UNIVERSITY OF DELHI

MASTER OF INFORMATICS

(M.Sc. Informatics)

(Effective from Academic Year 2018-19)

PROGRAMME BROCHURE

DRAFT FOR FEEDBACK

Please email your feedback/comments to

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Institute of Informatics & Communication (IIC)

University of Delhi South Campus

New Delhi - 110021

CONTENTS

I. About IIC

Information Technology integrates a wide spectrum of knowledge and skill ranging from the design of computer hardware, software systems, and telecommunication to the impact of information technology on society. To achieve this holistic goal the Institute of Informatics & Communication (IIC) was established in 1997 with the following objectives:

1. *To serve as an inter-disciplinary centre for humanities, social sciences, pure and applied sciences and as a nodal point between university and various Institutions/Industries, related to communication and informatics.*
2. *To conduct professional / socially relevant post-graduate teaching programmes, independently or in collaboration with various departments on different aspects on communication and informatics.*
3. *To conduct research on various aspects of informatics and communication*.

The Institute of Informatics and Communication of the University of Delhi South Campus is a unique institution from several points of view. For one, it offers a two-year M Sc (Informatics) that combines high-end knowledge with useful real world applications in several areas of information technology and communications. For another, it trains the student to think analytically and imparts a degree of maturity and independence to the student through some innovative schemes. The Institute also trains its students to imbibe the ability to stay abreast with recent developments in the various areas that are related to Informatics so that they are able to perform at optimum levels in their subsequent professional careers. The curriculum at Institute of Informatics and Communication (IIC) attempts to prepare its graduates for meaningful and challenging jobs in IT Industry. The learning environment in the Institute encourages initiative, teamwork and development of entrepreneurial skills.

The learning approach at IIC includes classroom lectures, tutorials, project assignment and Internet access. The students are encouraged to develop their skills and acquire theoretical knowledge and practical training in electronics, telecommunication and computer hardware and software. To improve the communication skills of students and to increase their confidence, students are required to make presentations with the help of visual aids during the fortnightly seminar sessions.

The selection process to enter the Postgraduate programme is rigorous and the number of seats is restricted to ensure quality education. The Institute provides an excellent environment for learning and innovation. IIC aims towards the development of intense research activity in various areas of Informatics and Telecommunications, and towards participating in national and international competitive research and development projects to attract external resources. The research staff of the IIC Department is thriving for quality work have published papers in leading scientific journals, have developed important national cooperations with related departments abroad, and participate in scientific committees of prestigious international and conferences.

II. Introduction to CBCS (Choice Based Credit System)

Choice Based Credit System:

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations which enables the student to move across institutions of higher learning. The uniformity in evaluation system also enable the potential employers in assessing the performance of the candidates.

Definitions:

(i) 'Academic Programme' means an entire course of study comprising its programme structure, course details, evaluation schemes etc. designed to be taught and evaluated in a teaching Department/Centre or jointly under more than one such Department/ Centre

(ii) 'Course' means a segment of a subject that is part of an Academic Programme

(iii) 'Programme Structure' means a list of courses (Core, Elective, Open Elective) that makes up an Academic Programme, specifying the syllabus, Credits, hours of teaching, evaluation and examination schemes, minimum number of credits required for successful completion of the programme etc. prepared in conformity to University Rules, eligibility criteria for admission

(iv) 'Core Course' means a course that a student admitted to a particular programme must successfully complete to receive the degree and which cannot be substituted by any other course

(v) 'Elective Course' means an optional course to be selected by a student out of such courses offered in the same or any other Department/Centre

(vi) 'Open Elective' means an elective course which is available for students of all programmes, including students of same department. Students of other Department will opt these courses subject to fulfilling of eligibility of criteria as laid down by the Department offerring the course.

(vii) 'Credit' means the value assigned to a course which indicates the level of instruction; One-hour lecture per week equals 1 Credit, 2 hours practical class per week equals 1 credit. Credit for a practical could be proposed as part of a course or as a separate practical course

(viii) 'SGPA' means Semester Grade Point Average calculated for individual semester.

