

**Curriculum Structure  
for**

**M. Sc. in Data Science for Logistics**

**Draft Curriculum Structure**  
**M.Sc. in Data Science for Logistics**  
**SEMESTER- I**

Course Number	Subject	Scheme of Studies Per Week			Credits
		Lecture	Tutorial	Practical	
1LDS01	Logistics – I	3			3
1LDS02	Supply chain Management	3			3
1LDS03	Costing	3			3
1LDS04	Plant Location and Layout	3			3
1LDS05	Statistics	3			3
1LDS06	Operation Planning and Control	3			3
1LDS07	Work Design and measurement	2	-	-	2
	Python Programming	-	-	4	2
	Comprehensive viva ( Virtual)				4
<b>Total ( Th. + P + C) = 20 + 2 + 4</b>					<b>26</b>

**SEMESTER- II**

<b>Course Number</b>	<b>Subject</b>	<b>Scheme of Studies Per Week</b>			<b>Credits</b>
		<b>Lecture</b>	<b>Tutorial</b>	<b>Practical</b>	
<b>2DS01</b>	<b>Logistics -II Reverse logistics</b>	<b>3</b>			<b>3</b>
<b>2DS02</b>	<b>Inventory Control</b>	<b>3</b>			<b>3</b>
<b>2DS03</b>	<b>Data Science</b>	<b>3</b>		<b>4</b>	<b>5</b>
<b>2DS04</b>	<b>Optimisation Techniques -I ( Including Transportation Network Optimisation )</b>	<b>4</b>			<b>4</b>
<b>2DS05</b>	<b>Distribution Management</b>	<b>2</b>	<b>-</b>	<b>-</b>	<b>2</b>
<b>2DS06</b>	<b>Revenue Management</b>	<b>2</b>	<b>-</b>		<b>2</b>
<b>2DS07</b>	<b>Basic Data Analytics</b>	<b>3</b>	<b>-</b>		<b>3</b>
	<b>Comprehensive viva ( Virtual)</b>				<b>4</b>
<b>Total ( Th. + P + C ) = 20 + 2 + 4</b>					<b>26</b>

**SEMESTER- III**

Course Number	Subject	Scheme of Studies Per Week			Credits
		Lecture	Tutorial	Practical	
3DS01	Optimisation Techniques -II	3			3
3DS02	Machine Learning	3		2	4
3DS03	Risk Management	2			2
3DS04	Logistics Documentation, UCP, INCO, Customs, Taxation(GST) and Insurance	3			3
3DS05	Block Chain Management	3			3
3DS06	Internet of Things	3			3
3DS07	Advanced Data Analytics	3		2	4
	Comprehensive viva ( Virtual)				4
<b>Total ( Th. + P + C) = 20 + 2 + 4</b>					<b>26</b>

**SEMESTER- IV**

Course Number	Subject	Scheme of Studies Per Week			Credits
		Lecture	Tutorial	Practical	
4DS01	APPRENTICESHIP/ Project Work in Industry			40	22

# M. Sc. in Data Science for Logistics

## Detailed Syllabus

### 1. LOGISTICS – I

#### UNIT- I

**Basic Principles of Logistics:** Introduction – History and need for logistics – Cost and Productivity- Cost saving and Productivity improvement – Logistic cost – reduction in logistics cost-benefits of efficient logistics – Principles of Logistics – Logistics Optimisation- development of logistics management – Key logistics activities – Global Logistics

#### UNIT - II

**Warehousing:** Introduction- Nature and importance of Warehousing – Types of Warehousing - Warehousing Operations – Ware housing Tasks- Warehousing Functions – Public and Private Ware housing - Location Analysis- Warehouse layouts and design- international dimensions o Ware housing – Distribution functions of Ware housing - warehouse safety rules and procedures.

#### UNIT- III

**Port infrastructure:** Ports and their functions – Major and minor ports – Ships and Cargos – Port management and legal aspects of port managements -Competition and marketing- Port pricing - port planning- Port equipment – Port Ownership - Unit and Factor (TEU)-Throughput of Terminal – Water side area –Land side area – Throughput of the stack – Storage capacity – Technical handling capacity - Container terminals – container monitoring and stacking- inland container depots- Dry ports.

