensive overview of the fundamental principles of
telecommunications, including current status and future directions of the
public switched telephone network, cellular networks, satellite networks,
and computer networks. Recommended Books:

Telecommunications and Data Communications Handbook by Ray Horak
Published by Wiley-Interscience 2007

Transmission and Switching Systems 3 + 0

Prerequisite: Telecommunication Systems

Course Outline:

Transmission systems overview including ISDN, PDH and SDH, EI and T1 Transmission systems, mapping of bits Transmission Systems including PDH and SDH, Synchronization, routing techniques, Line Encoding Techniques (HDB3, 2B1Q), Types of Switching Review of switching technologies - Circuit, Message and Packet Switching, Telecommunication Network (PSTN, PLMN), Exchanges Hierarchy, Telecommunications Traffic characterization and models including characterization of PABX and Public exchange traffic, GOS, BHCA, Network Traffic Load and Parameters, Blocking Probabilities, Modeling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking Models and Loss Estimates, Delay Systems, Time and Space Switching, T-S-T and S-T-S Systems and its variations, rationale and applications, Numbering Plans, Routing Tables, Charging Plans, Call detail recording(CDR), numbering plans, Classifications of Signaling Systems, Channel Associated Signaling (CAS) and Common Channel Signaling (CCS) ITU's Common Channel Signaling System # 7 (CCS7 Or SS7),

Recommended Books:

Digital Telephony by Bellamy published by Wiley Series

MAJOR COURSES

Analog & Digital Communications Systems 3 + 1

Prerequisite: Probability and Statistics, Signals and Systems

Course Outline:

The requirement for modulation, assignable frequency spectrum, block diagrams showing transmission and reception of signals. Time – domain and frequency – domain representation of AM Waves, Double side – band (DSB), single side – band (SSB) and vestigial side band (VSB). Applications of DSB, SSB & VSB. Demodulation. The time domain and frequency domain representation of FM and PM waves, comparison of FM and PM, generation of FM & PM, demodulation. Pulse amplitude modulation, pulse width modulation, Pulse position modulation, pulse code modulation (PCM), Differential PCM, Delta modulation. PSK, FSK, DPSK, QAM.

Recommended Books:

Modern Digital and Analog Communications Systems International By B. Bhagwandas Pannalal Lathi, Zhi Ding Published by Oxford University Press

Wireless and Mobile Communication 3 + 0

Prerequisite: Analog and Digital Communication Systems

Course Outline:

Evolution of Wireless Communications, Wireless communications principles, Wireless standards and KPI's, Outdoor propagation models, Fading channels, Overview of Fading channel models (Rayleigh, Ricean etc.). Fading channel characterization. The cellular concept, basic building blocks of cellular systems, handoffs, power control, traffic engineering. Digital modulation techniques, spread spectrum modulation (direct sequence and frequency hopping), orthogonal frequency-division multiplexing (OFDM). Mitigation Techniques, Equalization, diversity, channel coding. Multiple Access Techniques Frequency division multiple access, time division multiple access, code division multiple access and random access techniques. Wireless Standards and Systems, GSM, wireless LANs, Bluetooth, WiFi and WiMAX.

Recommended Books:

1. T. S. Rappaport, Wireless Communications: Principles & Practices, 2nd Edition, Prentice Hall, 2003
2. A. Molisch, Principles of Wireless Communications, Latest Edition, IEEE Press.

Optical Fiber Communication 3+0

Prerequisites: Applied Physics

Course Outline:

Comparison between optical and electrical mediums, basic optical communication system, Snell's law, refractive index, line width, optical and electrical bandwidth. Step index fibre, graded index fiber, refractive index profiles, meridional and skew rays, acceptance angle and acceptance con, numerical aperture for meridional and skew rays. Parameters for single mode fiber (cutoff wavelength, mode field diameter, effective refractive index, group delay). Attenuation due to: (i) absorption, (ii) scattering (iii) bending losses Dispersion, Reflectance and optical return losses, special types of fibers. Optical sources, modulators and modulating schemes, line coding, optical detectors, demodulator and demodulation methods, couplers, connectors, switches, splicing, optical amplifiers and repeaters, Optical time division multiplexing, wavelength division multiplexing (techniques and devices) link budgeting w.r.t time and power. LAN system, FDDI, SONETS and SDH, Wavelength routing based optical networks, Optical burst switching.