(ix) 'CGPA' is Cumulative Grade Points Average calculated for all courses completed by the students at any point of time. CGPA is calculated each year for both the semesters clubbed together.

(x) 'Grand CGPA' is calculated in the last year of the course by clubbing together of CGPA of two years, i.e., four semesters. Grand CGPA is being given in Transcript form. To benefit the student a formula for conversation of Grand CGPA into %age marks is given in the Transcript.

M. Sc. Programme Details:

Programme Objectives (POs):

The Institute of Informatics and Communication offers a modern and competitive study programme, that incorporates the international developments of the respective fields. The curriculum aims to provide students with basic knowledge and skills on informatics and telecommunications, as well as with specialised knowledge so that they acquire a sound sci- entific background and be able to fully cope with the increasing demands of the associated industry.

The aims of the program are, in more detail, the following:

- To inspire the students on the subjects they have chosen to study and to create an interesting and fruitful learning experience for them.
- To develop knowledge, understanding and abilities in informatics and telecommunications and related technologies.
- To provide the students with the knowledge and abilities necessary for them to evolve into competent professionals.
- To provide the students the opportunity to get in touch with the most recent and innovative scientific and technological advances in informatics and telecommunications.
- To provide education and learning through a multitude of educational activities, in order to develop abilities that will be applicable to the professional career.
- To prepare the students for further work and research in informatics and telecommunications.
- To provide the students with the knowledge and abilities necessary for them to be able to form scientifically sound solutions to problems pertaining to informatics and telecommunications.

Principles

The structure of the curriculum follows the guidelines of the main international scientific and professional associations on Informatics and Telecommunications, i.e. those of ACM and IEEE. It has incorporated the accumulated experience of the faculty, as well as the findings of the External Evaluation Report.

Learning Outcomes

Students of the Department of Informatics and Telecommunications that have successfully graduated

will:

Knowledge and understanding

- Have acquired the necessary knowledge on working principles on the fields of information and telecommunication systems, networks, services and applications.
- Know the fundamental issues of the disciplinary fields of Informatics and Telecommuni- cations and will be able to propose scientifically grounded and innovative solutions in the field of ICT applications, as well as to estimate the cost-benefit ratio of each solution.
- Understand the principles of economical and managerial aspects of running projects re- lated to Informatics and Telecommunications.
- Understand issues related to social, legal, educational end ethical aspects of Informatics and Telecommunications.

Application of knowledge and understanding

- Be capable of applying their knowledge and understanding so as to become effective professionals
- Possess appropriate skills to develop sector-specific solutions.
- Have the ability to apply the theories of informatics and telecommunications in modern information & telecommunication systems, as well as in related research areas.
- Have the potential to recognize the tools and techniques suitable for the problems at hand and apply them effectively, so as to successfully complete complex projects.
- Be able to conduct experiments that involve tests and measurements, as well as analyze, interpret and present the produced results.
- Have the ability to undertake and successfully execute projects both as individuals and as members of a technical team.
- Be capable of working effectively in a team in order to manage, design, test certify the performance of ICT systems.

Outcome

- Will be capable of recognizing, formulating and solving problems in the design, manage- ment and evolution of informatics and communication systems.
- Have the potential to carry out experimental testing and assess the performance of ICT hardware/software, as well as evaluate the extent to which an implemented system con- forms

to its specifications.

- Understand scientific and technical publications and be able to formulate their personal opinion on their importance and implications.
- Demonstrate insight into the potential limitations of technology, the role it plays in the society and the personal responsibility on its use, including social, economic, environmental and work aspects.
- Be able to determine their needs to acquire new knowledge and continuously extend their knowledge and skills.

Communication

- Be proficient in communicating problems, ideas, solutions, technical information effectively and efficiently;
- Have the capability produce technical reports on the activities carried out and present summaries of the key results in group discussions;

Learning

- Be able to recognize and adapt to new methods, techniques and instruments used in all phases of ICT systems' and applications' lifecycle.
- Have the capacity to follow scientific and technological developments in the ICT domain and determine needs for further knowledge acquisition and skill development
- Have the potential to continue further studies in all fields of informatics and communications.

