Department of Information and Communication Engineering
Faculty of Applied Science and Technology
Islamic University, Kushtia, Bangladesh

Syllabus for Master of Science (M. Sc.)
Session : 2016-2017
Final Examination : 2017

01. ADMISSION

For admission to M. Sc program in any subject a student should have following qualifications:

(a) Passed the four years B. Sc. (Honours) Examination in the same or relevant subject from this university

(b) The students appeared at the B.Sc. (Honours) Final Examination of this university may be admitted provisionally to the M. Sc. program and their admission shall be confirmed after their results are published and passed the examination. The attendance of the students shall, however, be counted from the date on which the class begins.

02. MEDIUM OF INSTRUCTION AND ANSWER

The medium of instruction and answer in the examination scripts shall be English.

03. DURATION OF THE PROGRAM AND EXAMINATION

(a) The M. Sc. program consisting of General and Thesis Group shall extend over one academic year. The program shall have at least 28 weeks for class teaching, 2 weeks recess before the final examination and 8 weeks for holding the final examination.

(b) Student shall to appear at the viva-voce examination after the end of final examination.

(c) The M. Sc. Degree program in the Faculty of Applied Science and Technology shall comprise of two groups:

(A) The General Group (Group A)
(B) The Thesis Group (Group B)

04. DISTRIBUTION OF COURSES AND MARKS

(a) The total marks for M.Sc program (General or Thesis group) shall be 1200 for all the subjects. The marks shall be distributed among the theoretical courses, practical, dissertation, viva-voce, project and field works.

(b) The General Group (Group A) shall consist of 1200 marks with the following distribution:

Seven Theoretical courses of 100 marks each	=	700 marks
Practical / Field works/ project	=	400 marks
Oral Examination	=	100 marks

(c) The Thesis Group (Group B) shall consist of 1200 marks with the following distribution:

Seven Theoretical courses of 100 marks each	=	700 marks
Comprehensive practical courses	=	100 marks
Dissertation	=	200 marks
Presentation/ Viva-voce on dissertation	=	100 marks
Oral Examination	=	100 marks

(d) All courses shall be designed by the committee of courses of relevant Department and shall be approved by Academic Council through the Faculty.

(e) The marks allotted for practical courses/field work/project shall be distributed and designed by committee of courses of the relevant Department and shall be approved by Academic Council through the Faculty keeping the total credits and marks unchanged.

(f) The title of the dissertation shall be approved by the Academic Committee of the relevant Department.

(g) Each theoretical course shall carry 100 marks and the written examination shall be 4 (four) hours duration for each course. The practical examination shall be 12 (twelve) hours duration for each unit course of 100 marks or as suggested by the relevant committee of courses.

05. ASSIGNMENT OF CREDITS:

(a) Theoretical Courses: One class lectures per week for a period of 14 weeks shall be considered as one credit.

(b) Practical classes: Minimum two class hours of a practical class per week for a period of 14 weeks shall be considered as one credit.

(c) A student has to complete at least 39 credit of the program.

(d) Each credit shall be equivalent to 14 hours class lectures or academic work.

(e) The total number of credits of M. Sc degree program shall be as follows:

Credit per Course:

Credits for each Theoretical course	= 3.5
Credits for each Practical/Field work/Project	= 3.0
Credits for oral Examination	= 2.5

Total Credits:

For general group:

Credits for Theoretical courses	= 24.5 credits
Credits for Practical/Field work/project	= 12 credits
Credits for oral Examination	= 2.5 credits
Total Credits	= 39 credits

Total Credits:

For thesis group:

Credit for Theoretical courses	= 24.5 credits
Credit for Comprehensive Practical courses	= 4 credits
Credit for dissertation	= 5 credits
Credit for Presentation/Viva-voce for dissertation	= 3 credits
Credit for oral Examination	= 2.5 credits
Total Credits	= 39 credits

06. EVALUATION

(a) Each course(Theoretical and Practical) shall be evaluated as follows:

Internal Evaluation of each Theoretical course :

(i) Tutorial/ Assignment	= 15 marks
(ii) Class Attendance	= 10 marks
Year end final examination	**= 75 marks**
Total	= 100 marks

Internal Evaluation of Each Practical Course :

(i) Laboratory performance /Assignment/ oral test during Laboratory hours	= 5 marks
(ii) Laboratory attendance	= 10 marks
(iiI) Laboratory Note Book on experiment	= 05marks
Year-end Practical Examination	**= 80 marks**
Total	= 100 marks

(b) The course teacher(s) shall prepare five copies of the mark sheets for the marks obtained by the students in internal evaluation (Theoretical and Practical). Three copies of the mark sheets is to be submitted to the Chairman of the Examination Committee, one copy to the Controller of Examinations and another copy shall be published through the notice board before the year-end final examinations starts.

(c) The course teacher submit the answer scripts of tutorial examination/assignment taken by him/her to the Chairman of the Examination Committee when submitting for marks.

(d) The distribution of marks for class attendance (theoretical and practical) shall be as follows:

Attendance	**Marks**
95% and above	10
90% to 94%	9
85% to 89%	8
80% to 84%	7
75% to 79%	6
70% to 74%	5
65% to 69%	4
60% to 64%	3
Less than 60%	0

(e) The field work will be evaluated by the internal members of the examination committee on the basis of report, written test, oral presentation and the viva-voce on the report submitted by the students.

(f) The project will be evaluated by the internal members of the examination committee on the basis of report, oral presentation and the viva-voce on the project submitted by the students.

(g) The examination committee shall conduct the viva-voce examination at the end of the academic year.

07. EXAMINATION

(a) There will be a year-end final examination. The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks.

