

**CURRICULUM  
OF  
TELECOMMUNICATION  
FOR  
B.E/B.S  
M.E/M.S**

(Revised 2004)



**HIGHER EDUCATION COMMISSION  
ISLAMABAD**

## **CURRICULUM DIVISION, HEC**

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## CONTENTS

1.	Introduction	6
2.	List of Core Courses for B.E/B.S	9-10
3.	List of Elective Courses for B.E/B.S	10-11
4.	List of General Education Courses for B.E/B.S.	11-12
5.	Vision of Curriculum	13
6.	Topical outlines of General Courses	14
7.	Topical outlines of Core Courses	19
8.	Topical outlines of Elective Courses	28
9.	List of Master level Courses	38
10.	Recommendations	39

## 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 Higher Education 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 special meeting of 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.

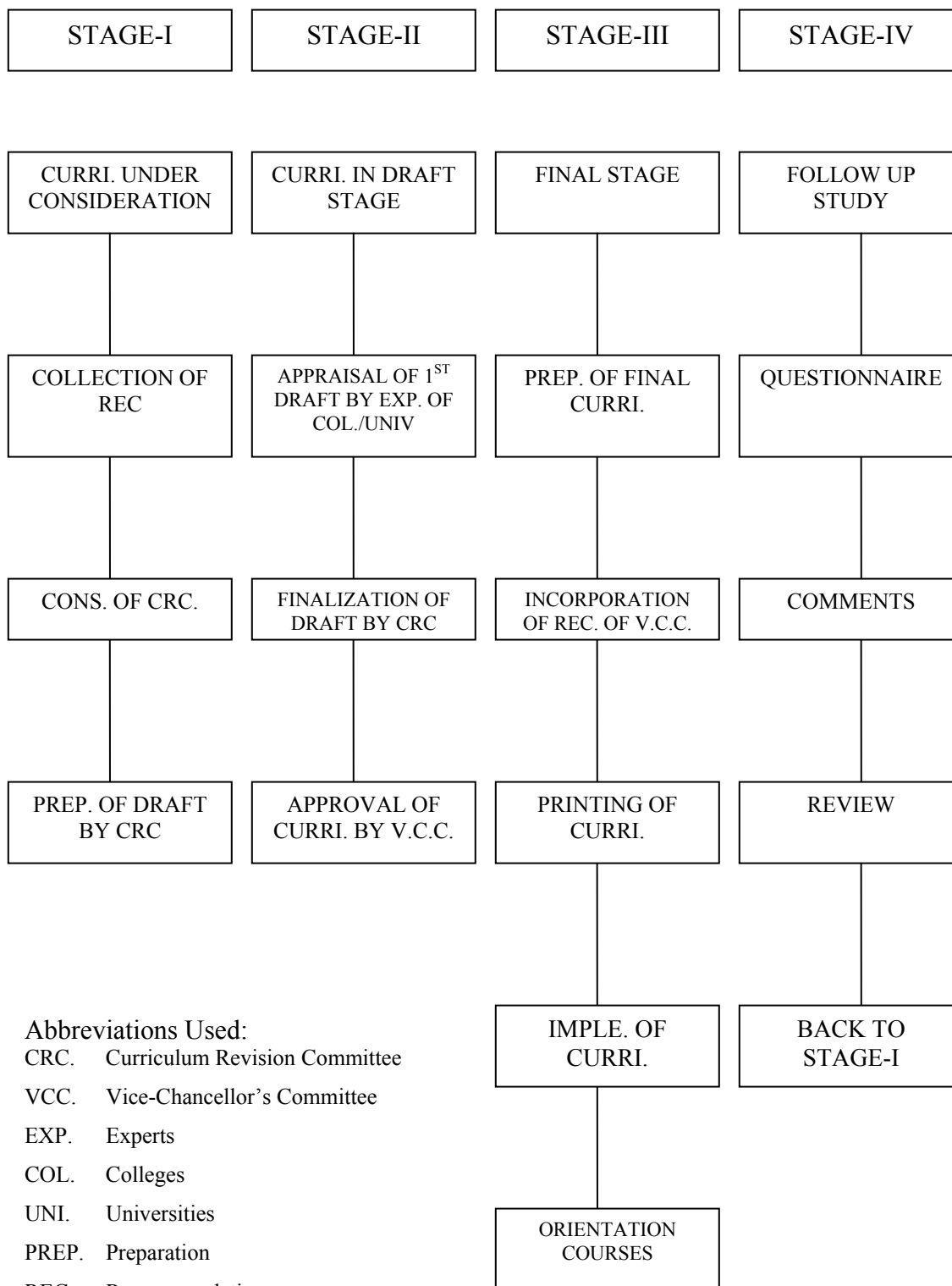
The National Curriculum Revision Committee on **Telecommunication** in its meeting held in June 2004 at the HEC, Islamabad finalized the draft curriculum after due consideration of the comments and suggestions received from the Universities and Colleges where the subject under consideration is taught.

The Final draft prepared by the National Curriculum Revision Committee duly approved by the Competent Authority is being circulated for implementation by the Universities.

**(PROF. DR. ALTAF ALI G. SHAIKH)**  
*Adviser (HRD)*

July 2004

## CURRICULUM DEVELOPMENT



## INTRODUCTION

The final meeting of National Curriculum Revision Committee was held from 08-10 June, 2004. The basic agenda was to finalize the curriculum of B.S (Telecommunication)/B.E (Telecommunication Engineering)/B.Sc. (Telecommunication Engineering) drafted in an earlier meeting held in January 2004. The meeting was inaugurated by Dr. Altaf Ali G. Shaikh, Adviser (HRD), HEC. The meeting started with recitation of verses from Holy Quran and introduction of the participants. The following attended the meeting:

1. Dr. Abdul Karim Baloch, Convener  
Professor,  
Department of Electronics & Telecommunication,  
Mehran University of Engineering & Technology,  
Jamshoro, Sindh
2. Prof. Dr. Tauseef-ur-Rehman, Member  
Professor and Head,  
Department of Telecommunication & Computer Engineering,  
International Islamic University, Islamabad
3. Dr. Noor M. Sheikh, Member  
Professor & Dean,  
Faculty of Electrical Engineering,  
University of Engineering. & Technology, Lahore
4. Prof. Dr. Jamil Ahmed, Member  
Prof. (HEC Foreign Faculty Hiring Programme),  
Institute of Space Technology, Islamabad
5. Prof. Dr. Imdad Ali Ismaili, Member  
Professor,  
Institute of Information Technology,  
University of Sindh, Jamshoro
6. Mr. Muhammad Iqbal Khan,  
Director, College of Engineering,  
PAF-Karachi Institute of Economics & Technology,  
Korangi Creek, Karachi-75190
7. Dr. Syed Ismail Shah, Member  
Centre for Advance Studies in Engineering,  
Sir Syed Memorial Building, 19 Attaturk Avenue,  
G-5/1, Islamabad

8. Dr. Abdul Qadir, Member  
Associate Professor,  
Department of Electrical Engineering,  
NED University of Engineering & Technology,  
University Road, Karachi
9. Prof. Dr. Ijaz Mujtaba Ghauri, Member  
Professor & Director,  
Centre of Advance Studies in Physics,  
Government College University,  
Church Road, Lahore
10. Prof. Akbar Rahmatullah, Member  
Visiting Professor, 66-A/4, Abid Majeed Road,  
Lahore Cantonment
11. Col. (Retd) Akhlaq Ahmed, Member  
Director, Institute of Engineering & Technology,  
604-Israr Plaza, Lane # 5 Main Peshawar Road,  
Near Chaur Chowk, Rawalpindi
12. Engr. Lt. Col. Saleem, Member  
Faculty of EE Department,  
Military College of Signals,  
National University of Science & Technology, Rawalpindi
13. Col. Raja Iqbal, Member  
Head, Department of Electrical Engineering,  
Military College of Signals,  
National University of Science & Technology,  
Rawalpindi Cantt.
14. Col. (Retd) Muhammad Anwar, Member  
Director Studies, 11EC, C/o Al-Mizan, 274,  
Peshawar Road, Rawalpindi
15. Maj. Muhammad Tariq Siddique, Member  
Milatry College of Signals, NUST, Humayun Road,  
Rawalpindi