Degree Requirements

A degree will be awarded to a student who meets the following academic requirements:

- Successful completion of assessments in 20 core courses
- Successful completion of the summer internship dissertation.

When the student has successfully completed the assessment of courses of a total of 138 credits The degree grade has the following classification:

Grade	Grade points	Percentage	Description of performance
A	10	(91-100)	Outstanding
A-	9	(81-90)	Excellent

B	8	(71-80)	Very good
B-	7	(60-70)	Good
C	6	(50-60)	Average
D	4	(40-50)	Below Average
P	0	<40	Poor
I	-	-	Incomplete

Educational Procedure

Through the educational procedure applied at IIC, students learn to analyse scientific problems and find solutions to them, work individually and in groups, and effectively coordinate working groups. Lectures, laboratory activities and projects are basic elements of the educational procedure.

In-class and laboratory activities are an extremely important part of the unique educational experience of the student. Through these activities students and tutors share their knowledge and experience and advance their educational level both individually and collectively. Concerning the importance of these activities, students must systematically attend the lectures and the laboratory activities, be at the classroom before the beginning of the lecture, attend the lecture to the very end, and engage in the educational procedure.

The Institute of Informatics and Communication uses modern e-learning tools, such as online lecture notes, online project submission tools, announcement lists, additional educational material, etc. However, these tools cannot substitute under any circumstances the lectures and the laboratory exercises or any other activity that requires the student's physical presence, including the procedure of the exams (e.g., the assessment of the laboratory exercises). Students are expected to participate in the activities of the courses according to the course timetable and the teachers' directions.

Programme Structure:

The M. Sc programme is a two-year course divided into four-semester. A student is required to complete 96 credits for the completion of course and the award of degree.

Year	*Semester*	*Semester*
First Year	**Semester I**	**Semester II**
Second Year	**Semester III**	**Semester IV**

Course Credit Scheme

Total credits of the course = 96
Number of core papers = 13
Project (Dissertation) = 1
Number of elective papers = 02
Number of Open elective paper = 01

Semester	Core Courses			Elective Course			Open Elective Course			Total Credits
	No. of papers	Credits (L+P)	Total Credits	No. of papers	Credits	Total Credits	No. of papers	Credits	Total Credits	
I	4Th + 4 P	16 L + 8 P=24	**(4+2)x4 = 24**	0	0	**0**	0	0	**0**	**24**
II	4 Th + 4 P	16L + 8 P=24	**(4+2)x4 = 24**	0	0	**0**	0	0	**0**	**24**
III	3 Th + 3 P	12L + 6 P=18	**(4+2)x3 = 18**	1	4	**4**	1	2	**2**	**24**
IV	2Th 1 Proj.	8L 12 Proj. =20	**(4)x2=8+ 12 = 20**	1	4	**4**	0	0	**0**	**24**
Total Credits for the Course			**86**			**8**			**2**	**96**

L= Lecture, P = Practical
*For each Core and Elective Course there will be 4 lecture hours of teaching per week.
* Open Electives to the maximum total of 8 credits.

Courses List

This section summarises the courses of the programme; courses are grouped according to their category and some basic information about them is listed.

3.1.2 Foundation courses

Orientation Semester (two weeks-non credit)

Code	Paper	Credits
IT01	Computational Numerical and Statistical Methods	0
IT02	Introduction to Programming	0
IT03	Analog Electronics	0
IT04	Digital Electronics and Computer Organisation	0
		0

3.1.3 Core courses

First Semester

Code	Paper	Credits
IT11	Programming Methodology	6
IT12	Computer Architecture & Interface Programming	6
IT13	Introduction to Communication and Systems	6
IT14	Mathematical Foundation for Computer Science	6
		24

Note: The seven credit paper have three hours theory, one hour tutorial and three hours practicals in a week. The three credit papers do not have practicals. A candidate has to clear theory and practical separately. A minimum of 96 credits are required for M.Sc.(Informatics).

