

INSTITUTE OF INFORMATICS & COMMUNICATION
FACULTY OF INTERDISCIPLINARY & APPLIED SCIENCES
UNIVERSITY OF DELHI SOUTH CAMPUS

Syllabus for Ph.D course work

The department offers the following five papers for Ph.D course work:

PH-I (PHIT-01): Computational Modelling and Performance of Stochastic Systems, is aimed at introducing to the students the basic ideas prevailing in the area of computational modeling and performance of stochastic systems. On doing this course students will be able to understand the basic ideas of mathematical modeling, stochastic dynamics and will be equipped to handle various problems in the area of network dynamics, communication network etc.

Paper- II (PHIT -02): Advanced Communication Networks, is aimed at making the students acquainted with basic ideas in communication network and the associated problems which needs to be tackled in a real setting. Students will be introduced to various performance measure of typical communication networks and this will enable the students to handle various practical problems in this promising area

Paper -III (PHIT -03): Communication Theory and Wave Propagation

(cf. Paper 2.3 of M.Tech Syllabus of Department of Electronic Science), is aimed to provide basic introduction to communication theory and wave propagation. Doing this course students will be learning how probabilistic ideas can be used to get insight into various fundamental problems associated with wave propagation in different media.

PH-IV(PHIT -04): Communication Systems

(cf. Paper 3.2 of M.Tech Syllabus of Department of Electronic Science), is aimed at introducing to the students various communication systems . The students will be introduced to the ideas in digital communication and their use in real practical situation. Further various issues related to wireless communication and mobile communication will be unfolded and therefore students will be equipped to handle practical problems.

PH-V(PHIT -05): Cloud Computing, is aimed to introduce to the students the ideas in cloud computing. This course will prepare students to make use of the ideas in cloud computing in various practical settings.

PH-VI (PHIT-06): Research Methodology, is aimed at teaching the essentials to fresh Ph.D students the salient features of several model systems, highlighting their utility in Informatics & Communication research.

Table: I *

	Total marks (100)	
Paper	End semester examination	Continuing Assessment
PHIT-01	70	30
PHIT-02	70	30
PHIT-03	70	30
PHIT-04	70	30
PHIT-05	70	30
PHIT-06	50	50

*{Students are required to take 03 papers in all for the course work. PHIT-06 is compulsory. Students may opt any two papers from PHIT-01 to PHIT-05 for the Ph.d course work.}

Paper-I (PHIT-01): Computational Modelling and Performance of Stochastic Systems:

Unit-I: Introduction to probability theory

Definition, identities, probability distribution -Bernoulli, Binomial, Poisson, Gaussian, Weibul, Pareto etc. and their basic properties; Testing hypotheses

Unit-II: Stochastic Processes

Basic introduction, random walk, Computer simulation and Monte Carlo Methods (MCM)-simulation of random variables, solving problems by
0.23 MCM, Markov processes, Markov chains, simulation of stochastic processes.

Unit-III: Queuing system

Poisson processes, Birth and death process, Bernoulli single server queuing system, single server queue (M/M/1), multiple server queue (M/M/c), Client-server model, single server queue with general service (M/G/1), Performance of queuing systems; busy time analysis, Basics of Forward Data Link Performance and optimization; Queuing Network.

Paper-II (PHIT-02): Advanced Communication Networks:

Unit-I: Modeling and Traffic Management

Birth-Death model, Continuous-Time and Discrete-Time modeling for Incoming Traffic and Inter-arrival time characterization using Poisson and Bernoulli traffic models.

Modeling and Performance evaluations of Flow Control Protocols like Leaky Bucket algorithm, Token Bucket algorithm using Single Arrival/Single Departure Model (M/M/1/B) and Multiple Arrival/Single Departure Model (Mm/M/1/B). Modeling and Performance

evaluations of Error Control Protocols like Stop-and-Wait ARQ, Go-Back-N (GBN ARQ), Selective-Repeat (SR ARQ). Modeling and Performance evaluations of Medium Access Control Protocols like ALOHA, Slotted ALOHA, CSMA, CSMA/CD, Distributed and Point Co-ordination functions for Wireless LANs.

Unit-II: Scheduling and Routing Algorithms

Packet selection, dropping and fair scheduling, Time-based and rate-based scheduling, Modeling and analysis of common scheduling algorithms like FIFO, weighted round-robin, processor sharing, packet-by-packet generalized processor sharing, frame based fair queuing, core-stateless fair queuing, random early detection, etc. Switches, Routers, Analysis and performance evaluations for Input and Output queuing switch, Shared-buffer switch, single-stage and multi-stage interconnection networks, Generalized Cube Network, Banyan Network, Improved Logical Neighbourhood networks.

Paper III (PHIT-03): Communication Theory and Wave Propagation

(cf. Paper 2.3 of M.Tech Syllabus of Department of Electronic Science)

Probability and random variables; Baye's Theorem; Probability density and Probability distribution functions, statistical expectation, moments and characteristic functions, various distributions, multiple random variables, transformation of PDFs; Random Processes: Basic concept, description of random process, correlation functions, Stationary and non-stationary process, ergodic process, power and energy;

Multiple random process; Random processes in frequency domain; Fourier transform of random processes, power spectrum of stochastic processes; Gaussian and White processes; Markov process; Various modulation systems and multiple access systems like FDMA, TDMA and CDMA.

Wave Propagation: Free space propagation model, ground reflection; Earth and its effect on propagation, terrain formation considerations and its effects on free transmission, Diffraction and scattering from obstacles; Atmospheric attenuation; Practical link budget; Troposphere propagation; Tropo system fading characteristics; Troposcatter loss calculations; Fading in LOS troposcatter; Statistical behavior of fading; Diversity techniques.