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|-----|---|-----------|
| 16. | Engr. Muhammad Yousif Shaikh,<br>Assistant Professor,<br>Department of Engineering. & Technology,<br>Allama Iqbal Open University, Islamabad  | Member    |
| 17. | Mr. Zaka-ul-Mustafa,<br>Demonstrator, Institute of Communication Technology,<br>PTCL, Plot # 19, H-9/1, Islamabad   | Member    |
| 18. | Engr. Fazal Ahmed,<br>Assistant Professor, EE Department<br>National University of Sciences & Technology,<br>Military College of Signals, Humanyun Road, Rawalpindi                           | Member    |
| 19. | Engr. Amir Malik,<br>Asstt. Professor, Faculty of Engineering & Computer Science,<br>Muhammad Ali Jinnah University, Islamabad  | Member    |
| 20. | Mr. Bilal Munir,<br>Assistant Prof.<br>Department of Electronic Engg.,<br>Balochistan University of Information<br>Technology & Management Sciences,<br>Jinnah Town, Samungli Road,<br>Quetta | Member    |
| 21. | Engr. Shujaat Ali,<br>Lecturer/IT Cum Network Administrator,<br>Institute of Business & Management Science,<br>NWFP Agricultural University,<br>Peshawar                                      | Member    |
| 22. | Dr. Muhammad Abdul Qadir,<br>Associate Professor,<br>Faculty of Engineering & Computer Science,<br>Muhammad Ali Jinnah University, Jinnah Avenue,<br>Blue Area, Islamabad                     | Secretary |

The Convener, Dr. A.K. Baloch, briefed on the previous proceedings for the members who were attending the meeting for the first time. He highlighted the scope and TOR for the Committee. The issues raised by few members related to the name of the degree were addressed. It was finally decided that the name of the degree will remain same i.e. Telecommunication Engineering, however

universities that are running the programme with the name of Electrical Engineering with specialization in Telecommunication Engineering, may get guidance from the recommended curriculum.

Two sub-committees were formed to refine/revise the previous recommendations for Core & Elective Courses and prepare their recommendations for the house to finalize.

Core Revision Committee was formulated to revise the first draft of the core courses and suggest any changes/addition/improvements which would be incorporated in the final draft after getting it approved from the house. The Committee comprises of:

- a. Dr. Noor A. Sheikh (Convener)
- b. Dr. Jamil Ahmad
- c. Col. Akhlaq Ahmad
- d. Col. Raja Iqbal
- e. Prof. Akbar Rahmatullah
- f. Mr. Amir Malik

After a thorough discussion, the Core Revision Committee presented the list of core courses to the House. Again the whole House deliberated upon and after suggesting some changes approved the following courses:

#### **List of Core Courses for B.E/B.S**

<b>S.No.</b>	<b>Name of Courses</b>	<b>Theory</b>	<b>Lab</b>	<b>Total</b>
1.	Circuit Analysis	3	1	4
2.	Electronic Devices	3	1	4
3.	Digital Electronics	3	1	4
4.	Electromagnetic Theory	3	1	4
5.	Signals and Systems	3	1	4
6.	Digital Signal Processing	3	1	4
7.	Analogue Communications	3	1	4
8.	Digital Communications	3	1	4
9.	Wave Propagation & Antenna Theory	3	1	4
10.	Control Systems	3	0	3
11.	Telecommunication Systems	3	0	3
12.	Telecom Transmission & Switching Systems	3	0	3
13.	Digital Logic Design	3	1	4
14.	Computer Programming	3	1	4

15.	Data Structures and Algorithms	3	1	4
16.	Data Communication & Computer Networks	3	1	4
17.	Mobile & Wireless Communication	3	0	3
18.	Computer Architecture	3	0	3
19.	Project	0	6	6
	Total SCH	54	19	73

Elective Revision Committee was formulated to revise the first draft of the elective courses and suggest any changes/addition/improvements which would be incorporated in the final draft after getting it approved from the house. The committee comprises of:

- a. Dr. Ismail Shah (Convener)
- b. Dr. Ejaz Ghori
- c. Dr. Abdul Qadir (NED)
- d. Mr. Iqbal Khan
- e. Dr. S.Tauseef-ur-Rehman
- f. Dr. Imdad Ismaili
- g. Maj. Tariq Siddique
- h. Mr. Fazal Ahmad
- i. Mr. Bilal Munir

After a thorough discussion, the Committee for elective courses proposed following courses for the undergraduate programme in Telecommunication. The list is not exhaustive and serves as general template only. The courses mentioned in the list are further subdivided into four major areas namely; Computer Sciences (CS), Communication (Com), Signal Processing (SP) and Support (Gen). Again the whole House deliberated upon and after suggesting some changes approved the following courses:

#### **List of Elective Courses for B.E/B.S**

<b>Course No..</b>	<b>Title of Courses</b>	<b>Theory (SCH)</b>	<b>Lab</b>	<b>Total</b>
1.	Stochastic Processes	3		
2.	Information Theory & Coding	3		3
3.	Satellite Communications	3		
4.	Microwave Engineering	3	1	4
5.	Selected Topics in Telecommunication	3 to 6		
6.	Routing & Switching Principles	3	1	4
7.	Network Security	3		

8.	Radar Systems	3		
9.	Multimedia Systems	3		
10.	Compression Techniques	3		
11.	ASIC Design	3	1	4
12.	Parallel/Distributed Computing	3		
13.	Advanced Computer Programming	3	1	4
14.	Operating Systems	3		
15.	Quality Control in Telecommunication Systems	3		
16.	Telecom Traffic Engineering	3		
17.	Engineering Materials	3		
18.	Communication Protocols	3		
19.	Optical Fibre Communication	3		
20.	Digital Image Processing	3		
21.	Neural Networks	3		
22.	Numerical Methods	3		
23.	Electronic/Computer Workshop	2	2	4
24.	Advanced Filter Theory	3		
25.	Measurement & Instrumentation	2	1	3
26.	Electrical Machines	3		
27.	Engineering Management	3		
28.	Telecommunication Policies & Regulations	3		
29.	Network Management Systems	3		

Dr. S. Tauseef-ur-Rehman was delegated the task of preparing the course contents for General Education as well as for Mathematical courses. The house later on approved the course list, which is reproduced below and the details of these courses are attached in Appendix-A.

### List of General Education Courses for B.E/B.S

Course No.	Course Title	Theory (SCH)	Laboratory (SCH)	Total (SCH)
1.	Calculus 1	3		3
2.	Calculus 2	3		3
3.	Complex Variable & Transforms	3		3
4.	Linear Algebra & Differential Equations	3		3
5.	Probability & Random Variables	3		3
6.	Applied Physics	3	1	4
7.	Communication Skills	2		2
8.	Technical Report Writing	2		2
9.	Pakistan Studies	3		3

10.	Islamiyat/Ethics	3		3
11.	Engineering Economics	2		2
12.	Engineering Management	2		2
	<b>Total</b>	<b>32</b>	<b>1</b>	<b>33</b>

Due to illness of Dr. Abdul Qadir, Dr. S. Tauseef-ur-Rehman was elected as Acting Secretary. The Convener outlined the tasks to the House and requested the sub-committees to prepare topical outlines for their respective groups. Again the committees deliberated upon extensively on their tasks and prepared the outlines.

The outlines prepared by the Core Courses Committee were discussed at length in the House and the changes, suggested and proposed by the House were duly incorporated. The same are attached in Appendix-B.

The outlines prepared by the Elective Courses Committee were discussed at length in the House and the changes, suggested and proposed by the House were duly incorporated. The same are attached in Appendix-C.

The Master Level programme in Telecommunication Engineering was discussed in detail. The House agreed that in order to have greater flexibility and keeping in view the different levels of expertise and facilities available at various universities/ institutes, only course titles will be provided for Master Level programme in Telecommunication Engineering. The selected course titles for a minimum of 30 SCH are attached as per Appendix-D.

The House prepared a list of recommendations for consideration by the educational institutions and HEC. The same is attached at Appendix-E.

Dr. Nazir A. Sangi, Dean, Faculty of Science, Allama Iqbal Open University thanked all the participants on behalf of HEC. Finally, the Convener expressed his vote of thanks to all the participants for sparing their valuable time and taking keen interest in this task of national importance.

## Vision of Curriculum

Engineering and Applied Sciences play an important role in the overall development of a nation. It reflects the sense of national development and could be considered as a pride. A nation with an advanced engineering programme and facilities forms the backbone of industrial revolution and is an envy of other countries and is a role model for other nations to follow. Strength in engineering areas provides special leverage and clout, which is reflected in the political and foreign policies as well. In order to survive and be a role model for the whole Ummah, Pakistan needs to strengthen its base.