Second Semester

Code	Paper	Credits
IT21	Voice and Data Communication	6
IT22	Data Structure and Design of Algorithms with OOPS	6
IT23	Operating Systems	6
IT24	Programming Languages	6
		24

Third Semester

Code	Paper	Credits
IT31	Network Architecture & Tele Communication Networks	6
IT32	Data Base Management	6
IT33	Software Engineering	6
IT34	Elective	4
	Open Elective	2
		24

Fourth Semester

Code	Paper	Credits
IT41	Network Application Development	6
IT42	IT & Tele Communication Network Management	4
IT43	Project	12
	Elective	4
		24

Course Descriptions

M.Sc. (Informatics)

Foundation Courses

IT01: Computational, Numerical and Statistical Methods

Category: Foundation
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- describe the basic principles of computational, numerical and statistical models
- infer the distribution modeling the behavior of a random variable
- apply and combine probabilistic tools and methods
- solve probabilistic problems in computer science, communications, and in general

Course contents: Floating points, Errors and their propagation, interpolation and Extrapolation approximations, Spline function & their uses, Numerical Integration, Solution of differential equation, Solution of linear and non-linear systems of equations, Eigen vector and Eigen value. Probability, distributions, random variables and generating functions, point and interval estimation, testing of hypothesis, non-parametric methods, curve fitting from least square method, Regression analysis, Analysis of variance, Monte Carlo Analysis, Introduction to optimization Linear and non-linear Programming. Stress will be laid on use of statistical packages and Numerical analysis software using MATHLAB/MATLAB Tools.
Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT02.Introduction to Programming

Category: Foundation
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- design all stages of a database
- express simple queries
- express complex and aggregate queries
- implement applications using database management systems

Course contents: Conceptual frame work of computer languages, C-language, Data types, Operators, Expressions, Control flow, Sub program, Recursion, Input, Output, file access, Abstract data types e.g. Stack, Queue, List and Tree, Pointer, Array, Structure, Union, Structured Program, O.S. Interface. Introduction to Formal languages and Design of programming Languages, Introduction to Object Oriented Programming.
Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT03. Analog Electronics

Category: Foundation
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- Analyse simple electronic circuits based on diodes and transistors
- Design simple linear power supplies according to the required specifications; Design and analyse bias circuits for BJTs and Amplifiers for FETs);
- Perform Analysis at AC of Amplifiers based on BJTs and FETs using weak signal models;
- Demon them in homework and laboratory exercises

Course contents: Bipolar, Unipolar Transistor Biasing, Transistor amplifiers, Audio and RF amplifiers, Calculation of gain, input and output impedance, Frequency response, Feedback power amplifiers, Operational amplifiers and their applications, timer and their applications, Regulators, Oscillators, Multimeters, PLL and its applications.
Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT04. Digital Electronics and Computer Organization

Category: Foundation
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- An ability to understand theory of Digital Design and Computer Organization to provide an insight of how basic computer components are specified.
- An ability to understand the functions of various hardware components and their building blocks
- An ability to understand and appreciate Boolean algebraic expressions to digital design
- An in depth understanding of how different hardware components are related and work in coordination
- An ability to understand computer buses and input/output peripherals

Course contents: Operation of transistor as a switch, flip-flop of various types: Master-Slave, JK & D type flip flops, Gates, Half adder, Full adder, Number systems, Code converters, Error detection and correction, Counters, A/D and D/A converters, Registers, Buffers, Multipliers, Memories, Introduction to MSI, LSI, VLSI. Organization of a computer, I/O, ALU, CPU, Control unit, Registers and Flags, Memory systems, Assembly language, Programming with reference to a particular Microprocessor, Introduction to various Bus systems, Introduction to IBM architecture.
Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

Core Courses

IT11. Programming Methodology

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms.
- Describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs.
- Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs.
- Demonstrate different methods for traversing trees
- Compare alternative implementations of data structures with respect to performance
- Compare and contrast the benefits of dynamic and static data structures implementations

Course contents: Concept of programming and structured program development, Problem specifications: Top down design, Step-wise refinement, Sub programs, Recursion algorithms, Analysis of algorithms. Data structure and data types, Program debugging and testing, Performance evaluation, Correctness of programs, Programming exercises as a part of laboratory.
Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT12. Computer Architecture