(d) Tutorial Examination/assignment on the courses shall be taken by the course teacher or teachers during the progress of the course for internal evaluation. Each course teacher shall take minimum 4 (four) tutorial examinations for each course and the average marks shall be taken into consideration. The marks obtained by the student for each tutorial examination/assignment shall be published by the course teacher through the notice board within 15 days after taking the examination.

08. Thesis Examinations:

(a) Each dissertation for M. Sc. Degree shall be examined by two external examiners from outside this university to be appointed by the Examination Committee.

(b) The thesis shall be submitted within 04 (four) months from the date of the last theoretical examinations. This time may, however, be extended by the academic council on recommendation of the academic committee of the concerned Department.

(c) Four copies of the dissertations shall have to be submitted to the Chairman of the Examination Committee on or before the date prescribed by the Department concerned. Each dissertation must be type- written or printed and bound in cloth.

(d) Two copies of the dissertations shall be sent by the Chairman of the Examination Committee to the Controller of Examination who will arrange to send these to the examiners.

(e) The Chairman of the Department shall arrange to preserve the thesis or dissertation approved for M. Sc. Degree in University library and in the Seminar Library of the Department for future reference.

09. GRADING SYSTEM

(a) Total marks obtained in each course, Viva-voce Examination and the Research Report/Dissertation shall be converted into Letter Grade (LG) and Grade Point(GP) as follows:

Numerical Grade	Letter Grade		Grade Point
80% and above	A+	(A plus)	4.00
75% to less than 80%	A	(A regular)	3.75
70% to less than 75%	A–	(A minus)	3.50
65% to less than 70%	B+	(B plus)	3.25
60% to less than 65%	B	(B regular)	3.00
55% to less than 60%	B–	(B minus)	2.75
50% to less than 55%	C+	(C plus)	2.50
45% to less than 50%	C	(C regular)	2.25
40% to less than 45%	D	---	2.00
Less than 40%	F	---	0

(b) A student securing less than Letter Grade C+ (GP 2.5) in Viva-Voce Examination, Practical and Dissertation shall have no credit i.e. this mark will not be counted while determining his/her results.

(c) Calculation of Grade Point average (GPA) and cumulative grade point averages, (CGPA): Grade Point average is the weighted average of Grade Points obtained in all courses completed by a student.

10. RESULT PUBLICATION:

(a) The Degree of Master of Science (M. Sc.) in any subject in the Faculty of Applied Science and Technology shall be awarded on the basis of the combined results of theoretical, practical/field work/ project, dissertation and oral examinations.

(b) The tabulation sheets shall consists of marks of internal evaluation, year end final examination of each course (theoretical, Practical, Viva-voce) and the corresponding LG, GP, GPA and CGPA.

(c) The results published for students will show only LG, GP and CGPA.

(d) The Controller of Examinations shall publish the final results of the examination and shall provide the transcript showing the course-wise LG and the Corresponding Grade Points. No numerical marks will be shown on the transcript.

(e) The results of M.Sc program for general group shall be published within 3(three) months from the date of last theoretical course examination group. In the case of thesis group results shall be published within 2 months after the last date of submission of dissertation.

(f) The Controller of Examinations shall send one copy of the tabulation sheet to the Chairman of the concerned Department duly signed by him.

(g) In the final result (after the completion of the program), marks of internal evaluation, total marks, the individual LG and GP in each course, CGPA shall be shown in the tabulation sheets.

(h) Result sheets of each examination as prepared by the Controller of Examinations shall be compared and signed by the Chairman of the Examination Committee or his / her nominee.

11. EXAMINATION ENTRY REQUIREMENTS

(a) In order to be eligible for appearing at the M. Sc final examination a candidate shall have to attend minimum 75% of the total number of classes held in each course (theoretical and others).

(b) Student will not be allowed to appear in the examination if his/her class attendance is less then 60%.

(c) The academic Committee of the Department, on special ground, may recommend in the cases of shortage of attendance ordinarily not below 60% on payment of a non-collegiate fee as determined by the University.

(d) Each course teacher shall submit the class attendance report along with the documents to the Chairman of the Department at least 10 days before processing the prescribed entry form for examination.

(e) Every candidate for admission to each Examination shall submit his application in the prescribed entry Form to the controller of examinations. The application shall be submitted through the Chairman of the Department so as to reach the Controller of Examinations at least 4 (four) weeks before the date fixed for the Commencement of Examination. This time may be relaxed for the students seeking readmission.

12. READMISSION

(a) A student must complete the M. Sc. program within a maximum period of two consecutive academic years from the original admission year.

(b) In case a student fails to appear at the M. Sc final examination or fails to appear at the examinations due to shortage of required percentage of attendance or fails to deposit the examination fees due to some unavoidable circumstances or is expelled from the University for any reason as the case may be, he/she shall have to get himself / herself re-admitted to the subsequent batch. The syllabus in-force for the examination concerned will be applicable for such students.

(c) A student failing to get the CGPA below 3.00 in the final result may seek readmission with the subsequent batch. For readmission, a student shall have to apply within 4(four) weeks after publication of the M. Sc. result.

(d) On readmission, grades earlier earned by a student in the program shall be cancelled and the student shall have to retake all the course-works (such as in course/tutorial, practical, dissertation, viva-voce exam etc.) and final examinations.

(e) A student will not get chance for readmission more than once during the program.

(f) A readmitted student failing to earn the CGPA of 2.5 or complete 39 credit hours in grade improvement examination shall be dropped out from the M. Sc program.

(g) A readmitted student shall be dropped out from the M. Sc. program if he/she fails to complete the program within two consecutive academic years.

13. AWARD OF THE M. Sc DEGREE

(a) M. Sc degree shall be awarded to a student on completion of 39 credits successfully and on securing a minimum CGPA of 2.5.