Recommended Books:

1. John M. Senior, "Optical Fibre Communications: Principles and Practice", Latest Edition, Prentice Hall

2. Gerd Keiser, "Optical Fibre Communications," Latest Edition, McGraw-Hill
Harold Kolimbris, "Fiber Optics Communications," Latest Edition, Prentice Hall

Project Management 3 + 0

Prerequisite: Organizational Behavior

Course Contents:

The course provides specific guidelines for achieving greater project success. It addresses the need for modern techniques in project management geared and suited to projects. It provides opportunity to students to have orientation towards lessons learned from failures and problems in projects, and suggest alternative solutions for project issues. The critical success factors for managing projects together with management issues related to vendors and outsourcing across national boundaries are also discussed. It further deals with managing businesses effectively address cross-cultural, social, and political issues.

Recommended Books:

1. Engineering Project Management by Nigel J. Smith Published by Wiley, Latest edition available

Telecomm Networks Management 3+0

Prerequisite: None

Course Outline:

Introduction to TMN, TMN interface Specification Methodology, Enhanced Telecommunication Operations Map (eTOM), Managing Next generation Networks, Generic Network Information Model, Management Services, Management Services, Management capabilities at the F Interface, Simple Network Management protocol (SNMP), common management interface protocol (CMIP, X.700), Enterprise NMS Architecture, Hierarchical Approach to Network Management.

Recommended Books:

1. Performance Evaluation of Communication Networks, Artech House, Inc., Boston 1998, by A. Olsson, et al.
2. Understanding Telecommunications 1, Ericsson Telecom, Telia and Student literature, Lund 1997 PLANITU Teletraffic Engineering and Planning, Vol. 1-6,
3. International Telecommunication Union, November 1994 T.G. Robertazzi:
4. Planning Telecommunications Networks, IEEE Press, New York 1999, CCITT Handbook,
5. General Network Planning, ITU, Geneva 1983 CCITT Handbook,

E-Business Management 3 + 0

Prerequisite: None

Course Outline:

Introduction to the E-Business Management, Types of organizations and products from E-Business point of view, E-commerce v/s E-Business, E-Commerce models from Transaction point of view (e.g. B2B, C2C, G2G, E2E, P2P etc), E- Market places, E- auctions & E-bartering, E-tailing, E-insurance, Online stock-trading, E-banking, Cyber-mediation & Hyper-mediation, Issues in E-tailing, Consumer behavior & Mass-marketing in E-business, Advertising strategies, Online Viral & Biometric Marketing, E-Supply Chain: RFID & RUBEE, C-Commerce & Group-ware, EDI, E-Governance, E-Voting, E-learning, Edutainment, E-books, Ebrary & Digital Library, M-Commerce & WWAN, Wireless wallets, M-Commerce & WWAN, Wireless wallets, L-commerce, Smart Homes, cars & associated applications, Types of E-auctions, Double & reverse auctions, E-security & E-crimes, Honey-net & Honey-pot, Digital payment systems, fraudulent & virtual cards, E-checking, E-billing & E-identification, E-CRM, Future of E-CRM, Speedy Deliveries, Global EC & E-strategy, Compliance Issues in EC, IP Law, Web 2.0 Environment, Virtual Communities, You-Tube, Web 3.0, How to start your own E-business, Future of EC and EC job market for Telecom personnel.

Recommended Books:

Turban, E. (2008), Electronic Commerce: A Managerial Perspective, ISBN: 0132243318, Prentice Hall, USA.

Telecommunication Policies and Regulations (3+0)

Prerequisite: Telecommunication Systems

Course Outline:

Categorizing the Environment at a National, Regional and International Level. The Elements that affect the behavior of Telecommunication Organizations at a National Level.

The Rules, the Skills and the Players in the Standardization Game: A snapshot of the International Standards Structure. The Skills required participating in the Game. The role of the United Nations and of ITU. The Pakistani Policy, Standards and Regulatory Environment. The old PTT Model. Changes to Pro-competitive models. Managing Change.

The Regulatory Process: Why Regulate? What to Regulate? How to Regulate? The main elements of a Regulatory System. The general goals of regulation Universal Services, the specific goals of Regulatory body in Pakistan. How to ensure that the Regulatory Authority succeeds or fails?

The Technology and Services of the Environment: Services as “Distributive, Centralized Interactive and Communicative.

Spectrum Management: The role of Scarcity in Spectrum Management, Licensing and Regulation. International Spectrum Allocation.

Inter Connect: What is Interconnect? The 5 objectives of interconnection policy. Why are regulators involved in Interconnect?

Technical Regulation and Compliance Approval of CPE: General aspects of compliance approval. Permit process and PTA accredited test houses. Permit variations and the consequences of non-compliance. Application for a permit. Statement of compliance. Compliance folder. Equipment labeling. Permit document.