2. Recently a new paradigm shift is obvious in the policies of the government. Herein, a strong emphasis is being placed on all the disciplines with a special focus on engineering and applied sciences. This is a welcome change. However, to fully benefit from the generous policies offered by the government, we have to adopt a long-term and far-reaching policy. This requires a vision; a vision which is not only sufficient for today but is also valid for the next 10 years and so. It is imperative that such a vision is just not only based on tall claims but have adequate tangible figures that can form the basis of evaluation, and subsequent upgradation. This document is a step forward towards this direction.

3. Another focal point in such an exercise lies with the quality of the work force being produced. The proliferation of colleges offering Bachelor and Master degree programmes (related to different disciplines) has resulted in large variations in curricula, the critical shortage of qualified faculty and quality universities, the high cost of education, hindering growth and expansion of current universities and poor monitoring and accreditation mechanisms are the key reasons for the poor quality of manpower being produced.

Based on the facts delineated, the vision is:

*“To produce telecommunication graduates of high standards and to meet the prevalent and future challenges in the field of telecommunication by providing significant contribution in theoretical foundations with quality of the methodology, analytical techniques and clarity of organization”*

## Topical Outlines: General Courses

### Calculus I

Introduction, Limits, Extension of the Limit Concept, Continuity, Derivatives, Differentiation Rules, Derivatives of Trigonometric Functions, Application of Derivatives, Integration, Techniques and Application of Integration, Transcendental Functions.

#### **Suggested Text:**

Calculus by Thomas Finney

Calculus by H Anton

### Calculus II

First Order Differential Equations and Their Solutions, Series Limit, Theorems for Calculating Limits of Sequences, Infinite Series, Integral Test for Series, Absolute and Conditional Convergence, Power Series, Taylor and Maclaurin Series, Convergence of Taylor Series, Vector Calculus, Parameterization of Plane Curves, Lines and Planes in Space, Function of Several Variables, Partial Derivative, Equation of Tangent Planes and Parameterization of Normal Lines, Curl, Gradient, Divergence, Laplacian, 3-D Geometry, Conics.

#### **Suggested Text:**

Calculus by GB Thomas R I Finney

Calculus by Swokowski, Olinick & Pence

Calculus by Edwards and Penny

Calculus by Howard Anton, 6<sup>th</sup> Edition

### Complex Variable Transforms

Complex Numbers, Demoivers Theorem, Analytic Functions, Elementary Functions, Complex Integration and Cauchy's Theorem, Taylor and Laurent Series, Residue Theory, Conformal Mapping, Fourier and Laplace Transforms.

#### **Suggested Text:**

Advance Engineering Mathematics by Erwin Kreyzig

Mathematical Methods by Dr S M Yousaf

## **Linear Algebra and 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, Non-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 & Laplace equations and their solution. Set theory, Vectors and Norms, Linearly Independent and Dependent Vectors, Euclidian Vector Spaces and Subspaces, Matrices & Determinants, Linear Transformations, Inner products, Eigen-Values & Eigen vectors. Gaussian Elimination, Factorization of Matrices and Applications of Matrices in Engineering.

### **Suggested Text:**

*Linear Algebra* by David C Lay

## **Probability & Random Variables**

Introduction, Descriptive Statistics, Graphical Method, Stem-Leaf Display, Tally Bars, Frequency Distributions, Histograms, Quantitative Data, Multivariate Data, Measures of Location the Mean, Median and Mode, Quartiles Percentiles and Trimmed Mean, Categorical Data and Sample Proportions, Measures of Variability, Range, Mean (Absolute) Deviation, Standard Deviations, Skewness and Coefficient of Skewness, Chebyshev's Theorem, Empirical Rule, Coefficient of Variation, Measures of Relative Standing, the Pth Percentile, Z-Scores, Probability, Random Experiment, Event and Sampling, Additive Rule and Mutually Exclusive Events, Complementary Events, Counting Techniques, Law of Total Probability and Baye's Rule, Prior and Posterior Probabilities, B Aye's Rule, Discrete Random Variables, Binomial Distribution, Poisson's Distribution, Continuous Random Variables, Continuous Normal Distributive, Regression Models, Probabilistic Models, Fitting the Model (Method of Least Squares) Estimating Model Parameters, Correlation (Measure of Usefulness of Model), Coefficient of Determination, Inferential Methods in Regression Models, Inferences about the Slope Parameters  $\beta$ .

**Suggested Text:**

Introductory Statistics (Neil A Weiss) 4<sup>th</sup> Edition

Probability and Statistics (Jay L Devore) 3<sup>rd</sup> Edition

Introduction to Probability and Statistics (J S Milton, J C Atnold)

Statistics for Business & Economics (McClave, Benson) 6<sup>th</sup>/7<sup>th</sup> Ed.

Probabilities, Random Variables, & Random Processes Michel O'Flynn.

Probability & Statistics for Engineering & Sciences (William W Hines, Douglas C Montgomery) 3<sup>rd</sup> Edition

Modern Elementary Statistics (Freund and Simon) 9<sup>th</sup> Edition

Introduction to Statistics (Ronald E Walpole)

**Applied Physics**

Review of Vector Motion, Position, Velocity, and Acceleration Vectors, Applications of Laws of Motion, Projectile Motion, Motion in Resistive Media, Rocket Motion, Motion of Charged Particles in Electrical and Magnetic Fields, Rotational Motion, Constant Angular Acceleration, Uniform Circular Motion, Torque, Linear and Angular Momentum and Their Conservation, System of Particles, Centre of Mass, Two-Body Collisions in Two-Dimensions, Moment of Inertia of Objects, Wave Motion, Mathematical Concepts of Simple and Damped Harmonic Motion, Analytical Treatments of Superposition of Waves, Concepts and Applications of Diffraction and Polarization of Light and Sound Waves, Thermo dynamical Concepts and Basics of Electrodynamics, Electric Charge, Coulomb's Law, Electric Field and Intensity, Electric Potential, Capacitors and Charge Storage Concepts, Magnetism, Magnetic Fields, Faraday's and Lenz's Laws, Ampere's Law and its Applications, Eddy Currents, Inductance, Induced Current and Their Applications (Transformers, Generators Etc.), Definitions of the Values of AC Signals (Average and RMS Values), Electric and Magnetic Circuits, Electric Current, Resistance, Ohm's Law, Simple Resistive Circuits (Series and Parallel), Kirchoff Laws, Network Theorems (DC Analysis), RC and RL Circuits, Fundamentals of Semiconductor Physics, Band Theory, Semiconductors (Intrinsic and Extrinsic), PN Junction, PN- Junctions As A Rectifier,

**Suggested Text:**

University Physics by Freedman and Young (10<sup>th</sup> and higher editions),

College Physics by Resnick, Halliday and Krane (6<sup>th</sup> and higher edition)

**Communication Skills**

Business Communications, Planning Messages, Writing Concise But With Impact, Letter Formats, Mechanics of Business, Letter Writing, Letters, Memo and Applications, Summaries, Proposals, Writing Resumes, Styles and Formats, Oral Communications, Verbal and Non-Verbal Communication, Conducting Meetings, Small Group Communication, Taking Minutes, Presentation Skills,

Presentation Strategies, Defining the Objective, Scope and Audience of the Presentation, Material Gathering Material Organization Strategies, Time Management, Opening and Concluding, Use of Audio-Visual Aids, Delivery and Presentation.

**Suggested Text:**

Business English by Vawdrey, Stoddard and Bell

**Technical Report Writing**

Overview of Technical Reporting, Use of Library and Information Gathering, Administering Questionnaires, Reviewing the Gathered Information, Technical Exposition, Topical Arrangement, Exemplification, Definition, Classification and Division, Casual Analysis, Effective Exposition, Technical Narration, Description and Argumentation, Persuasive Strategy, Organizing Information and Generation Solution, Brainstorming, Organizing Material, Construction of the Formal Outline, Outlining Conventions, Electronic Communication, Generation Solutions, Polishing Style, Paragraphs, Listening Sentence Structure, Clarity, Length and Order, Pomposity, Empty Words, Pompous Vocabulary, Document Design, Document Structure, Preamble, Summaries, Abstracts, Table of Contents, Footnotes, Glossaries, Cross-Referencing, Plagiarism, Citation and Bibliography, Glossaries, Index, Appendices, Typesetting Systems, Creating the Professional Report, Elements, Mechanical Elements and Graphical Elements, Reports, Proposals, Progress Reports, Leaflets, Brochures, Handbooks, Magazines Articles, Research Papers, Feasibility Reports, Project Reports, Technical Research Reports, Manuals and Documentation, Thesis, Electronic Documents, Linear Verses Hierarchical Structure Documents.