(b) The student shall have to obtain a minimum Letter Grade of C+ (GP 2.5) in the practical, dissertation and viva-voce examination.

(c) A student shall have to complete the program within two consecutive academic years from the first admission year into the program.

14. IMPROVEMENT:

(a) A student who has failed to complete 39 credit hours successfully or obtained the letter grade 'B regular' or below is allowed to improve his/her grade after publication of the M. Sc results. The students shall get one opportunity improve the grade.

(b) Student will not be allowed to improve a course if his/her grade is B or better.

(c) A students willing to write improvement Examination shall have to apply to the Controller of Examination through the Chairman of the Department concerned in the Prescribed Form within 30 days of the publication of the result of M. Sc final Examination. The M. Sc final year Examination

Committee shall conduct and complete the improvement examination within 4 months after the publication of the result.

(d) To improve the grade and to appear in the examination the student shall have to pay the examination fee for each course as determined by the University from time to time.

(e) The improvement marks shall be written in the original tabulation sheet of the concerned student.

(f) If a students fails to improve the grade his/her previous grade in the same course will remain valid.

15. ACADEMIC ADMINISTRATION

(a) The academic committee of each Department of the Faculty shall design the academic calendar showing the dates for starting and finishing the classes, commencement of examinations and probable date for publication of the results before the commencement of each academic year and shall send it to the Dean of the Faculty, Controller of Examinations and the respective University authorities.

(b) Reexamination of any course shall not be allowed.

(c) Within the framework of the statutes, ordinances, and the rules of the university, the Academic Committee of the Department may adopt policies for strengthening the academic and co-academic activities of the Department.

M.Sc. Course outline and detail

The admission to M. Sc. Courses in Information and Communication Engineering (ICE) shall be in accordance with the ordinance for the degree of Master of Science of this University. The M. Sc. Course shall consist of two groups: General Group (Group A) and Thesis Group (Group B). The corresponding syllabus shall consist of Seven Theoretical Courses of which four will be compulsory and three will be optional. Each course will carry 100 marks including class attendance and Tutorial/Assignment and will be taught over one academic year. The students of group A shall have to perform Practical, Project, Field Works and or Viva-Voce. The students of group B shall have to perform Comprehensive Practical, Viva-voce and submit Dissertation and attend Dissertation viva-voce. Either group shall cover a grand total of 1200 marks distributed as shown bellow.

Theoretical Courses:

Course No.		Course Title	Total Marks	Unit	Credit
Compulsory Courses					
ICE 501	**:**	**Advanced Wireless Communication**	100	1	3.5
ICE 502	**:**	**Advanced Digital Communications**	100	1	3.5
ICE 503	**:**	**High-Speed and Broadband Networks**	100	1	3.5
ICE 504	**:**	**Networks Management and Security**	100	1	3.5
Optional Courses (Any Three)					
ICE 505	**:**	**E-Commerce and E-Governance**	100	1	3.5
ICE 506	**:**	**Information Coding and Transmission**	100	1	3.5
ICE 507	**:**	**Pattern Recognition**	100	1	3.5
ICE 508	**:**	**Telecommunication Management & Policy**	100	1	3.5
ICE 509	**:**	**Advanced Computer Vision**	100	1	3.5
ICE 510	**:**	**Client Server Technology and System Programming**	100	1	3.5
ICE 511	**:**	**Artificial Neural Networks: Theory & applications**	100	1	3.5
ICE 512	**:**	**Bio-Informatics**	100	1	3.5
		Total Marks	**700**	**7**	**24.5**

Practical, Project, Field Works, Dissertation:

ICE 514 : **Laboratory I (Practical for Group A)**

Unit-I: Communication Systems and Unit-II: Networking Systems

(i) Laboratory performance /Assignment/ oral test during Laboratory hours	= 5 marks
(ii) Laboratory attendance	= 10 marks
(iiI) Laboratory Note Book on experiment	= 05marks
Year-end Practical Examination	**= 80 marks**
Total	= 100 marks

ICE 515 : **Laboratory II (Practical for Group A)**

Unit-I: Digital Signal Processing; Unit-II: Multimedia Systems

(i) Laboratory performance /Assignment/ oral test during Laboratory hours	= 5 marks
(ii) Laboratory attendance	= 10 marks
(iiI) Laboratory Note Book on experiment	= 05marks
Year-end Practical Examination	**= 80 marks**
Total	= 100 marks

ICE 516 : **Laboratory III (Practical for Group A)**

Unit-I: Advance AI; Unit-II: System Simulations

(i) Laboratory performance /Assignment/ oral test during Laboratory hours	= 5 marks
(ii) Laboratory attendance	= 10 marks
(iiI) Laboratory Note Book on experiment	= 05marks
Year-end Practical Examination	**= 80 marks**
Total	= 100 marks

ICE 517 : **Project and Fieldwork (for Group A)**

Total Marks : 100 (Project: 80 and Fieldwork: 20)
Unit : 1
Credits : 3

ICE 518 : Comprehensive Practical and Fieldwork (for Group B)

Unit-I: Communication Systems and Unit-II: Advance AI

(i) Laboratory performance /Assignment/ oral test during Laboratory hours	= 5 marks
(ii) Laboratory attendance	= 10 marks
(iiI) Laboratory Note Book on experiment	= 05marks
Year-end Practical Examination	= 60 marks
Year-end Fieldwork	= 20 marks
Total	= 100 marks

ICE 519 : Dissertation (for Group B)
Full Marks : 200
Credits : 5

ICE 520 : Viva-Voce
Full Marks : 100
Credits : 2.5

ICE 521 : Presentation/Dissertation Viva-Voce (for Group B)