Case Studies: General

Recommended Books:

1. Kenndy C.H. and Paster M.V. “An Introduction to International Telecommunication Law”, Artech House
2. Frieden R. “International Telecommunication Handbook” Artech House
3. International Telecommunication Union Handbook of Standards, www.itu.org.

Antenna and Wave Propagation 3+0

Prerequisite: Electromagnetic Theory

Course Outline:

Review of electromagnetic radiation. Radiation from current elements, loops, short wires. Antenna parameters. Reciprocity, equivalence and induction theorems. Linear antennas. Radiation pattern and impedance. Antenna arrays and the general antenna formulas. Receiving antenna theory. Elements of ground wave, tropospheric and ionospheric propagation.

Recommended Books:

Antenna Theory: Analysis and Design”, Constantine A. Balanis, Wiley, Latest edition

Information and Network Security 3+0

Prerequisite: Data Communications and Networking

Course Outline:

This course covers fundamental principles and the best practices of computer systems and network security. Key topics include security

architecture, cryptographic systems, and security management tools. Specifically, we will study major security protocols and standards, network attacks and defenses, database security, virus, malware, denial of service, firewalls, Botnet, intrusion detection, and wireless security.

Recommended Books:

Computer Security: Principles and Practice, Latest Edition by William Stallings, Lawrie Brown

Economics 3+0

Prerequisite: None

Course Outline:

This course is designed to help gain a basic understanding of economic principles and issues, without highlighting economic theory and modeling. Topics includes : economic systems opportunity cost and the production possibility frontier demand and supply; the price mechanism; elasticity cost and revenue; economies of scale market structure; business objectives and strategy in market failure and government intervention in markets , introduction to macroeconomics; measures of economic performance different approaches to macroeconomic policy.

Recommended Books:

Hird, Richard H... Working with Economics: A Canadian Framework. 8th Edition/Latest Edition Prentice-Hall.

Introduction to Business and Marketing 3+0

Prerequisite: None

Course Outline:

In this course covers basic components of business and marketing, its methods and uses to business firms. Topic includes; Organization, functions, activities, and roles of business; orientation to business terminology, practices, problems, and career opportunities. Marketing focuses on the promotion of various products offered by business firms.

Recommended Books:

Introduction to Business by Jeff Madura published by Paradigm 5th edition/Latest edition

Scheme of Study MS Telecommunication Systems (As per HEC guidelines 24 + 06=30 CrHrs)

The proposed list of courses is for MS in Telecommunication Systems. The list is not exhaustive. Individual universities/ institutions may design specializations and courses keeping in view the demand and availability of faculty and facilities. The curriculum/ syllabus shall be approved by the individual university/ institution as per procedures listed in their charters.

Technical Courses

(Select minimum 18 credit hours)

- Probability and Random Processes
- Advanced Communication Systems
- Advanced Digital Communication
- Information Theory and Coding
- Microwave Systems
- Digital Signal Processing
- Advance Mobile Communication
- Advanced concepts in Radar Systems
- Cyber Security
- Wireless Local Positioning Systems
- Global Positioning and Navigation Systems
- Signal Detection and Estimation
- Advanced Optical Communication Systems
- Advanced Satellite Communication Systems
- Advanced electromagnetic and Antenna systems
- Advanced Broadband Communication Systems
- Multimedia Communication Systems
- Cryptography and Security Systems
- Modeling and Simulation of Telecommunication systems
- Electromagnetic Compatibility Regulations
- Telecommunication Network Operations
- Quality of Service in Telecommunication systems
- Advances in transmission & switching system
- Selected Topics in Telecom systems

Electives Courses

(Select minimum 6 credit hours)

- Advanced Telecommunication Management

- Advanced e-business Management
- Business Process Management
- Multinational Project Management
- Management Information Systems
- Review of International Telecommunication Laws
- Macro Economics
- Investment Management

Recommendations of the NCRC for Master Program in Telecommunication Systems

Due to the variation in expertise and facilities available in different universities of Pakistan, NCRC recommended a flexible type of Master's Degree program. Their recommendations follow:

- a) For award of Masters degree, candidates will either need to complete 30 credit hours of course work or complete 24 credit hours of course work along with a minimum of 6 credit hours for research work/thesis. For universities not following Semester System, the requirement is 8 courses plus thesis or ten courses with each course having a theory contact for at least three hours per week during the term.
- b) The course titles of the MS in Telecommunication Systems have been outlined. Other specializations may be added as required by each university offering the Masters program keeping in view the availability of resources. The details of course contents, structure, and requirement of programs is the responsibility of the individual university according to faculty availability, suitability and needs.