**Suggested Text:**

Research Method: Guidance for Postgraduates, Greenfield, T Arnold

**Islamic Studies**

Fazail-E-Quran, Surat Hujraat With Translation, Surat Al-Furgan (Ayat 63 60 77), Kitab and Sunnat, Importance of Sunnat, Twenty Selected Hadiths With Translation, Islam in the Light of Quran and Hadiths, Tauheed, Risalat, Aakhrat, Prayer (Salaat), Fasting (Soam), Zakaat, Hajj, Jihad, Seerat-un-Nabi, Study of Seerat-ul-Nabi, Makkah Life of Holy Prophet (Peace Be Upon Him), Birth, Hijrat and Methods of Teaching, Madina Life of Holy Prophet (Peace Be Upon Him), Fatah-e-Makkah and Hajjat-UI-Wida.

## **Pakistan Studies**

Ideology of Pakistan, Historical Aspects, National Struggle (Shaikh Ahmed Sarhandi, Shah Waliullah and Others), Political Struggle, Constitutional Amendments and Muslims, Separate Elections, Tahreek-e-Khilafat, Tehreek-e-Pakistan, Muslim Nationality, Initiation of Two-Nation Idea, Problem of Indian Freedom and Muslims, Speech of Allama Iqbal in Allahabad, Elections of 1937 and the Attitude of Congress Government, Resolution of Pakistan, Election of 1946 and Transfer of Power.

### **Suggested Text:**

Zafar MD, Pakistan Studies

## **Engineering Economics**

Introduction, Time Value of Money, Operations, Reality Issues and Practical Applications, Measuring the Worth of Investments, Comparison of Alternatives, Income Taxes and Depreciation, Economic Analysis of Projects in the Public and Regulated Sectors, Cost Concepts.

### **Suggested Text:**

As Deemed Fit by the Faculty.

## **Engineering Management**

Introduction to Principles of Management and Organizational Behaviour as They Apply To the Engineering Profession. Special Emphasis on Project Management, Team Building, Quality Leadership, and the Marketing of Technology. Group Exercises, Case Studies, Extensive Writing and Speaking Assignments.

## Topical Outlines: Core Courses

### **Circuit Analysis**

Current Voltage Relationship for Passive Circuit Elements, Constant Voltage and Current Sources, Kirchoff's Laws, Loop and Node Equations, Use of Matrices and Cramer's Rule, Concept and Use of Duality, Coupled Circuits, First Order Differential Equations, Concept of Forced and Natural Responses, Determination of Current and Voltage In R-L and R-C Circuits, Initial Conditions, Second Order Differential Equations, Determination of Current and Voltage In R-L-C Circuit, Analysis of Networks Using Laplace Transforms, Trigonometric and Phasor Representation, RMS and Average Values, Power Factor Complex Power, Network Theorems, Max Power Transfer, Characterization of Two Port Networks, Parameters (Including s-Parameters), Inter Connections.

#### **Suggested Text:**

Engineering Circuit Analysis by William H, Hayat Kemerly, 5<sup>th</sup> Edition, McGraw- Hill

Basic Engineering Circuit Analysis by J David Irwin

#### **Pre-Requisites:**

Calculus-I, Calculus-II

### **Electronic Devices**

Semi-Conductor Diode, Forward and Reverse Biasing, Non Ideal Behaviour, Switching Response, Half and Full Wave Rectifiers, Clippers and Clamper Circuits, Voltage Multipliers, Zener, Tunnel and Varactor Diodes, LED, Laser Diodes, Bipolar Junction Transistors (BJT), FET, JFET and MOS Devices, DC Analysis and Design of Biasing Circuits for BJT and FET Amplifiers, Bias Stability, AC Design and Analysis, Frequency Response of BJT and FET Amplifiers, Power Amplifiers, Multistage Amplifiers, Ideal Operational Amplifier, Op-Amp, Non-Idealistic, Op-Amp Circuits, Frequency Response of Op-Amps, Voltage Regulators.

#### **Suggested Text:**

Electronic Devices by Floyd – 5<sup>th</sup> edition

Micro-electronics by Jacob Millman and Arvin Grabel

#### **Pre-Requisites:**

Applied Physics

## **Digital Electronics**

Transistor Inverter Design and Analysis, Noise Margin, Fan Out, Propagation Delay Switching Speed, Multi Vibrators, Schmitt Trigger, Precision Timing Circuits, Sweep Generators, Digital Logic Families, DTL, TTL, ECL, IIL and CMOS, Transfer Characteristics, Speed, Power Consumption, Introduction To Fabrication of Digital Microelectronics PMOS, NMOS, CMOS A/D and D/A Converters, Design Methodologies for Combinational and Sequential Circuits, Finite State Machine, Sequential Machines, Bussing and Sequencing of Control.

### **Suggested Text:**

Digital systems by Floyd

Electronic Circuits: Discrete and integrated by Schilling and Belove

### **Pre-Requisites:**

Electronic Devices, Circuit Analysis

## **EM Theory**

Review of Vector Analysis, Orthogonal Coordinates, Vector Integration, Gradients Divergence and Curl, Coulomb's Law, Gauss Law, Electric Flux Density, Poisson's Value Problems, Magnetic Fields, Current Density, Biot-Savart Law, Vector Magnetic Potential Magnetic Field Intensity, Boundary Conditions, Maxwell's Equations In Integral and Point Form, Boundary Conditions, Poynting Vector, Plane Wave and Propagation In Isotropic Media.

### **Suggested Text:**

Electromagnetic Waves and Radiating systems by Edward C Jordan

Electromagnetics by John D Krans, McGraw-Hill

### **Pre-Requisites:**

Calculus-II, Applied Physics

## **Signals and Systems**

Introduction To Signals & Systems, Different Types of Signals, Properties of Systems, Fourier Series and Fourier Transforms, ESD, PSD, Properties & Applications of Fourier Transforms, Convolution, Correlation Function, Block Diagram & Transfer Function, Laplace Transform and Inverse Transform, Solution of LTI Systems, Importance, Pole-Zeroes LTI Systems, Response of System To Different Inputs, Introduction To Difference Equation, Analogue Filters.

**Suggested Text:**

Signals and Systems by Oppenheim & Wilsky  
Signals and System, Schaum Series

**Pre-Requisites:**

Complex Variable & Transforms

**Digital Signal Processing**

Review of Linear Time Invariant Systems, Discrete Time Systems and its Properties, Frequency Response of DT Systems, Discrete Time Convolution and Correlations, Z-Transform, Inverse Z-Transform, Different Z-Transfer Structures for FIR and IIR Filters, DFT and FFT, Design of FIR and IIR Filter.

**Suggested Text:**

Discrete time Signal Processing by Oppenheim and R W Schaffer  
Fundamentals of Digital Signal Processing by Paul A Lynn

**Pre-Requisites:**

Signal and Systems, Linear Algebra

**Analogue Communications**

Introduction, Communication Model, Essential Bandwidth of Signal, Shannon's Equation, Review of Fourier Techniques & Convolution, Correlation Function, Auto-Correlation, Cross Correlation, Linear Modulation, Analysis of Linear Modulation Techniques in Time and Frequency Domains, Base Band and Carrier Communication, AM, DSB, SSB, VSB, QAM, Signal Acquisition, Phase Locked Loop, Super Heterodyne AM Receiver, Angle Modulation, Instantaneous Frequency Concept, Bandwidth of Angle Modulated Waves, Generation of FM and PM Waves, Demodulation of FM & PM Waves, Interference in Angle Modulation, Pre-Emphasis and De-Emphasis, Random Processes, Random Variable and Random Process, PSD of A Random Process, Types of Random Processes, Multiple Random Processes, Behaviour of Analogue Systems in Presence of Noise, Amplitude Modulated Signal, Angle Modulated Systems, Optimum Pre-Emphasis, De-Emphasis Systems.

**Suggested Text:**

Modern Analogue and Digital Communication System by B P Lathi  
Communication System by A B Carlson

**Pre-Requisites:**

Probability and Random Variables, Signal and Systems

## **Digital Communications**

Base Band Modulation, Analogue To Digital Conversion, Sampling Theory and Its Application (PAM), Quantization and Its Types (Uniform and Non-Uniform Quantization), Pulse Code Modulation, Differential PCM, Delta Modulation, ADPCM, PCM Pulse – Shaping, Inter-Symbol Interference, Equalization, Synchronization, Basic Detection Theory and Optimum Receiver Design, Multiplexing, TDM, FDM, T-1 Systems and Hierarchy, E-1 Systems Hierarchy, Digital Modulation Techniques, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), and Phase Shift Keying (PSK, DPSK, DEPSK, QPSK), Differential Encoding and M-Ary Signalling, Performance of Binary and M-Ary Signalling, Forward Error Correction Codes.