Full Marks : 100
Credits : 3

COURSE DETAILS

ICE 501: **Advanced Wireless Communication**

Full Marks : 100 **Unit 1, Credit 3.5**

- ***Marks Distribution for Theoretical Course***

Year end theoretical final examination	:	**75 marks**
Internal Evaluation of each theoretical course		
Tutorial / Assignment	:	**15 marks**
Class Attendance	:	**10 marks**

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Introduction to Wireless Communication: evolution of mobile communications, mobile radio systems around the world, trends in cellular radio and personal communications.
Modern Wireless Communication Systems: Second Generation (2G) Cellular Networks, Third Generation (3G) Wireless Networks, Fourth Generation (4G) Wireless Networks, Wireless Local Loop (WLL) and LMDS, Wireless Local Area Networks (WLANs), Blue tooth Personal Area Networks (PANs).

The Cellular Concept-System Design Fundamentals: Introduction, frequency reuse, channel assignment Strategies, handoff Strategies, interference and system capacity, trunking and grade of service, improving coverage and capacity in cellular systems.

Mobile Radio Propagation-Large scale path loss: Introduction to radio wave propagation, Free space propagation model, relating power to electric field, basic propagation mechanisms, Reflection, Ground reflection (Two Ray), Diffraction, Scattering, Practical Lin Budget design using path loss models, outdoor and indoor propagation models.

Mobile Radio Propagation- Small Scale Fading and Multi-path: Small scale multipath propagation, Impulse response model of a multipath channel, Small-scale multipath measurements, Parameters of mobile multipath channels, types of small scale fading, Rayleigh and Ricean distributions, statistical models for multipath fading channels, Theory of multipath shape factors for small scale fading wireless channels.

Modulation Techniques for Mobile Radio: Frequency modulation vs. Amplitude modulation, Amplitude modulation, angle modulation, digital modulation, digital modulation, line coding, pulse shaping techniques, geometric representation of modulation signals, linear modulation techniques.

Equalization, Diversity, and channel coding: Introduction, fundamentals of equalization, linear inequalities, nonlinear equalization, algorithms for adaptive equalization, diversity techniques, interleaving, fundamentals of channel coding.

Speech Coding: Introduction, Characteristics of speech signals, quantization techniques, ADPCM, Frequency domain coding of speech, vocoders, linear predictive coders.

Multiple Access techniques for Wireless communications: Introduction, FDMA, TDMA, spread spectrum multiple access, SDMA, packet radio, reservation protocols, capacity of cellular systems.

Recommended Books:

Wireless Communications, Theodore S. Rappaport

Wireless and Mobile Network Architectures, Yi-Bing Lin, Imrich Chlamtac.

ICE 502 : Advanced Digital Communications

Full Marks : 100 **Unit 1, Credit 3.5**

- ***Marks Distribution for Theoretical Course***

Year end theoretical final examination	**:**	**75 marks**
Internal Evaluation of each theoretical course		
Tutorial / Assignment	**:**	**15 marks**
Class Attendance	**:**	**10 marks**

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Introduction: Elements of a Digital Communication system. Communication Channels and their characteristics. Mathematical Models for communication channels. Basic Digital Communication Nomenclature. Classification of Signals. A historical perspective in the development of Digital Communications.
Formatting and Baseband modulation: Baseband systems, Message, Characters and Symbols, Formatting Analog Information, Sources of Corruption, Pulse Code Modulation, Uniform and Nonuniform Quantization, Baseband Modulation.
Baseband Demodulation/Detection: Signals and Noise, Detection of Binary Signals in Gaussian Noise, Intersymbol Interference, Equalization.
Bandpass Modulation and Demodulation/Detection: Why Modulate, Digital Bandpass Modulation Techniques, Complex Envelop, Error Performance for Binary Systems, M-array Signalling and Performance
Multiplexing and Multiple Accesses: Allocation of the communication resources. Multiple Access Communications System and Architecture, Access Algorithms, Multiple Access Techniques for Local Area Networks.
Spread spectrum Techniques: Spread Spectrum Overview, Pseudonoise Sequences, Direct- Sequence Spread Spectrum, Frequency Hopping Systems, and Commercial Applications.
Fading Channels: The Challenge of Communicating over Fading Channels, Characterizing Mobile-Radio Propagation, Signal Time-Spreading, Time Variance of the Channel Caused by Motion, Mitigating and Degradation Effects of Fading.

Recommended Books:
Digital Communications, Fundamentals and Applications by Bernard Sklatior
Digital Communications by John G. Proakis
Digital Communications by Simon Haykin

ICE 503 : High-Speed and Broadband Networks

Full Marks : 100 **Unit 1, Credit 3.5**

- ***Marks Distribution for Theoretical Course***

Year end theoretical final examination	:	**75 marks**
Internal Evaluation of each theoretical course		
Tutorial / Assignment	:	**15 marks**
Class Attendance	:	**10 marks**

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Evolution and Technical Foundation: Evolution and Convergence, Telecommunications, Computer Data Networks, Broadcast Networks, Technical Foundation, Modulation Techniques, Error Detection and Correction Techniques, Challenges and Limitations of the transmission Medium.

DSL Access Networks: The State of Affairs, Challenges of the Local Loop, The DSL Family.

Emerging Broadband Access Technologies: Emerging Passive Optical Network Technologies, Ethernet Optical Networks (EPONs), Gigabit Ethernet as a Broadband Access Technology, HPPI.

Frame Relay: Frame Relay: protocol architecture, UNI, call control, congestion control. Multi-protocol encapsulation, Voice over Frame Relay, NNI, multicasting.