Category: First Semester
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- describe the basic techniques of instruction level parallelism for enhancing performance in general purpose processors
- describe the basic techniques of data level parallelism in SIMD (Single Instruction Multiple Data), Vector and GPU (Graphics Processing Units) architectures
- describe the basic techniques to exploit thread level parallelism in parallel systems with distributed or shared memory architectures
- apply the algorithms of memory coherency protocols for shared and distributed memory architec- tures
- describe the structure and models of warehouse scale computers and describe the algorithms for exploiting request-level and data level parallelism.
- apply existing techniques for memory hierarchy design
- assess performance of parallel computer systems

Course contents: us based architecture, IBM PS ISA, EISA, PCI, VME bus, Peripheral devices, Devices drivers, IDE driver for HDD, Communication in inter parallel ports, Kernel and Device drivers, Power PC architecture, Evaluation of Computers, Information representation, Instruction formats, Instruction types. ALU design, Instruction Sequencing and Interpretation, Hardwired control, Microprogrammed Virtual memory, Parallel processing, Pipe line processing, Multiprocessing. IBM PC Architecture overview, RISC Architecture, Hardware overview of peripheral devices e.g. Key Board, Display monitor, Printers, Storage devices etc.
Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT13. Introduction to Communication Systems

Category: Core
Teaching: Lectures 4 hours (per week).

Learning outcomes: At the end of the course the student will be able to:

- Compute the Fourier transform and the energy/power spectral density of communications signals.
- Calculate the bandwidth and signal-to-noise ratio of a signal at the output of a linear time-invariant system given the signal and the power spectral density of the noise at the input of the system.
- Explain the operation of amplitude and angle modulation systems in both the time and frequency domains including plotting the magnitude spectra and computing the power and bandwidth requirements of each type of signal.
- Evaluate a given analog or digital communications system in terms of the complexity of the required transmitters and receivers and the power and bandwidth requirements of the system.

Course contents: Introduction to Communication Systems, Analysis of transmission of Signals, Fourier Series and Transform, Power and Energy spectra, Distortion less Transmission, Signal distortion over a Channel, Bandwidth and Rate of Transmission, Amplitude Modulation, DSB, SSB, VSB Modulation types. Base band and carrier Communication, Detection, Interference and Noise Generation, Generation of FM, Interference and Noise in FM, Phase Locked Loops. Pulse Modulation, PAM, PPM, PCM and their detection, Communication in Noisy channels, Digital systems, Optimum Signal Detection, Introduction to Probability and Random Variables. Introduction to Information Theory, Channel capacity, Hartley Shannon Law, Error Correcting codes.

Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT14.Mathematical Foundation for Computer Science

Category: Core

Teaching: Lectures 4 hours (per week).

Learning outcomes: At the end of the course the student will be able to:

- An ability to apply knowledge of computing and mathematics appropriate to the discipline;
- An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution;
- An ability to design, implement and evaluate a computer-based system, process, component, or program to meet desired needs;
- An ability to use current techniques, skills, and tools necessary for computing practices.
- An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices

Course contents: Discrete Mathematics Set, Relations, Functions, Operations, Well Ordering and Equivalence relation, Partial Order. Lattice and Combinatorics, Boolean Algebra, Normal forms, Trees, Graphs, Matrix representations and Enumeration of Graphs, probability, Time series Analysis, Stock'sProcess, Mathematical Logic and Methods of Computation (Finite State Machines, Push down Automata, Turing m/c), Regular Set finite Automata, Introduction to Recurring functions.

Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT15.Microprocessor and Interface Programming

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- To introduce architecture and programming in assembly language.
- To introduce basic concepts of interfacing memory and peripheral devices to a microprocessor.
- To introduce serial and parallel bus standards.
- To introduce microcontroller.
- To introduce various advanced processor architectures such as 80X86, Pentium and Multicore Processors.