### **Suggested Text:**

Digital Communication by Bernard Sklar  
Principle of Communication System by Taub & Schilling  
Communication System by A B Carlson

### **Pre-Requisites:**

Analogue Communications, Digital Signal Processing

## **Transmission, Propagation and Antenna Theory**

Standard Line Equation, Distributed Parameters, Characteristic Impedance, Concept of Standing and Travelling Waves On Transmission Line, Reflection (Partial and Total), Standing Wave Ratio, Matching Smith Chart and Its Applications, Isotropic Antenna, Power Radiated From Short Electric Dipole, Voltage Received In Antenna, Half Wave Dipole, Loop Antenna, Radiation Pattern, Intensity and Resistance, Calculation of Antenna Gain and Efficiency, Effective Aperture, Relation Between Gain and Aperture, Antenna Impedance, Bandwidth, Polarization, Beamwidth, Antenna Arrays with Isotropic Antennas, Pattern Multiplications, Width of Major Lobe and Directivity of Antenna Arrays, Binomial and Chebychev Arrays, Folded Dipole Antenna, Yagi Antenna, Log Periodic Antenna, Parabolic Reflector, Horn Antenna, Feed Systems, Lens Antennas, Cabinet's Principle and Slot Antenna, Antenna On A Flat Earth, Spherical Earth, Angle of Tilt, Field Strength, Attenuation In Ground Wave Propagation, Bending of Waves, Skip Distance, MUF, Optimum Working Frequency, Critical Frequency, Virtual Height, and Ionosphere Irregularities, Ranges, Field Strength, Inversion of Layers, Line-of-Sight Communication.

### **Suggested Text:**

Telecommunication by Warren Hioki  
ARRL Hand Book Antenna Design

**Pre-Requisites:**

EM Theory and Circuit Analysis

**Control Systems**

Introduction To Feedback Central Systems, Block Diagrams & Topologies, Stability, Feedback Systems, (Bode, Nyquist, Routh-Hurwitz, M&N Circles, Root Locus), Frequency Response Design, State-Space Design, Introduction To PID Controllers.

**Suggested Text:**

Modern Control System by Richard Dorf and Robert Bishop Addison Wesley

Control System Engineering by I J Nagrath & M Gopal

Control System Engineering & Design by S Thompson

**Pre-Requisites:**

Linear Algebra, Signals and Systems

**Transmission & Switching Systems**

Review of TDM, MUX Standards, SONET/SDH/PDH, ATM, Carrier XMN, Synchronization, Channels & Error Control, Line Encoding Techniques (HDB3, 4B3T, 2B1Q) Digital Communications (PCM), Types of Switching Systems – Circuit, Message and Packet Switching, Telecommunication Network (PSTN, PLMN), Exchanges Hierarchy, Basic Functions of A Typical Digital Switching Exchanges, SPC, Software Structure of SPC Digital Switches, Software Life Cycle, Erlang Models, GOS, BHCA, Network Traffic Load and Parameters, Blocking Probabilities, Modelling 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, Numbering Plans, Routing Tables, Charging Plans, PPM PMM, SPM, MPM, Charging Database, Signalling, Areas of Signalling, Various Types/Classifications of Signalling Systems, Channel Associated Signalling (CAS) and Common Channel Signalling (CCS) ITU's Common Channel Signalling System # 7 (CCS7 Or SS7), – System Architecture Layers, MSU, LSSU, and FISU, Error Detection/Correction, ISUP Signalling TUP, Case Study of FMM on Call Scenarios such as PATED, LSIF, TRA and Private Access Resource Management from Commercial Exchange.

**Suggested Text:**

Digital Telephony by Bellamy, John Wiley and Sons

Telecommunications Switching Principles by M T Hills

Telecommunication Switching Systems and Networks, by Thiagarajan Vishwanathan

Telecommunications Signalling, IEEE by Richard Manterfield.

Digital Switching Systems – System Reliability and Analysis by Syed R Ali

**Pre-Requisites:**

Analogue Communications, Digital Communications

**Telecommunication Systems**

Introduction of Telecommunication Network (Message Switching, Circuit Switching, Packet Switching) TV/CATV Systems/Standards, Radio Systems and Digital Radio, LOS (MW) Communication, Satellite Systems, Optical Communication, Tropospheric Scatter Systems, Spread Spectrum Techniques (DSS & Frequency Hopping), WLL (Wireless Local Loop).

**Suggested Text:**

Basic TV Circuits by Grob

Spread Spectrum System by David L Nicholson

Telecommunication Transmission Handbook

**Pre-Requisites:**

Analogue Communications, EM Theory and Transmission, Propagation & Antenna Theory

**Digital Logic Design**

Review of Boolean Algebra, Logic Gates (AND, OR, NOT Etc.), Sum of Products, Products of Sums, Minterm & Maxterms, K-Maps, QM Method, Flip Flops (RS, D, JK, T, Master-Slave, Flip-Flop), Adders (Half & Full) & Subtractor (Half & Full), Comparators, Combinational and Sequential Circuits, Encoders & Decoders, Multiplexers & Demultiplexers, Counters (Ripple Counters, MOD Counters Etc), Registers (Serial & Parallel Load), Memories (ROMS & RAMS), PLAs, State Transition Diagrams.

**Suggested Text:**

Digital Electronics and Microprocessor Technology by Dr B S Choudhry and Dr A K Baloch, Naseem Book Depot

Logic and Computer Design Fundamental by Morris Mano and Charles R Kime

Principles of Digital Design by Deniel D Ganski

Digital Logic Fundamental by R J Tocci

Digital Logic Design Fundamental by Norman Balabanian & Bradley Carlson

Verilog HDL – A Guide to Digital Design and Synthesis by Samir Planitkar

**Pre-Requisites:**

Digital Electronics

**Computer Programming**

Introduction To Programming, Constants, Variables, Operators, Expressions/ Statements, Data Types, Input/Output Statements, Data Type Conversion, Loops, Arithmetic & Logical Operators, If-Else Statement, Array & Strings, Functions, Structures, Pointers, Classes, Inheritance and Polymorphism, Aggregation and Composition, Operator Overloading, Friend and Virtual Functions.

**Suggested Text:**

C/C++ by Robert Lafore

Object Oriented Programming, C++ by Robert Lafore

C/C++ for Electronics and Telecommunication Engineers by J K Kella, Dr B S Chowdhry, A R Memon, Naseem Book Depot

**Data Structure & Algorithms**

Introduction, Linear Data Structure (Stack, Linked Lists & Queue), Non-Linear Data Structure, Binary Tree, B-Tree, B+ Tree, Binary Search, Quick & Selection Sort, Recursion, Graphs, Hash Structure, Heaps, Indices.

**Suggested Text:**

Data Structures and Algorithms (SAMS teach yourself) by Lafore, Sams Publishing, 1999

Fundamentals of Data Structures in C++ by Horowitz, Sahni, and Mehta, Computer Science Press, 1995

Data Structures in JAVA by Standish, Addison Wesley, 2000

**Pre-Requisites:**

Computer Programming

## **Data Communication & Networks**

Data Transmission, Communication Model, Communication Tasks, Transmission System Utilization, Interfacing, Signal generation, Exchange Management, Error Detection and Correction, Flow control, Addressing, Routing, Recovery, Message formatting, Security, Circuit Switching, Packet Switching, Frame Relay, ATM, ISDN and Broadband ISDN, Point to Point and Multipoint, Simplex, Half-Duplex and Full-Duplex Transmission, Analogue and Digital Data Transmission, Transmission Impairments, Attenuation, Delay Distortion, Noise, Channel Capacity Transmission Media-Guided Transmission, Media-Twisted Pair, Coaxial Cable and Optical Fibre, Wireless Transmission, Asynchronous and Synchronous Transmission, Line Configurations, Interfacing, Null Modem Data Link Control, Flow Control Techniques, Stop & Wait, Sliding Window, Multiplexing-Frequency, Division Multiplexing, Synchronous and Statistical Time Division Multiplexing, Network Concepts, Network Models, Network Operating Systems, Network Applications, LAN Technology, Physical And Logical Topologies, LAN Architecture, LAN System & Network Standards, Ethernet and Fast Ethernet (CSMA/CD), Token Ring And FDDI, 100VG, OSI, TCP/IP, SLIP, PPP, IEEE802 Family, NDIS & ODI, Connectivity Devices , Modems, Hubs, Repeaters, Bridges, Routers Connection Services, Public Telephone Networks, X, 25, Frame Relay, ISDN & B-ISDN, ATM Managing And Securing Network, Resource Sharing, Managing User Accounts And Group, Implementing Security, Disaster Recovery, Protecting Data, Recovering From System Failure, Network Adapter Cards, Installing And Configuring Nacs, Resolving Hardware Conflicts.