ATM Architecture and Protocols: Basic concepts: services, protocol layers, cell, virtual path, virtual channel, VPC, VCC, service categories and QoS parameters. Physical Layer: functions, PDH, FDDI, and SDH alternatives. ATM Layer: functions and protocol operation. AAL: functions, AAL types, operational details of each type. ATM Interfaces: public and private UNI and NNI, DXI, user plane, control plane, and management plane functions.

ATM Switching and Signaling: ATM switching requirements. ATM switch architectures: input module, output module, switch fabric, queuing and buffering options. ATM signaling: SAAL, BISUP, Q.2931, PNNI.

ATM Traffic Management, Congestion Control, and Traffic Engineering: Traffic contract, QoS classes and parameters, traffic descriptors and tolerances, leaky bucket algorithm. Usage/Network parameter control, priority control, traffic shaping, connection admission control, resource management. Congestion control categories, congestion management, congestion avoidance, tagging, blocking, widow-based, rate-based, and credit-based flow controls, congestion recovery. Traffic source models, performance of buffering methods, performance of CBR and VBR .

Books Recommended:

"Broadband Networking: ATM, SDH and SONET", Mike Sexton and Andy Reid, Artech House Publishers, Norwood, MA.
“Broadband Networking”, Glen Carty.

D.Minoli, "Broadband Network Analysis and Design", Artech House, 1993.

R.O.Onvural, "Asynchronous Transfer Mode Networks, Performance Issues", Artech House, 1995.

L.G.Cuthbert, J.C.sapanel, "ATM", IEE, 1993.

P. Bocker, "ISDN The Integrated Service Digital Network", Springer-Verlag, 1988.

ATM Networks: Concepts, Protocols, Applications, Rainer Handel, Manfred N. Huber, Stefan Schroder, Addison-Wesley, 1994.

ATM switching systems, Thomas M. Chen, Stephen S. Liu, Artech House, 1995.

Broadband Integrated Networks, Mischa Schwartz / Hardcover / Published 1996.

Telecommunication Networks : Protocols, Modeling, and Analysis, Mischa Schwartz / Hardcover / Published 1986.

Computer-Communication Network Design and Analysis, Mischa, Schwartz / Published 1977.

ICE 504 : Network Management and Security

Full Marks : 100 **Unit 1, Credit 3.5**

- ***Marks Distribution for Theoretical Course***

Year end theoretical final examination	**:**	**75 marks**
Internal Evaluation of each theoretical course		
Tutorial / Assignment	**:**	**15 marks**
Class Attendance	**:**	**10 marks**

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Network Management & CMIP: Introduction, Significance, Integrated Network Management, Network Management Systems, Network Management Standards, The OSI Management Model; Organization Model, Information Model, Communication Model, Functional Model.

SNMP,SnmpV2-V3,RMON: Internet Management Model; Polling, Proxies, Organization Model, Information Model, Communication Model, Functional Model, Major Changes in SNMPV2-V3.

Network Monitoring & Control: Architecture, Performance Monitoring, Fault Monitoring, Fault Management, Configuration Control, Security Control, Security Management.

Security Fundamentals: Information Security, Threats & Attacks, Intrusion Techniques, Intrusion Detection, Viruses & Related Threats, Virus Countermeasures, General Model For Network Security.

Security In Layered Architecture: Protocol Layering, The OSI Security Architecture, Security Services, Security Mechanism, Placement of Encryption Function, Traffic Confidentiality.

Conventional Encryption: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Key Distribution, Key Control Schemes.

Public-Key Encryption: Public Key Cryptosystem, Applications & Requirements, Cryptanalysis, The RSA Algorithm, Key Management, Diffie-Hellman Key Exchange.

Authentication & Signature: Authentication Requirements, Functions, Message Authentication Code, Hash Function, Digital Signature Requirements, Types of Digital Signature.

Books Recommended:

Franz-Joachim Kauffels, "Network Management", Addison Wesley, 1992.

Allan Leinwand and Karen Fang-Conroy, "Network Management", Second Edition, Addison-Wesley, 1996.
Morris Sloman, "Network and Distributed Systems Management", Addison-Wesley, 1994.
William Stallings, "SNMP, SNMPV2 and RMON", Addison-Wesley, 1996.
Warwick Ford: Computer Communications Security, Prentice Hall, 1994.
Ervin Toffer, "Third Wave", J. D. Zelezny, "Communications Law", Wadsworth Publishing Co., 1997.
William Stalling, Cryptography & Network Security.
Pearson Education uyless Black, Network Management standards.

Optional Courses (Any three)

ICE 505: E-Commerce and E-Governance

Full Marks : 100 **Unit 1, Credit 3.5**

- ***Marks Distribution for Theoretical Course***

Year end theoretical final examination	**:**	**75 marks**
Internal Evaluation of each theoretical course		
Tutorial / Assignment	**:**	**15 marks**
Class Attendance	**:**	**10 marks**

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Introduction: Introduction, Understanding e-commerce, E-commerce comes on age, Why e-commerce?, E-commerce reality and myth. E-commerce obstacle course: Cost/benefit analysis, Technology issues, security, staffing for e-commerce, decision-making factors.

E-commerce Building Blocks: Hardware and Software basics, External service providers, Interface and Integration, Building and e-commerce program, Extranets for business to business transactions, Management tools.

E-commerce Best Practices: Managing the visitor relationship, Managing and maintaining visitor privacy, Managing visitor perceptions, Site consistency, Managing business knowledge using e-commerce.

Brand Management Strategies: Managing e-brand risk, Partnering with everyone, Protecting your brand, Innovating constantly to beat competitors, Acquiring and Retaining customers.

E-Commerce Strategy: Strategy statements, creating and managing internet content, e-commerce platform foundation, Processing e-commerce foundation, Web portals, Partnering.

