Details of M.Phil. Programme in Operational Research

1. Course Structure

(a) There will be 3 courses for the M.Phil. Part-I. A course on Research Methodology is compulsory and the two courses are optional, which are to be selected out of the following 11 optional courses. Each course will be of 100 marks out of which 70 marks for written paper, and 30 marks for internal assessment.

Courses (i) – (xi) : Any two of the following

(i) Mathematical Programming
(ii) Inventory and Production Management
(iii) Queuing Systems
(iv) Theory of Reliability
(v) Marketing Management
(vi) Software Reliability
(vii) Queuing Networks
(viii) Financial Engineering
(ix) Supply Chain Management
(x) Network Analysis
(xi) Game & Decision Theory

(b) Dissertation (compulsory) based on preferably any of the courses offered by the candidate.

2. Attendance

A student admitted to the Ph.D. coursework shall be required to attend not less than 2/3rd of the number of contact periods and seminars held separately.

* All other rules mentioned in Amendment to the Ordinance VI (amended vide notification dated 9th August, 2017) of Ordinances of the University of Delhi related to Doctorate of Philosophy (Ph.D.) are also applicable.
3. **Duration**

The duration of M.Phil. shall be one and a half year starting from August every year. It will be a full time course with two parts.

**Part-I** (August to March of next year): This part will be devoted to teaching and examination of above courses.

**Part-II** (April to January of next year): This part will be devoted to dissertation work under an approved supervisor from the Department.

Note: Re-examination or supplementary exam of Part-I if needed will be conducted in July.
Introduction To Research Methodology: Objectives and motivation in research, Research analysis, Significance of research, Types of research, Research and Scientific methods, Criteria of good research, Defining the research problem and research framework, Literature search, Report writing and interpretation- Research article; Reviews; Technical reports, Presentation skills, Importance and protection of intellectual property rights, Ethical issues in research (plagiarism, falsification, integrity, misleading authorship, etc.).

Data collection and related analysis: Primary and secondary data, Data collection methods, Difference between survey and experiment, Processing operations, Types of analysis, Statistical measures, Analysis of variance, Research design, measurement and scaling techniques, Computer applications.

Sampling and hypotheses testing: Sampling fundamentals, Sampling distributions, Sampling theory, Estimation, Determination of sample size, Hypotheses, Procedures for testing of hypotheses, Regression, Factor and discriminate analysis.

**Suggested Books:**

4. Relevant Research Papers.
Deterministic Inventory Lot-Size Models with Time proportional demand, Deterministic Joint replenishment policy, Inventory Control of deteriorating Items (discrete and continuous), Inventory Control under Inflationary Conditions, Inventory models with stock dependent demand, Interaction of Inventory and trade credit policies, Impact of marketing policies on Inventory decisions, Joint buyer-seller inventory model.

The Distribution free newsboy problem and its extensions.

Aggregate Production Planning: Fixed and Variable Work Force Model, Inventory Location Model, Production Planning with Time Varying Demand.

Suggested Books:

9. Relevant research papers.
Marketing Management

Consumer Behavior, Market Segmentation, Purchasing under varying Marketing Parameters viz. Price, Quality, Promotional Efforts and Distribution Expenditure, Promotional and Pricing decisions under Competition, Media Planning and Media Allocation Models, Promotional Effort Allocation Models, The carry over effect of Advertising, Models determining the optimal return on Investment for an advertising Campaign

Diffusion of Products and Services, Diffusion of Multi-Generational Technological Innovations, Optimal timing of introduction of new Generations, Diffusion of Products with Limited Supply and Known Expiration Date

Suggested Books:

5. Related Research Papers
M.Phil.: 04 Mathematical Programming

Generalized Convexity: Invexity and its Generalization, Optimality and Duality under invexity.

Complementarity Problem: Linear Complementarity Problem (LCP), Applications of LCP, Complementary Pivot Algorithm and Its variants, Vertical LCP, Horizontal LCP, Generalized Leontief input-output model as vertical LCP.


Vector Optimization: Pareto Optimality, Optimality Conditions, Solution Algorithms, Interactive Approaches, Goal Programming

Suggested Books:

5. Relevant Research Papers on the Selected Topics
M.Phil.: 05                   Theory of Reliability


Suggested Books:

Introduction to Software Reliability, Software Development Life Cycle, Software Testing (Verification & Validation), Error, failure and faults in Software, Difference between Hardware & Software Reliability

Software Reliability Growth Models (SRGMs) based on NHPP, SRGMs with Error Generation/Imperfect Debugging, Concept of Change Point, SRGMs using Stochastic Differential Equations, Unification scheme for SRGMs, Allocation and Control of Testing Effort

Release Time Problems: When to Stop Testing Software under different criteria (cost, reliability, warranty, risk, safety), bi-criterion release policy

Modelling Software Up-gradations, testing stop time for multi up-gradations

Software Vulnerability Analysis: Problems with Definitions and Assumptions

Suggested Books:

5. Relevant Research Papers
Queueing Systems

Stochastic processes and Markov chains (Discrete Time Markov Chains and Continuous Time
Markov Chains), Characteristics of queueing systems; Little’s formula, Markovian and non-
Markovian queueing systems, Transient behaviour; Embedded Markov chain and its applications
to M/G/1, G/M/1, and related Queueing Systems.

Networks, Series, and Cyclic Queues; Semi Markov and Markov renewal processes in Queueing.

Design and control of queues, Fluid queues.

Stochastic Petri Net Modelling and its application in Queueing, Applications of the theory to the
performance modeling of computer and communication networks.

Text and references:

   Applications, Wiley.
4. R. Nelson, Probability, Stochastic Processes, and Queueing Theory: The Mathematics of
   Computer Performance Modelling, Springer.
7. Kishor S. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer
8. T.G. Robertazzi, Computer Networks and Systems: Queueing Theory and Performance
Introduction to supply chain network, Supply chain evaluation, Supply chain decisions- strategic, tactical and operational, Supply chain strategies- push, Pull and push-pull, Bullwhip effect supply chain evaluation and performance measures.

Mathematical Programming models for supply chain planning, Design and optimization, Vendor buyer coordination, Production distribution coordination, Inventory distribution, Coordination and procurement distribution coordination, Reverse and closed loop supply chain, Green supply chain and Sustainability in supply chain.

Suggested Books:

3. V. V. Sople, Supply Chain Management: Text and Cases. Pearson Education India (2011).
9. Relevant research papers
M.Phil.: 09  Financial Engineering

Introduction to Financial Engineering, Financial securities- fixed-income securities, index linked securities, Derivative securities- Forwards, Futures, Swaps, Options; Arbitrage and Hedging, No Arbitrage pricing of forward and futures contracts, Bounds for option prices, put-call parity, Valuation of contingent claims, fundamental theorem of asset pricing, The Cox-Ross-Rubinstein (CRR) model.

Introduction to Stochastic Calculus – Martingale, Brownian motion, Ito process, Diffusion and stochastic differential equation, Ito’s lemma; Black-Scholes PDE and Black-Scholes option pricing formula, Delta hedging and Greeks

Applications of optimization methods in finance: Linear programming models- asset pricing and arbitrage, Non-linear programming models- volatility estimation, Integer Programming models- constructing an index fund, Dynamic programming models- structuring asset backed securities, Quadratic Optimization: mean-variance portfolio selection (Markowitz model)

Suggested Books:

8. Relevant research papers
M.Phil.: 10  Network Optimization


Suggested Books:

5. Relevant Research Papers on the Selected Topics.