### **Suggested Text:**

Data Communication by Driscoll

Data Communication by W Stallings, Prentice Hall

Compupedia: The Art of Living with Computer by M K Kella, Dr B S Chowdhry, Dr. A Q K Rajput, A R Memon, Naseem Book Depot

Computer Networks by W Stallings, Prentice Hall

Computer Networks by A S Tanenbaum

ISDN and Broadband ISDN by W Stallings, Prentice Hall

### **Pre-Requisites:**

Digital Communications

### **Mobile Communications**

Evolution of Mobile Communications, Principles and Regulations (GSM Standards From ETSI, 3GPP Standards R-99), Technical Features of AMPS, GSM, GPRS, GERAN, UMTS, Systems and Protocol Architecture (e.g. IPv4 –

IPv6, UTRAN), Cellular Security and Cryptography (e.g. A8, A3, A5 Algorithms), Wireless Technologies and Engineering (Air Interface, Core Network), Emerging Wireless Communication Industry (National and International).

**Suggested Text:**

Mobile Communications by Jochess Schiller, 2<sup>nd</sup> Edition, Addison Wesley

**Pre-Requisites:**

Digital Communications

**Computer Architecture**

Different Generations of Computers VLSI & Computers, Design Methodology, Gate Level, Processor Level, Register Level Processor Organization, Instruction Sets, Encoding ALU Design, Control Design, Instruction Sequencing, Instruction Interpretation, CPU Control Unit, Micro-Programmed Control & Computers, Memory System Organization, Virtual Memory, I/O System Organization, Address Bus, Data Bus, Interrupts & DMA, Operating Systems, Performance Evaluation.

**Suggested Text:**

Microprocessor and Interfacing by Douglas V Hall

Micro Computer & Microprocessor System by M. Rafiquzzaman, Saunder College Publications

The 8086/8088 Microprocessor by W A Triebel & A Singh

**Pre-Requisites:**

Digital Logic Design

## **Topical Outlines: Elective Courses**

### **Stochastic Processes**

Review of Probability Theory, Deterministic Signal Representation and Analysis, Introduction to Random Processes and Spectral Analysis, Markovian Processes (up to M/M/1), Correlation Function and Power Spectral Density of Stationary Processes, Gaussian and Poisson Processes, Analysis of Linear with Random Inputs, Stochastic Signal Representation, Linear Mean Square Filtering, Optimum Wiener and Kalman Filtering, State Estimation for Discrete Stochastic Systems.

#### **Suggested Text:**

Probability and Random Processes by A Popoulis, 4<sup>th</sup> Edition, McGraw-Hill  
Probability and Random Processes for Engineers by Leon Garcia, 2<sup>nd</sup> Edition

### **Information Theory & Coding**

Information as Measurable Quantity, Information Contents of A Message, Average Information Per Symbol, Units of Information, Source Coding for Discrete Memoryless Channel, Information Transmission On Discrete Channel, Discrete Channel Capacity, Shannon Harley Theorem, Huffman Coding, Error Correcting Codes.

#### **Suggested Text:**

Digital Communication by Simon Haykins  
Information Theory by Thomas & Cover

### **Satellite Communication**

Introduction To Satellite Communication, Satellite Link Design, Propagation Characteristics of Fixed and Mobile Satellite Links, Channel Modelling, Access Control Schemes, System Performance Analysis, System Design, Mobile Satellite Services, Global Satellite Systems, National Satellite Systems, Mobile Satellite Network Design, Digital Modem Design, Speech Codecs Design, Error Control Codecs Design, Geo Stationary Communication Satellite Systems, Low Earth Orbit Communication Satellite Systems.

#### **Suggested Text:**

Mobile Communication Satellite by Tom Logsdon  
Global System for Mobile Communications System by Joachim Tisat

## **Selected Topics in Telecommunication**

Subject To The Topic as Devised by The Instructor.

### **Suggested Text:**

Subject To The Topic as Devised by The Instructor

## **Network Security**

Mathematical Methods, Introduction To Number Theory, Complexity, Information Theory, Conventional Encryption Models, Classical Encryption Techniques, Types of Attacks, Symmetric Algorithms, DES, asymmetric Algorithms, Public Key Cryptosystems, RSA, Key Management, Authentication Requirements, Elementary Methods of Message Authentication, Authentication Functions, Cryptographic Checksums, Digital Signatures, Digital Signatures Standards, Method Digest Algorithm, Hash Functions and Hash Algorithm, International Data Encryption Algorithm, AES, Linear Feed Back Shift Register, One Way Cipher and Password, Smart Cards and Information Cards, Un Forgeable ID Cards Using Smart Cards, Pretty Good Privacy (PGP), Privacy Enhanced Mail (PEM), PGP Random Number Generation, Text / Data Embedded in Images

### **Suggested Text:**

Applied Cryptography by Bruce Schneier

Network and Inter Network Security — Principals and Practices by William Stallings, Prentice Hall 1995

## **Radar Systems**

An Introduction To Radar, Radar Equation, MTI and Pulse Doppler Radar, Tracking Radar, Detection of Signals in Noise, Information From Radar Signals, Radar Clutter, Propagation of Radar Waves, Radar Antenna, Radar Transmitters, Radar Receiver.

### **Suggested Text:**

Introduction To Radar Systems 3<sup>rd</sup> Edition, by Merrill I Skolnik

Radar Handbook by Skolnik

Communication Systems 3<sup>rd</sup> Edition, by Carlson

Antennas and Radio wave Propagation by Collin

Digital Communications by Proakis

Introduction To Random Signals and Noise by Davenport and Root

## **Advance Filter Theory**

Importance of Filters, Historical Perspective, Types of Filters, Filter Parameters, Roll off, Electronically Tunable Devices, Operational Amplifier (OA), Operational Transconductance Amplifier (OTA), OA and OTA Based Active Filters, Bilinear Transfer Functions, Simulation of Negative Circuit Elements Using Otas, Direct and Cascade Form Synthesis Approaches, Inductance Simulation Approach, Frequency Dependent Negative Resistance Approach, Phase Shaping Using All Pass Design, Different Responses (Butterworth, Chebychev, Inverse Chebychev), Equiripple Characteristics, Biquads, Design Parameters  $\omega O$  and  $Q$ , Gain Constant Adjustments, Sallen-Key Circuit, RC-CR Transformation, Universal Filters, Switched Capacitor Filters, Switching Techniques, Time Delay Transfer Functions, Bessel Thompson Filters & Their Response, Sensitivity, Sensitivity Function, Multiparamters Sensitivity, Bode Sensitivity, Sensitivity Analysis of Sallen-Key Filter.

### **Suggested Text:**

Analog Filter Design, by M V Van Valkenberg  
Analog Filter Theory & Design by Wye Kie Chen  
Handbook of Filter, Edited by W K Chen

## **Compression Techniques**

Introduction, Fundamental Concepts, Classification Of Methods, Semantic Dependent Methods, Static Defined-Word Schemes, Shannon-Fano Coding, LD-CELP, Huffman Coding, Arithmetic Coding, Lempel-Ziv Codes, Algorithm BSTW, Static Codes.

## **ASIC Design**

Physical Layouts (Stick Diagrams), CMOS (INVENTORS, and Their Theory) + (MOS Current Mode Leave MCML, Design Principles of CMOS, High Speed Techniques in CMOS, Small Projects in VHDL, Design Implementation on FPG, Development Environment of FPGAs.

### **Suggested Text:**

Digital Integrated Circuits by Brodersem and Choudrakasan

## **Multimedia Systems**

Introduction, Multimedia Scorecard, Digital Audio & Video Editing, CD-ROM Technologies, Multimedia Conferencing, H 320 Standards, H,261 Standards, H 320 Cell Movement, Transcoding, Video Broadcasting, Multimedia PC.

### **Suggested Text:**

Multimedia Systems by J F Koegel and Buford, ACM Press

## **Parallel/Distributed Computing**

Data Parallelism, Multi-Processor Architecture, Process Communication, Data Sharing, Synchronous Parallelism, Multi-Computer Architecture, Data Partitioning, Distributed Memory, Scheduling Parallel Program, Object Oriented Parallel Program, Deadlock Handling, Concurrency Control.