Electronic Payment Systems: Web based payment systems, Web based payment system based on credit cards, checking accounts and cash, Business to consumer e-commerce: e-commerce business models, On line publishing, On line customer service and support, On line banking; Legal Issues: Intellectual property, Copyright, Trademark and Patents, Cyber Crime and Money Laundering.

E-Governance: Introduction, Understanding of e-governance, Understand the basic concepts of e-governance and the use of information systems in government; Apply strategic planning models to the development of e-government; Develop and present a preliminary e-government project.

Books Recommended

Charles Trepper, E-commerce Strategies, Prentice-Hall, 2001.

Vandome, Nick, E-Commerce In Easy Steps

Bajaj, N.K, E-Commerce

Singh, Alwyn Didar, E-Commerce For Managers

Sharma, Pankaj, Knowledge Management

Khristine Annwn Page Macromedia Dreamweaver MX: Training from the source

Ben Shneiderman, 'Designing Information- Abundant Websites.

ICE 506: Information Coding and Transmission

Full Marks : 100 **Unit 1, Credit 3.5**

- ***Marks Distribution for Theoretical Course***

Year end theoretical final examination	:	**75 marks**
Internal Evaluation of each theoretical course		
Tutorial / Assignment	:	**15 marks**
Class Attendance	:	**10 marks**

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Information Sources: Introduction, Probability Spaces and Random Variables, Random Processes and Dynamical Systems, Distributions, Standard Alphabets, Expectation, Asymptotic Mean Stationarity, Ergodic Properties

Entropy, Relative Entropy, and Mutual Information: Entropy and Entropy Rate, Basic Properties of Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality

Asymptotic Equipartition Property Asymptotic Equipartition Property Theorem, Consequences of the AEP: Data Compression, High-Probability Sets and the Typical Set.

Entropy Rates of a Stochastic Process: Markov Chains, Entropy Rate, Example: Entropy Rate of a Random Walk on a Weighted Graph, Second Law of Thermodynamics Functions of Markov Chains.

Information Rates: Introduction, Stationary Codes and Approximation, Information Rate of Finite Alphabet Processes, Conditional Relative Entropy, Limiting Entropy Densities, Information for General Alphabets, Some Convergence Results. Information Rates for General Alphabets, A Mean Ergodic, Theorem for Densities, Information Rates of Stationary Processes

Data Compression Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length, Kraft Inequality for Uniquely Decodable Codes, Huffman Codes, Some Comments on Huffman Codes, Optimality of Huffman Codes, Shannon–Fano–Elias Coding, Competitive Optimality of the Shannon Code, Generation of Discrete Distributions from Fair Coins

Channels and Codes: Introduction, Channels, Stationarity Properties of Channels, Examples of Channels, The Rohlin-Kakutani Theorem, Distortion and Fidelity Criteria, Performance, The rho-bar distortion, d-bar Continuous Channels, The Distortion-Rate Function

Source Coding Theorems: Source Coding and Channel Coding, Block Source Codes for AMS Sources , Block Coding Stationary Sources, Block Coding AMS Ergodic Sources, Subadditive Fidelity Criteria, Asynchronous Block Codes, Sliding Block Source Codes, A Geometric Interpretation of OPTA's

Coding for noisy channels: Noisy Channels, Feinstein's Lemma, Feinstein's Theorem, Channel Capacity, Robust Block Codes, Block Coding Theorems for Noisy Channels, Joint Source and, Channel Block Codes, Synchronizing Block Channel Codes, Sliding Block Source and Channel Coding

Books Recommended :

Mischa Schwarhtz, information transmission modulation & noise

Carlson, Communication system.

Simon Haykin, Communication Systems

ICE 507 : Pattern Recognition

Full Marks : 100 **Unit 1, Credit 3.5**

- ***Marks Distribution for Theoretical Course***

Year end theoretical final examination	**:**	**75 marks**
Internal Evaluation of each theoretical course		
Tutorial / Assignment	**:**	**15 marks**
Class Attendance	**:**	**10 marks**

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Introduction of pattern recognition: Pattern and Feature-training and learning pattern recognition approaches-Statistical Pattern recognition-Syntactic Pattern recognition-Neural Pattern recognition-Reasoning driven Pattern recognition-Discriminant Functions-Linear and Fisher's discriminant functions.

Statistical Pattern Recognition: Gaussian Model-Supervised Learning, Parametric estimation-Maximum likelihood estimation-Bayesian Parameters estimation, Perception Algorithms- LMSE Algorithms-Problems with bayes approaches-Pattern classification by distance functions- Maximum distance pattern classifier.

Cluster Analysis: Unsupervised learning-clustering for unsupervised learning and classification-C-Means Algorithm-Hierarchical procedures-graph theoretic approach to pattern clustering-validity of clustering solutions.

Syntactic Pattern Recognition: Elements of formal grammar-string generation as patterns description-recognition of syntactic description-parsing-stochastic grammar and applications-graph based structural representation.

Feature Extension and Recent Advances: Entropy minimization-karhunen-Loeve transformation-Neural Network Structures for pattern recognition- unsupervised learning-self organizing networks-fuzzy pattern classifiers-genetic algorithm-application to pattern recognition, Hidden Marcov Model (HMM).