Course contents: Microprocessor Architecture, Micro Computer Architecture, Instruction Set and Timing Diagram, Programming Techniques, Microprocessor Development, System Programmable Timer, Programmable interrupt controller, I/O Interrupt, Interfacing ADC and DAC, Programmable Key Interface, Serial I/O and Data Communication, Programmable DMA controller, Bus Interfacing. Peripheral Interfacing, USART, Micro controllers, Special purpose Processors to Software Development Tools, Operating Systems, Compiler, Assembler, Linker, Loader, Introduction to Design of Assembler, Linker, Loader AND Compiler.
Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT21.Voice and Data Communication

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- Understand basic and some advanced concepts and techniques of telecommunications networks.
- Develop problem solving approaches as applied in telecommunications networking areas.
- Able to analyse performance of basic communication networks using both analytical and simulation techniques.
- Understand telecommunication network design techniques and practical implementation issues.
- Understand the basic properties of internet and telecommunications traffic properties.

Course contents: Introduction and Evolution of Telecommunication, Electronic Space Division Switching, Speech Digitization and Transformation, Time Division Switching. Traffic Engineering, Networks, ISDN, Modems, Channel Capacity, Noise, Signal to Noise Ratio, Transfer Defection, Propagation Delay, Clock Synchronization, Multiplexing Techniques: FDM, TDM. Statistical overview of Satellite Communication System, Broadcast Channel and

Optical Fiber Communication System.

Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT22. Data Structure and Design Algorithm

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

Course contents: Review of abstract data types and simple data structures. Linked list, Circular linked list, Array Stack, Queue, Trees, Hyper Graph, Forest and File. Introduction to Algorithms: Asymptotic notations, Summation, Recurrence relations. Divide and Conquer Binary Search, Quick sort, Merge sort. Dynamic Programming: Matrix chains Multiplication, trees, Knapsack problems, shortest path Algorithms. Graph Depth first search, Breadth first search, Topological sort and strongly connected components. Theory: Lower bounds for sorting and selection.

Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT23. Operating Systems

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- describe the goals of the operating system, its structure and the main types of operating systems.
- describe the modeling of processes, their switching on the CPU, the mechanisms for accomplishing interprocess communication and synchronization and the basic algorithms for process scheduling; apply the related algorithms and solve related problems.
- describe the concept of deadlock, the related problems, the mitigation strategies and the algorithms used to this end. The student will be also able to apply the related algorithms.
- describe the goals of memory management, the main techniques for managing memory and the related algorithms. The student will be also able to apply the related algorithms.
- describe the basic elements and the functionality of file systems, their structures, their implemen- tation methods and the related techniques and algorithms and solve related problems.
- describe the principles and structure of input/output software, and the way that input/output soft- ware handles the main device categories.

Course contents: UNIX, WINDOWS, DOS, C++, OS2. Programming in UNIX, Programming

in WINDOWS, Programming in DOS based languages, UNIX system tools, Programming language interface, awk, lex, yacc, File and Shared Libraries, Inter process communication, Common object file format, Sdb, Link, Make source code control system, Programmers productivity tools, Extended terminal interface, D Security, X Windows.
Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT24. Programming Languages

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- Principles of programming languages design; specification of syntax and semantics;
- underlying implementation of block structured languages;
- dynamic memory allocation for strings, lists, and arrays;
- imperative versus applicative programming; logic programming; modern programming languages.

Course contents: Syntax and semantics of Programming languages, Data types and Operations passing techniques, Program Structures, Control Structures, Runtime Structures and environmental languages for special purposes (string processing, multitasking processing), Introduction to C, C++, PASCAL, ADA, PERL, JAVA.Programming Methodology, Survey of old and new programming languages, Prolog, C++, Smalltalk 80 and Emphasis on design of programming language that will provide Expressiveness, Readability and Security.
Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT31. Network Architecture

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- Explain how protocols and standards benefit a global internetwork.
- Describe how the Ethernet Protocol transmits data within a LAN.
- Explain IPv4 addressing and the role subnet masks.
- Use Cisco Packet Tracer to connect hosts to a wireless router in a LAN.
- Use a protocol analyzer or "packet sniffer" to open and examine a data packet that has been transmitted across a network.
- Examine a Windows computer to locate the physical or MAC address used send and receive data.

Course contents: Review of Data Communication principles, Multi accesses protocols and link data protocols. Network topology design, Network layer switching, Routing, Congestion and flow control, Internetworking, transport layer error recovery, TCP/IP protocols, Application layer services and protocols (RPC, NFC, FTP, TELENET), Network security and Management.

Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT32. Database Management System

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- Differentiate database systems from file systems by enumerating the features provided by database systems and describe each in both function and benefit.
- Define the terminology, features, classifications, and characteristics embodied in database systems.
- Analyze an information storage problem and derive an information model expressed in the form of an entity relation diagram and other optional analysis forms, such as a data dictionary.
- Demonstrate an understanding of the relational data model.
- Formulate, using relational algebra, solutions to a broad range of query problems.
- Formulate, using SQL, solutions to a broad range of query and data update problems.
- Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
- Use an SQL interface of a multi-user relational DBMS package to create, secure, populate, maintain, and query a database.
- Use a desktop database package to create, populate, maintain, and query a database.

Course contents: Introduction to database concepts, Goals of DBMS including data independence consistency, Data security and Integrity. DBMS models: Hierarchical, Network and Relational, Relational algebra, Relational calculus, Query languages. Relational database design, Functional and Multi valued dependencies & normal forms. Database query optimization, Data abstraction and Modeling, ER Model, Relational Model, Hierarchical Model, Normalization, Query Processing, Crash Recovery, Concurrency Control, Distributed database, Object Oriented database, Data Mining, Multimedia Database, Digital Libraries.

Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT33.Tele-Communication Networks and Technology

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- explain the basic physical and technical principles underlying the modern digital telecommunications network.
- describe the basic principles of action with modern digital telecommunication devices, systems and networks, conduct experiments and measurements in the laboratory and on actual components, devices, equipment and systems in telecommunication.
- interpret the acquired multimedia systems measurements data
- describe the development and application of digital telecommunications systems

- examine the communications equipment for the technical functionality. describe the basic principles of computational, numerical and statistical models
- infer the distribution modeling the behavior of a random variable
- apply and combine probabilistic tools and methods
- solve probabilistic problems in computer science, communications, and in general

Course contents: Wired, Wireless, Broadcast, Point to Point, Satellite medium-SCPC, VSAT Broadcast medium etc., Link budget analysis, Link behavior, Pe, Burst error, Optimum packet size, Error control, Elementary coding ideas, ATM as a transport mechanism, An overview of Telecom Network, ISDN

Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT34.Object Oriented Technology

Category: Core

Teaching: Lectures 4 hours (per week).

Learning outcomes: At the end of the course the student will be able to:

- Explain the steps in creating an executable program for a computer, including the intermediate representations and their purpose.
- Explain the benefits of object oriented design and understand when it is an appropriate methodology to use.
- Apply good programming style and understand the impact of style on developing and maintaining programs.

Course contents: Object statics, Objects, class, Instance, Ensemble, encapsulation, Object relationship, Inheritance, Multiple Inheritance, Polymorphism, Object Dynamism, Messages, Object Inter-Relationship, Class Relationship, Foundation Class, Object Oriented Analysis, and Object Oriented Design.

Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT35.Software Engineering

Category: Core

Teaching: Lectures 4 hours (per week).

Learning outcomes: At the end of the course the student will be able to:

- Model the structure and behavior a software system the UML class diagrams and state diagrams.
- Design a solution to a given problem using one or more design patterns and implement the design in a programming language.
- Apply software testing and quality assurance techniques at the module level, and understand these techniques at the system and organization level.
- Understand common lifecycle processes including waterfall (linear), incremental approaches (such as Unified process), and agile approaches.

Course contents: Software life cycle, Requirement Definition, System Modeling,

Requirement Specifications, Formal Specifications, Algebraic Specifications, and Model based Specifications. Software Design, SSAD, Object Oriented Design, Function Oriented Design, Real time system Design, U.I. Design, Reliability, Reusage, CASE, Software Verification, Testing and Validation, Software Management, Configuration Management, Documentation, Software Quality Assurance, project planning and Scheduling.
Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT41.Network Application & Development

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- The course objectives are to provide the student with knowledge of network planning and performance principles including minimum cost and maximum flow methodologies and operations research techniques including network spanning models.
- The learning outcomes include students gaining an understanding of the process used to plan network operation and performance characteristics, including survivability and reliability through redundancy. Students gain knowledge of intelligent network features used in maintenance and operation including the process of automatic network restoration.
- Student capability development includes gaining an understanding of tele-traffic principles and application to digital networks.
- Network convergence has introduced a range of issues associated with achieving required performance across different network types.