### **Suggested Text:**

Introduction To Parallel Computing by Ted, G.Lewis, Hesham El-Rewani, Prentice Hall

The Art of Parallel Programming by Bruce P Lester, Prentice Hall

## **Advanced Computer Programming**

Review of Object Oriented Design Strategy and Problem Solving, Objects & Classes, Member Functions, Public and Private Members, Object Encapsulation, Inheritance and Polymorphism, Operator Overloading, Stream Class, Practical Design Through OOP, Linear Executable Format, Virtual Device Driver, New Executable Format, Module Management, COFF Obi Format 16 Bit, (Unix) Other 32-Bit O,S Programming for I 386, Unix Binary Executable Format (ELF), Dynamic Shared Objects, Unix Kernel Programming (Ring O).

## **Operating Systems**

History and Evolution of Operating Systems, Types of Operating Systems, Case Histories of Significant Operating Systems, Processes, Inter-Process Communication, Process Coordination and Synchronization, Process Scheduling, Memory Management, File Systems, Security and Protection, Case Operating Systems.

### **Suggested Text:**

Operating System by W Stallings, 2<sup>nd</sup> Edition, Macmillan

Operating System Concepts by A Silberschatz Et Al, 6<sup>th</sup> Edition, Wiley

Modern Operating Systems by A S Tanenbaum, Prentice Hall.

## **Quality Control in Telecommunication Systems**

Quality Control, Acceptance Sampling, Operating Characteristic Curve, Type of Sampling Schemes, Rectifying Schemes, Military Standard Plan Sampling Practical Problems, ISO 9000, Salient Features.

### **Suggested Text:**

ISO Manual

## **Telecom Traffic Engineering**

Outline of Telecommunication Switching Systems, Nature of Telecommunication Traffic, Erlang Model, Traffic as A Random Process, Traffic Variations, Negative Exponential Distribution, Traffic aspects of Networks Planning, Switch-Count Error, Traffic-Estimation Error and Total Error, Measurement of Congestion, Average-Holding-Time Measurement, Traffic Measurement, Traffic Prediction, Traffic Simulation, Case Study on Traffic Analysis.

### **Suggested Text:**

Principles of Telecommunication Traffic Engineering by Bear D Peter Peregrinus Ltd

Digital Telephony by Bellmany

## **Engineering Materials**

Conductors, Semi Conductors and Insulators, Energy Bands, Insulators Used in Electrical Systems, Super Conductors, Soft Magnetic Materials, Permanent Magnet Materials, Semi Conductor Materials, PN-Junction Fabrications, Epitaxially Grown, Diffused and Ion Implanted Junction, Depletion Approximation.

### **Suggested Text:**

Electronics by Grobe

## **Telecommunication Protocols**

Review of HDLC Protocol Structure, LAPD (Terminal Adoption), Bearer Channel, Data Link Control, Network Layer (Call Control, Supplementary Services), ISDN Protocol Architecture & Connection, User Network Interface Configurations, SCCP, ISUP, TUP in CCS7, Frame Relay Congestion Control, ATM Protocols and Congestion Control.

### **Suggested Text:**

ISDN and Broadband ISDN with ATM & Frame Relay by William Stallings, 4th Edition, Prentice Hall

Networking by Comer

Computer Networks by A S Tanenbaum, Prentice Hall

## **Optical Fibre Communication**

Optical Beams and Resonators Including Ray Tracing, Gaussian Beam Propagation, Stable and Unstable Resonators, Classical Theory of Spontaneous and Stimulated Emission including Discussion of Homogeneous and

Inhomogeneous Line Broadening, Laser Pumping and Population Inversion in Three Level and Four Level Systems, Fundamentals of Laser Oscillation, Dynamics and Threshold, Laser Cavity Equations, Laser Spiking and Mode Competition, Q-Switching, Active and Passive Mode Locking, Injection Locking, Single Frequency Operation, Introduction to Fibre, Lasers and Active Optical Fibre Devices, Design Considerations of a Fibre Optics Communication Systems, Analogue and Digital Modulator, Noise in Detection Process, BIT Error Rate (BER), System Design, Maximum Transmission Distance Due to Attenuation and Dispersion, Case Study.

**Suggested Text:**

Optical Fibre Communications by John Senior  
Optical Fibre Communications by Cruiser, Gerdkiser  
Opto Electronic by Wilson and Hawks  
Laser Electronics by Joseph T Verdeyen.

**Artificial Neural Network**

Introduction To Neural Networks Basic Building Blocks of Neural Networks, Hebb Network, Perception Networks, Adline Networks, Hetro associative Memory Neural Networks, Auto associative Nets, Recurrent Net, Hopfield Net, Bi-Directional associative Memory (BAM) Maxnet, Hamming Net, Kohonen Self Organizing Maps, Learning Vector Quantization (LVQ), Adaptive Resonance Theory (ART) Back Propagation Net.

**Suggested Text:**

Artificial Intelligence by E Rich, McGraw-Hill

**Digital Image Processing**

Introduction To Computer Vision, Image Acquisition, Levels of Vision Systems, Image Quality Enhancement Techniques, Histogram Manipulation, Thresh Holding, Binarization, Edge Based Segmentation, Region Based Segmentation, Dynamic Programming, Contour Refinement, Relaxation Techniques, Perceptual Organizations, Motion Detection, Texture Analysis, Spatial & Frequency Domain Analysis.

**Suggested Text:**

Digital Image Processing by Gonzalez and Wood, Addition Wesley, 1993  
Computer Vision by Balard Brown  
Introduction To Computer Vision by Robert

## **Numerical Methods**

Error in Computer Arithmetic, Root Finding for Non-Linear Equations, Interpolation and Polynomial Approximation, Solution of System of Linear Equations, Numerical Differentiation and Integration, Optimization Techniques, Numerical Solution of Ordinary Differential Equation, Solution of Partial Differential Equation.

### **Suggested Text:**

Mathematical Methods by Dr S M Yusuf

Numerical Recipes by Oxford University

Advance Engineering Mathematics by Erwin Kreyzig

Numerical Methods by Prof Mumtaz

## **Measurement & Instrumentation**

Precision Measurements Terminologies Including Resolution, Sensitivity, Accuracy, Uncertainty, Engineering Units and Standards, Specific Instruments and Systems Including Mechanical Measurements, Length, Force, Displacement, Stress and Strain Gauges, Thermodynamic Measurement, Data Manipulation and Presentation, Basic Data Manipulation Skills Using Personal Computers, Spread Sheets and Graphs, Power Factor and Its Measurement, Static and Dynamic Measurement, Time Series and Sampling Requirements, Data Acquisition System, Software Simulation Principle, Operation, Working and Construction of Different Analogue and Digital Meters, Oscilloscopes and Its Measurements, Recording Instruments and Signal Generators, Transducers, Different Types of Bridges for Measurements of Resistance, Inductance and Capacitance, High Voltage Measurements.

### **Suggested Text:**

Electronic Instrumentation and Measurement Techniques by W D Cooper

Measurement Systems, Application and Design by Ernest O Doebelin, McGraw-Hill Book Co

Sensors Principles and Applications by P Hauptmann, Prentice Hall

Principles of Measurement Systems by John P Bentley, John Wiley and Sons Inc

Principles of Electronic Instrumentation and Measurement by Berlin Getz, Merrill Publishing Co

## **Electrical Machines**

Magnetic Circuits, Transformers, Principles of Electromechanical Energy Conversion and Rotating Machines, Construction and Operation of Synchronous Generators and Motors, Induction Machines, Construction, Operation and

Performance of Different Types of DC Machines, Small Power AC Motors, Their Types and Applications, Introduction To Brushless DC Motors and Switched Reluctance Motors.

***Suggested Text:***

Fitzgerald, Kingsely and Umans, McGraw Hill

Electric Machines and Transformers by B S Guru and H R Hizirolu, Oxford University Press

Electrical Machines, Drives and Power Systems by Wieldy, John Wiley and Sons

Electrical Machines by M Yasmine

Electrical Machines by Siskind

**Microwave Engineering**

Microwave Components, Waveguides, Waveguide Junctions, Directional Couplers, Isolators, Circulators, Resonators, Microwave Generators, Microwave Tubes, Two Cavity Klystron, Reflex Klystron, TWT, Magnetron, Microwave Semiconductor Devices, Gunn Diode, Impact Diode, PIN Diode, Mixers, Detectors, Microwave Measurements, Measurement of Frequency, VSWR, Power, Noise and Impedance, Transmission Line, Smith Chart, Impedance Transformation, Scattering Parameters and ABCD Parameters, Magic TEE, Isolators, Faraday Rotators, Signal Flow Graphs, Planer Transmission Lines Including Microstrip Line, Even and Odd Mode Analysis, Periodic Structure, Microwave Tube Devices, Velocity Modulation, Bouncing Process in Klystron, Crossed Field Tube Devices, TWT, Microwave Solid State Devices, Varactor, PIN Diode, Tunnel Diode, VARISTORS, IMPATT DIODE, TRAPATT, BARITT Diodes and Gunn Diodes.