Books Recommended:

Richard, E.G, Johnsonbaugh & Jost, Pattern Recognition & Image Analysis, Prentice Hall of India Private. Ltd, New Delhi-110001, 1999

Duda R, O. and Hart P.E, Pattern Classification and Scene Analysis, wiley, New York, 1973

Morton Nadler and Eric Smith p., Pattern Recognition Engineering, John Wiley and Sons, New York, 1993

Tou and Gonzaler R., Pattern Recognition and Principles Addision Wesley, 1974

ICE 508 : Telecommunication Management & Policy

Full Marks : 100 **Unit 1, Credit 3.5**

- ***Marks Distribution for Theoretical Course***

Year end theoretical final examination	**:**	**75 marks**
Internal Evaluation of each theoretical course		
Tutorial / Assignment	**:**	**15 marks**
Class Attendance	**:**	**10 marks**

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Topic covered:

Technologies for Telecommunications Network Management: Introduction and overview, Management Information Models, Access and distribution Paradigm.

Management platforms: Introduction, Methods and Tools, Standards and Platform Building Blocks .

Management of PCS networks: Introduction, Management Approaches, Reference Models, Requirements, Management Functions.

Managing Mobile Networks: Introduction, Managing the Elements, Managing different layers.

Architectural Integrity: Introduction, TMSs in the context of the S&NI Life Cycle, Architectural Integrity as a countermeasure to complexity.

Telecommunications Network Management: Introduction, TMN functions, TMN reference points, Interconnecting functions through reference points, TMN manager and agent.

Telecommunication Policy : Introduction, Policy adapted by different telecommunication system approach.

Books Recommended:

Salah Aidarous, Thomas Plevyak, Telecommunications Network Management, IEEE Press, 1998

Uyless Black, Network Management Standards, McGraw-Hill, 1994

ICE 509 : Advanced Computer Vision

Full Marks : 100 **Unit 1, Credit 3.5**

- ***Marks Distribution for Theoretical Course***

Year end theoretical final examination	**:**	**75 marks**
Internal Evaluation of each theoretical course		
Tutorial / Assignment	**:**	**15 marks**
Class Attendance	**:**	**10 marks**

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Objective: This course gives an overview of fundamental methods in computer vision with strong mathematical background. The goal of this course is to enable computer to see through camera. In doing so, this curriculum integrates feature extraction techniques, stereo, motion analysis, photometry and some well established pattern analysis theory. This course divided into two parts. In this course, renowned and well established feature extraction and descriptors and their application in multi-view geometry are discussed. As this course outline is for graduate students, some revolutionary research papers are also suggested to enable students' ability to carry out research activity in computer vision arena.

Topic covered:

Mathematics for Computer vision: Eigen values and Eigen vectors, Singular value decomposition for eigen analysis. (SVD), Principal Component Analysis (PCA), Fisher Linear Discriminant Analysis (LDA)

Features: Points and patches, feature detectors, Corner detection using Harris corner detector, Scale-invariant feature transform (SIFT), Hough transform, Histogram of oriented gradient (HOG) descriptor

2D and 3D geometry: Geometric primitives: 2D, 3D transformation, rotation and projections, Pinhole camera model, Epipolar geometry, Essential Matrix, eight-point linear algorithm, Uncelebrated camera, fundamental matrix, Ambiguities and constraints in image formation, calibration with a rig

Homography: Planer scene and Homography, Estimating homography matrix, Decomposing homography matrix, Relation between homography and essential matrix Feature Matching

RANSAC: Feature Selection, Feature matching by RANSAC

Paper Reading: SIFT, SURF, HOG (freely available in the internet)

1. Active 3D shape acquisition using smartphones by Jae Hyun Won, Man Hee Lee, In Kyu Park (CVPR-2012)
   image.inha.ac.kr/paper/7_Won.pdf
2. CENTRIST: A visual Descriptor for Scene Categorization.
   http://cs.nju.edu.cn/wujx/paper/PAMI_CENTRIST.pdf
3. 2D-LDA: A statistical linear discriminant analysis for image matrix
   www.sciencedirect.com/science/article/pii/S0167865504002272

Books Recommended:

Pattern Classification by Richard O. Duda
Computer Vision Algorithms and Applications by Richard Szeliski
An invitation to 3-D Vision by Yi Ma
http://www.ling.ohio-state.edu/~kbaker/
pubs/Singular_Value_Decomposition_Tutorial.pdf

ICE 510 : Client Server Technology and System Programming

Full Marks : 100 **Unit 1, Credit 3.5**

- ***Marks Distribution for Theoretical Course***

Year end theoretical final examination	:	**75 marks**
Internal Evaluation of each theoretical course		
Tutorial / Assignment	:	**15 marks**
Class Attendance	:	**10 marks**

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Topic Covers:

The Client Server model and software Design

Concurrent Processing in Client Server Software

Application interface to protocols

The Socket API.

Algorithms in Client Software Design.

Iterative Connectionless Servers(UDP).

Concurrent Connection Oriented Services(TCP).

Multi-services Servers(TCP/UDP)concept.

NFS concept and protocols.

Telnet programs.

Books Recommended:

Internetworking with TCP/IP client server Programming and Applications, Douglas E Commer, Prientice Hall.

ICE 511: Artificial Neural Networks: Theory and Applications

Full Marks : 100 **Unit 1, Credit 3.5**

- ***Marks Distribution for Theoretical Course***

Year end theoretical final examination	:	**75 marks**
Internal Evaluation of each theoretical course		
Tutorial / Assignment	:	**15 marks**
Class Attendance	:	**10 marks**

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Introduction to Artificial Neural Network: History of Artificial Intelligence, From Biological Neuron to ANNs: Neuron model, architecture, Biological Neuron, Artificial Neuron Model, Network of Neurons, Network Architectures, Neuron activation functions, learning process.

Recurrent Neural Networks: Dynamical Systems, Phase Space, Major Forms of Dynamical Systems, Gradient, Conservative and Dissipative Systems, Equilibrium States, Stability, Effects of inputs and the initial states on the attraction, Cohen-Grossberg Theorem, Hopfield Network, Discrete time representation of recurrent networks.