Course contents: Evolution of Internet, Address and Domain Management, SNMP, Transport layer issues, TCP/IP, FTP, WWW, E-mail, Telnet, FTP, Gateway, Dial-up, SLIP/PPP, Dedicated lines. Internet searching tools, Gopher, Archie, Veronica, WWW, Lynx, Mosaic, WAIS, Usenet, Security issues, CGI, PERL, PHP, HTML, JAVA and other Internet development tools, Intranet, Internetworking, TCP/IP Administration, Modern Data Communication and Data networking. LAN and LAN Manager, twisted pair Ethernet, Serial Communication, Connecting LANs and WANs, serial Communication Circuits, Modems, PROTOCOLS, Synchronous Modems and Asynchronous Modems, ISDN Technology, Devices, Architecture Protocols. Flow control, Error detection and correction. Network Services architecture.
Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT42. Tele-Communication Network Management

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- Demonstrate broad knowledge of the fundamental principles and technical standards underlying telecommunication, networking, and information technologies.
- Architect and implement networked information systems
- Continuously improve their technology knowledge and communication skills
- Anticipate the way technological change and emerging technologies might alter the

assumptions underlying architectures and systems

Course contents: Different protocols for Telecommunication Networks, Empirically observed network traffic behavior and techniques for their management, Fundamentals of Network Management (NM). Need for NM, What is NM?, Elements of NM system (Manager, Agent and a protocol), Functional areas of NM defined by ISO 9Fault Management, Configuration Management, Performance Management, Security Management, Accounting Management), NM standards, Management, Information and underlying concepts (SMI, MIBs, OLD Tree, ASN1, GDMO, Object Oriented Design), SNMP, SNMPV2, CMIS/CMIP, TMN, Web based NM (Introduction), WAS frameworks (HP OpenView, IBM Netview, SUN Solaris Enterprise Manager).

Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT43. Modeling, Simulation and Performance Evaluation

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- Characterise engineering systems in terms of their essential elements, purpose, parameters, constraints, performance requirements, sub-systems, interconnections and environmental context.
- Engineering problem modelling and solving through the relationship between theoretical, mathematical, and computational modelling for predicting and optimizing performance and objective.
- Mathematical modelling real world situations related to engineering systems development, prediction and evaluation of outcomes against design criteria.
- Develop solutions and extract results from the information generated in the context of the engineering domain to assist engineering decision making.

Course contents: Discrete time and discrete event systems, Queuing systems, M/M1 systems, Multi server Multi Queue Networks, Mathematical analysis, System simulation, Simulation languages, Performance estimation, Sensitivity analysis, Examples from Transportation, Communication and Computer systems.
Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.

IT44.IT Management

Category: Core
Teaching: Lectures 4 hours (per week).
Learning outcomes: At the end of the course the student will be able to:

- understand the issues around defining ‘technology’, ‘innovation’ and ‘innovation management’
- recognise the diversity of types of innovation, innovators and innovation settings
- understand the nature and extent of technological change and innovation
- critically assess and explain key current issues in our understanding of innovation as a field of study.

Course contents: Management of Tele-communication Enterprises: Fundamental aspects of daily telecommunication operations, human factors in organization, acquisition and procurement, research and Development, Logical planning, Relations with carriers and manufacturers. # Management and Marketing of Telecommunications: Strategic planning in regulated and competitive Telecommunication industries, the management and marketing of a technology based enterprise, the strengths and weaknesses of different Management and Marketing approaches, their legal constraints, responsibilities and ethics. # Finance in Telecommunication: The principles and methods of asset valuation, Interpretation and measurement, Financial statements risk assessment, Capital market, Capital budgeting and the effects of economic regulation on capital formation. # Networks for Enterprises: Telecommunication and networking as applied to enterprises in public and commercial sector. Telecommunication Policy and Regulation.

Assessment: A midterm exam and internal assessment of 25% and final exam (end of semester) for 75% of the final grade.