#### UNIT - IV

**Air cargo handling and Terminals:** Air Cargo Concept – Types of Air Cargo – Air Cargo Tariff, ratios and charges – Airway Bill, function, purpose and validation - Cargo Handling – Handling of Perishable Cargo and animals – Cargo Inspection – Cargo consolidation – Break Bulk – PPE and safe lifting procedure – cargo Terminal Operational Safety- Safe use of material handling Equipment.

#### UNIT - V

**Transportation:** Containerization; CFS and inland container depots; Dry ports; Road-Multi-modal transportation and CONCOR; Role of intermediaries including freight booking, shipping agents, C&F agents.

#### References

1. **Desai**, H.P INDIAN SHIPPING PERSPECTIVES, *Anupam Publications, Delhi*,
2. **Khanna**, K.K. PHYSICAL DISTRIBUTION, *Himalaya Publishing, Delhi*.
3. **Lambert**, D et al STRATEGIC LOGISTIC MANAGEMENT, *Tata McGraw Hill, New Delhi*.

## 2. SUPPLY CHAIN MANAGEMENT

### Unit-1

**Understanding Supply Chain Management:** Introduction and definitions, Components of supply chain (Concept to Cash), Supply Chain drivers and obstacles, Make or Buy, Inventory Management – Different Policies, Levers, Echelon Inventory, Uncertainty and risk analysis, Supply Chain Performance Measures, Service Supply Chain, Supply Chain Management in India

### Unit-2

**Procurement and Sourcing:** Development of Supply Strategies, Demand Management and Forecasting in a Supply Chain, Purchasing Performance Evaluation, Supplier Price & Cost Analysis, Value Analysis, Purchasing & Supply Negotiations, Contract Administration & Management, Legal Aspects of Purchasing, Sourcing & Contracts

### Unit-3

**Channel Partners, Logistics and Network Strategies:** Role of Distribution Channels, Product Life Cycle and Distribution Challenges, Managing Customer Relationships, Measuring Channel Performance, Managing Channel Conflict. Warehousing Decisions and facility location, Transportation Decisions, Third Party Logistics, Logistics Engineering, Reverse Logistics, Global Logistics

### Unit-4

**Strategic Sourcing & Inventory Management:** Strategic Sourcing, Supply Contracts, Supply Chain Coordination, Supply Chain Innovation, Supply Chain Resilience, Impact of Information Technology on supply chains, Time-varying demand, Planning and Managing Inventory in a Supply Chain, Stochastic inventory models: Newsvendor models, Multi-period, finite horizon, Vendor Managed Inventories

### Unit-5 Supply Chain Modelling

Overview of optimization modelling and techniques, Distribution Centre Location Models, Supply Chain Network Optimization Models, Vehicle Routing Models, Inventory Deployment Models, Risk Management of Supply Chains

### Textbooks & Reference:

- 1) **B.S.Sahay- Supply Chain Management, Mc Millan India Ltd, Delhi,**
- 2) **Donald J Bowersox and David J Closs LOGISTICAL MANAGEMENT, Tata McGraw Hill, New Delhi.**

## **4. COSTING**

### **Unit I**

#### **Cost Accounting Methods and Systems**

(a) Necessity and importance of cost accounting, what management expects of cost accounting, cost department organization and relationship with other departments, installation of a costing system and modification thereof; planning and progressing of accounting, design of forms and records (b) Accounting entries for an integrated accounting system- cost ledgers; Reconciliation between cost and Financial profit and loss account; Integrated and non-integrated accounting and reporting (c) Job, batch, contract costing, process costing (including establishment of equivalent units in stock, work-in-progress and abnormal loss accounts and use of various methods like first-in-first out), operation costing, operating costing, unit costing, multiple costing, by-product and joint products

### **Unit II**

#### **Decision Making Tools (advanced level)**

(a) Marginal Costing: basic concepts; break even analysis and cost-volume-profit analysis; break-even charts and profit charts; differential cost analysis; stock valuation under marginal costing techniques versus absorption costing techniques; applications of marginal costing in decision making (b) Throughput Accounting (TA) – as a system of profit reporting and stock valuation (c) Activity-Based Costing (ABC) for profit reporting and stock valuation (d) Integration of Standard Costing with Marginal Cost Accounting, Absorption Cost Accounting and Throughput Accounting (e) Transfer Pricing – determination of inter-departmental or inter-company transfer price (f) Treatment of special expenses in costs such as – research and development expenses, preliminary expenses, rectification expenses, costs of obsolescence, etc. (g) Accounting and control of waste, scrap, spoilage, defective, etc.