Neural Networks as Associative Memory: Associative Memory, Linear Associators as Interpolative Memory, Hopfield Autossociative Memory, Bidirectional Associative Memory, Combinatorial Optimization

Problems, Mapping an Optimization Problem onto Neural Networks, Hopfield Network as Combinatorial Optimizer.

Stochastic Neural Network for Optimization: Statistical Mechanics and Simulated Annealing, Boltzmann Machine, Mean Field Theory, Mean Field Annealing, Gaussian Machine.

Learning in Feedforward Networks: Single Layer perceptron vs Multilayer Perceptrons, Perceptron Convergence Procedure, LMS Learning Rule, Steepest Descent Algorithm, The Backpropagation Algorithm, Recurrent Backpropagation, Backward Phase, Stability of Recurrent Backpropagation

Data Clustering and Self Organizing Feature Maps: Clustering methods, The K-Means, Clustering Algorithm, Self Organizing Feature Maps, SOFM versus K-means clustrering, Kohonen Feature Maps, Principal Component Analysis.

Radial Basis Function Networks: The Structure of the RBF Networks, Function approximation, Training RBF Networks, Support Vector Machine.

Application of Neural Networks to Control, Robotics and Manufacturing Processes: Identification and Prediction, Fault Detection, Systems Control, Pattern Recognition, Manufacturing Process, Robot Dynamics and Control.

Reference Books:

1. S.Kumar "Neural Networks : a classical approach", McGraw Hill 2004.
2. J.A.Freeman and D. M. Skapura, " Neural Networks: Algorithm, Applications and Programming Techniques", Addision-Wesley, 1991.
3. Simon Haykins: " Neural Network", Macmillan College Publishing Co. ,1994
4. Jacek M.Zurada " Introduction to Neural Systems" New York, West
5. Publishing Company, 1992. (out of print)
6. Journal Papers

ICE 512: **Bioinformatics**

Full Marks : 100 **Unit 1, Credit 33.5**

- ***Marks Distribution for Theoretical Course***

Year end theoretical final examination	**:**	**75 marks**
Internal Evaluation of each theoretical course		
Tutorial / Assignment	**:**	**15 marks**
Class Attendance	**:**	**10 marks**

[The examination of each theoretical course shall be of 4 (four) hours duration and a student will answer 5 questions out of 8 and each question will carry 15 marks]

Introduction to Bioinformatics: Life in space and time, Dogmas, data archives Biological classification and nomenclature, Use of sequences to determine phylogenetic relationships, Searching for similar sequences in databases: PSI-BLAST, Introduction to protein structure, Protein structure prediction and engineering, Genomics and proteomics, Eavesdropping on the transmission of genetic information.

Database and Data Visualization: Data Management, Data Life-cycle, Database Technologies, Sequence visualization, structure visualization, User interface, Animation Versus Simulation.

Part I Probabilistic Modeling: Introduction to Bayesian Networks, Learning Bayesian networks from complete and incomplete data, EM algorithm and HMM. Introduction to Perceptrons, Maximum Likelidood Estimation, Multi-Layer Perceptrons learning Algoritm, MLP training issues.

Part II Bioinformatics: Statistical Phylogenetics: Introduction to Statistical Phylogenetics, Distance and Clustering Methods, Parsimony, Likelihood Methods, Detecting Recombination in DNA Sequence Alignments, Recombination in Bacteria and Viruses, Maximum Chi-squared, PLATO, TOPAL, Probabilistic Divergence Methods, Combining Phylogenetic Trees with HMMs, Simulated Recombination, Gene Conversion in Maize, Recombination in *Neisseri.* RNA-Based Phylogenetic Methods: RNA Structure, Substitution Processes in RNA Helices, Mammalian Phylogeny

Statistical Methods in Microarray Gene Expression Data: Introduction, Gene Expression in a Nutshell Microarray Technologies, Image Analysis, Image Enhancement, Gridding, Estimators of Intensities, Transformation, Normalization, Explorative Analysis and Flagging of Data Points, Linear Models and Experimental Design, Non-linear Methods, Normalization of One-channel Data,

Inferring Genetic Regulatory Networks from Microarray Experiments: Learning Local Structures and Subnetworks, Application to the Yeast Cell Cycle, Biological Findings, Shortcomings of Static Bayesian

Networks, Dynamic Bayesian Networks, Accuracy of Inference, Evaluation on Synthetic Data, Evaluation on Realistic Data, State-Space Models (Linear Dynamical Systems), Kalman Smoothing, SSM Model for Gene Expression, Model Selection by Bootstrapping, Experiments with Simulated Data

Part III Medical Informatics: Probabilities in Medicine, Bayesian Statistics, Logistic Regression, Bayesian Logistic Regression, Gibbs Sampling and GLIB, Hierarchical Models, Multi-Layer Perceptrons, RBF, Probabilistic Neural Networks, Missing Data, Bayesian Neural Techniques, Moderated Output, Hyperparameters, Committees, Full Bayesian Models, The Na¨ıve Bayes Model, Bayesian Networks, Probabilistic Inference over BNs, Sigmoidal Belief Networks, Construction of BNs: Probabilities, Construction of BNs: Structures, Missing Data, Class-Probability Trees, Data Conditioning, Detection, Segmentation and Decisions Cluster Analysis Hidden Markov Models

Recommended Books:

Introduction to Bioinformatics; Arthur M. Lesk Oxford University Press Inc., New York, 2002

Bioinformatics Computing By Bryan Bergeron; Prentice Hall, 2002

Probabilistic Modeling in Bioinformatics and Medical Informatics: Dirk Husmeier, Richard Dybowski and Stephen Roberts (Eds); Springer 2004