***Suggested Text:***

Electronic Communication Systems by Kennedy, McGraw-Hill

Microwave Transistors, Amplifiers, Analysis and Design by Guillermo Gonzalez, Prentice Hall

Microwave Engineering by David M Pozar by John Wiley

Microwave Devices and Circuits by Leo, Prentice Hall

Foundations for Microwave Engineering by R E Collins, McGraw-Hill

**Electronic Workshop**

PCB Design and Fabrication, Fabricating Simple Electronic Circuit On Breadboard, Use of Software Tools for PCB Design, Fabricating A PCB (Drilling, Etching Etc.), assembling and Soldering Components On A PCB, Electronic Repair/Maintenance Lab Management Hazards and Safety, Electronic Instruments and Device Handling and Storage, Service Instruments and Tools

Operational Procedures, Use of Data Books, Specification Sheets and Applications Notes of Devices Etc., Industrial Process Controllers.

**Suggested Text:**

First Practical Book of Electronic Workshop by B S Chowdary and A A Ursani

**Engineering Management**

Methods Used in Industry to Determine the Relative Worth of Alternative Long Term Investments in Plants and Equipment, Topics Including Introduction to Accounting and Cost Analysis, Selection among Alternate Investments, Time Value of Money, Annual Cost, Present Worth and Rate of Return Methods of Analysis, Economic Life and Replacement, Risk Uncertainty and Effects of Inflation, Managerial Decision Making and Its Impact on Society, Selection of Corporate Goals, Measures of Corporate Performance and Concepts of Industrial Regulations, Maintenance Planning, Training on Software Package, Cost Analysis of Repair, Maintenance, Workshop and Stores Services, Procurement and Marketing, Management of Store, Reliability Estimation, Reliability Specification and Procurement, Consideration of Maintainability in Reliability Programmes, Acceptance Testing.

**Suggested Text:**

Reliability Handbook by W G Ireson, McGraw-Hill  
PMBOK Handbook, Project Management Institute, 2001

**Telecommunication Policies & Regulations**

Introduction To The Real World Environment of Policy, Standards & Regulation, Standards Setting Process, Regulatory Process, Current and Developing Models in International Telecommunication, Technology and Services of The Environment, Technology Law and Policy of International Satellites, Spectrum Management, Inter Connect, Technical Regulation and Compliance Approval of CPE, Convergence.

**Suggested Text:**

An Introduction To International Telecommunication Law by C H Kennedy and M V Paster, Artech House  
International Telecommunication Handbook by R Frieden, Artech House  
International Telecommunication Union Handbook of Standards

## **Network Management Systems**

Network Management in TCP/IP Environments, Network Management Station (NMS), Network Management Requirements, Fault (Configuration and Accounting), Performance & Security Management, Network Management Protocols, Abstract Syntax Notation One (ASN.1), OID/MIB, CMIS/CMIP, SNMP (V1, V2, V3), Structure of Management Information (SMI), Remote Monitoring (RMON), SNMP Commands, Telecommunications Management Network (TMN), Network Management Tools and Systems, TCL/TK Scripting for SNMP Agents.

### **Suggested Text:**

SNMP, SNMPV2, SNMPV3 and RMON 1 and 2 by William Stallings, Third Edition, Addison-Wesley, 1999

Understanding SNMP MIBs by David Perkins and Evan McGinnis, Prentice Hall PTR, 1997

SNMP, SNMPv2, and CMIP by William Stallings, Addison-Wesley, 1993

Telecommunications Network Management, Technologies and Implementations by Salah Aidarous and Thomas Plevyak, Wiley-IEEE Press, 1997

Integrated Management of Networked Systems by Heinz-Gerd Hegering, Sebastian Abeck, Bernhard Neumair, Morgan Kaufmann, 1999.

## **List of Master Level Courses**

Advanced Microprocessor Systems  
Advanced Data Communication  
Computer Vision  
Advanced Neural Networks & Fuzzy Logic  
Advanced Embedded Systems  
Advanced Computer Networks  
Parallel & Distributed Computing  
Advanced Mobile & Wireless Communication  
Modern Trends in Telecommunication and Information Super Highway  
Advanced DSP & Filter Design  
Human Computer Interaction  
Relational Data Base & Management System  
Advanced Signal Detection and Estimation  
Advanced Network Security  
Estimation Theory  
Queuing Theory  
Advanced Optical Fibre Communication  
Advanced Satellite Communication  
Advanced Microwave Systems  
Information Theory & Coding  
Selected Topics in Telecommunication  
Statistical Communication  
Advanced Digital Communication  
Multirate Systems, Filter Banks and Wavelets  
Telecommunication Management Network (TMN)  
Software Tools & Techniques in Telecommunication  
Multi Protocols Layer Switching  
Telecommunication Network Design  
IP Based Systems  
Mobile Ad hoc Networks  
Telecom Policies, Standards and Regulations  
Telecom Signalling and Intelligent Networks  
Telecommunication Operating Systems  
Advanced Telecommunication Switching Systems

**RECOMMENDATIONS**

1. The programme should not be counted with the number of courses rather it should be counted with the international norms of semester credit hours. If a course is being taught one hour per week for 16 weeks (excluding exam week) then it will be counted as one semester credit hour. In case of lab work, one semester credit hour means the course will be conducted in the laboratory for two hours per week for 16 weeks. Typically, a semester comprises 18 weeks with 16 weeks of study, one week preparations and one week for final examination. The programme should consist of at least 130 semester credit hours (sch) and has duration of 4 years. Individual universities may have more semester credit hours.
2. The minimum number of teaching weeks per academic year should be 32. An institution may have more than these.
3. The Practical/Lab work should comprise sufficient part of the total credit hours and in all the subjects of practical nature as proposed in the curriculum.
4. All the Universities/Institutions should make arrangements for practical training of their students in industrial organizations during summer vacation, especially in the Third Year/Final year.
5. The students should be evaluated during the session through tests, quizzes, assignments and case studies followed by a comprehensive examination at the end of the year/end of term/semester. The evaluation should be distributed uniformly over the complete semester.
6. A minimum of 75% attendance should be made compulsory for all years.
7. The Committee recommended that the title of the degree in Telecommunication should be B.S (Telecommunication)/B.Sc. (Telecommunication Engineering)/B.E (Telecommunication Engineering).
8. The programme should be measured from its semester credit hours instead of the duration in years. There are different systems e.g. semester system, term system, trimester system, annual system etc. The credit hours for these programs must be adjusted with reference to the semester system.
9. Efforts should be made to provide appropriate and latest equipment for the Laboratories of the teaching departments and the process should be continued so that latest/state of the art equipment is added replacing obsolete equipment. Special attention should be given to the provision of adequate funding for recurring expenditure to operate and maintain the Laboratory equipment.

10. Opportunities may be provided to the teachers of Universities for In-service training to update their knowledge in the advanced topics recently introduced in the proposed curriculum.
11. Lectures by subject experts may be facilitated by HEC.
12. University teachers may be provided proper incentives for encouraging them to write books/monographs in the field of their expertise.
13. The HEC may provide funds/facilities for the establishment of Departmental Libraries, which will stock books related to that particular subject. Special emphasis should be given to the provision of research journals. For this purpose the department should be provided with facilities to have E-mail, internet connection to major library services in Pakistan and abroad where they can have access to literature available in digital form. There should also be a national library, which should hold a comprehensive stock of books on the subjects and should serve as lending library for the departments.
14. Industrial training of engineering students is highly desirable and as such efforts should be made to provide training to all students. In order to create adequate training opportunities, the HEC may take up the matter with the Government of Pakistan to enforce legislation making it mandatory for industry to provide training to engineering students in proportion to their capital investment and/or number of engineers employed. For legislation purpose guidance may be obtained from the Apprenticeship Act 1984, and the practice in the neighbouring countries. The industrial training should be for senior students and preferably held during summer vacation, so that the academic activities are not disturbed.
15. Interaction between faculty members of the institutions must be facilitated and encouraged by HEC.
16. Curriculum development activity must be supported by HEC by providing on-line facilities to the interested members.