Paper IV (PHIT-04): Communication Systems

(cf. Paper 3.2 of M.Tech Syllabus of Department of Electronic Science)

Introduction to Wireless Communication Systems; Global system for mobile (GSM): Cellular concept, System design, Transmission system; Receiving system; Frequency reuse; Channel interference and system capacity; Outdoor and indoor propagation models, small scale and multipath fading; practical link budget; Digital modulation with reference to wireless communication; Spread spectrum modulation; Modulation performances in fading and multipath channel; Multiple access techniques as applied to wireless communication; Pocket Radio system; Wireless networking: 1G, 2G, 3G wireless networks, traffic routing; wireless data service.

Introduction to Satellite Systems; Orbiting satellites, satellite frequency bands, communication satellite systems, satellite modulation and multiple access formats; Satellite systems in India; Satellite receiving systems, G/T ratio; Satellite uplink and downlink analyses in C, Ku and Ka bands; Spot beam, multiple beam, frequency reuse; Satellite transponder; Satellite front end.

Introduction to Optical Communication Systems; Optical fibers, sources and detectors; Analog and Digital systems; Modulation and multiplexing; Power budget analysis; Synchronous optical networks (SONET/SDH); Fiber distributed data interface (FDDI).

Paper V (PHIT-05): Cloud Computing

This course gives an introduction to cloud computing and its techniques, issues, ecosystem and case studies. Students can familiar with cloud services and their techniques through labs and the term project.

Syllabus

Overview of Computing Paradigm

Emerging trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing, Evolution of cloud computing

Introduction to Cloud Computing

Cloud Computing, Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Properties, Characteristics & Disadvantages, Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing, Role of Open Standards

Cloud Architecture

Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services

Service Models (XaaS), Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS), Deployment Models, Public cloud, Private cloud, Hybrid cloud, Community cloud

Infrastructure as a Service (IaaS): Introduction to IaaS, IaaS definition, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM), Resource Virtualization, Server, Storage, Network, Virtual Machine (resource) provisioning and manageability, storage as a service, Data storage in cloud computing(storage as a service)

Live Case Examples (Not limited to)

Amazon EC2, Renting, EC2 Compute Unit, Platform and Storage, pricing, customers, Eucalyptus

Platform as a Service (PaaS) : Introduction to PaaS, What is PaaS, Service Oriented Architecture (SOA), Cloud Platform and Management, Computation, Storage, Live Case Examples: Google App Engine, Microsoft Azure, Sales Force.com's Force.com platform

Software as a Service (SaaS) : Introduction to SaaS, Web services, Web 2.0, Web OS, Case Study on SaaS

Service Management in Cloud Computing

Service Level Agreements (SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously, Managing Data, Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing

Cloud Security

Infrastructure Security, Network level security, Host level security, Application level security, Data security and Storage, Data privacy and security Issues, Jurisdictional issues raised by Data location

- Identity & Access Management
- Access Control
- Trust, Reputation, Risk
- Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations

Project Case Study on Open Source & Commercial Clouds [9 hours]

- Eucalyptus
- Microsoft Azure
- Amazon EC2

Reference Books

- Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
- Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011
- Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee

Gillam, Springer, 2012

- Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010

Paper- VI (PHIT-06) Research Methodology

The goal of Research Methodology is to learn how research is being done, and to put that knowledge into practice. The students would learn how to apply a great number of statistical techniques, draw conclusions from those, and determine what statistical technique would be suitable for a given dataset and/or research question. Here the emphasis lies on interpreting results and communicating those to the world at large. In

other words, student learn how to take a step back and think about what you can conclude from a certain experiment or computational/ modeling/ simulation test.

This course is meant as preparation for Ph.D. course work. The course builds on knowledge and skills one have acquired during Basic Scientific Skills. Lectures in this course are meant to be a complement to the knowledge you can obtain during the PG courses. The students will practice skills by making use of datasets from the research of some of the faculty.

Learning objectives

- Defending the use of Research Methodology
- Judging the reliability and validity of experiments
- Being able to perform exploratory data analysis
- Being able to draw conclusions from categorical data
- Using computer-intensive methods for data analysis
- Drawing conclusions from test results
- Being able to compare different models

These objectives will be achieved by means of lectures, discussions in the lectures, assignments and blogs. Following is the proposed syllabus:

Part I

Research: Definition

Objectives, Research and Scientific method, Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method, Plagiarism.

Types of Research:

Descriptive vs. Analytical Research, Applied vs. Fundamental Research, Quantitative vs. Qualitative Research, Conceptual vs. Empirical Research,

Research Process:

Basic Overview, Formulating the Research Problem, Defining the Research Problem, Research Questions, Research Methods vs. Research Methodology

Part II

Literature Review:

Review Concepts and Theories

Formulation of Hypothesis:

Sources of Hypothesis, Characteristics of Hypothesis, Role of Hypothesis, Tests of Hypothesis, Research Design, Sampling Design

Data Collection:

Observation Method, Interview Method, Questionnaires, Case Study Method

Processing and Analysis of Data:

Processing Operations, Statistics in Research, Descriptive Statistics, Inferential Statistics, Elements / Types of Analysis

Interpretation of Data:

Evolutionary and Evaluative, Identificatory and Impact studies, Projective and Predictive, Collative, Historical, Comparative

Current trends in Research:

Mono-disciplinary Research, Trans-disciplinary Research, Inter-disciplinary Research

Computer & Internet:

Its Role in Research, Technology and Software, Use of tools / techniques for Research, methods to search required information effectively, Reference Management Software, Software for paper formatting, Software for detection of Plagiarism
Threats and Challenges to Good Research

Books Recommended:-

- Business Research Methods – Donald Cooper & Pamela Schindler, TMGH 9th edition
- Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
- Research Methodology – C.R.Kothari
- Select references from the Internet