### **Unit III**

#### **Budgeting and Budgetary Control**

(a) Budget Concepts and Budget Preparation (b) Fixed and Flexible Budgets (c) Fixed, variable, semi-variable and activity-based categorizations of cost and their application in projecting financial results (d) Zero Base Budgeting (ZBB) (e) Budgetary Control

## **Unit IV**

### **Standard Costing, Cost Records and Cost Audit**

**1. Standard Costing:** (a) Concept and uses; accounting – methods and reconciliation – stock valuation (b) Variance Analysis: Cost, Profit and Sales Variances – presentation of variances, investigation of variances, revision of standards (c) Reporting – requisites of reports – interpretation and uses for Managerial decision-making activities (d) Uniform Costing and Inter-firm comparison **2. Cost Records and Cost Audit:** (a) Cost Accounting Records and Cost Audit under Companies Act, 2013 (b) Nature and scope of Cost Audit (c) Companies (Cost Records & Audit) Rules, 2014

## **Unit V**

### **Economics for Managerial Decision-Making**

(a) Concepts of Markets, analysis of market demand and empirical estimation of demand (b) Government Intervention and effect (c) Business and economic forecasting (d) Empirical production function and cost analysis (e) Factor demand and input decisions (f) Pricing Policies

#### **REFERENCES:**

1. <http://icmai.in/studentswebsite/studymat.php>



## **5. PLANT LOCATION AND LAYOUT**

### **Unit I**

#### **Plant Location**

Plant location analysis – factors, costs, location decisions – single facility location models, multi facility location models- set covering problem – warehouse location problems.

### **Unit II**

#### **Facilities Layout**

Facilities requirement, need for layout study – types of layout, Designing product Layout –Line balancing.

### **Unit III**

#### **Layout Design**

Design cycle – SLP procedure, computerized layout planning procedure – ALDEP, CORELAP, CRAFT

### **Unit IV**

#### **Group Technology and Line Balancing**

Group technology – Production Flow analysis (PFA), ROC (Rank Order Clustering) – Line balancing.

### **Unit V**

#### **Material Handling**

Principles, unit load concept, material handling system design, handling equipment types, selection and specification, containers and packaging.

### **REFERENCES**

1. Tompkins, J.A. and J.A.White, “Facilities planning”, John Wiley, 2003.
2. Richard Francis.L. and John A.White, “Facilities Layout and location – an analytical approach”, PHI., 2002.
3. James Apple, M. “Plant layout and Material Handling”, John Wiley, 1977.
4. Pannerselvam,R, “Production and Operations Management”, PHI,2007

## **5. STATISTICS**

### **Unit I**

#### **Measures of Central Tendency & Dispersion**

Introduction to Statistics-Primary and Secondary data- Nominal, Ordinal, Ratio, Interval scale (with examples)- Collecting & tabulating data - Measure of Central Tendency and Dispersion in Frequency Distribution- Coefficient of dispersion- Probability Theory: classical, objective & subjective Approach- Addition, Multiplication & Bayes Theorem –Applications

### **Unit II**

#### **Probability Distributions**

Binomial, Poisson and Normal - Decision Making under certainty, uncertainty and Risk

### **Unit III**

#### **Sampling Distribution & Estimation**

Sampling and Sampling Distribution: Types of sampling —Random Sampling-Concept of Standard Error Central Limit Theorem. Estimation: Types of Estimates-Point Estimate, Interval estimate of their population mean, variance and proportion-student-t distribution.

### **Unit IV**

#### **Hypotheses Testing**

Testing Hypotheses Significance Level-Type & Type II error- one Two tail tests -Hypothesis Testing of means, Proportion-Chi-Square Test-Analysis of variance (ANOVA)

### **Unit V**

#### **Non-Parametric methods**

Non-Parametric Methods-Rank Correlation-Kolmogorov Test-Median Test – Mann –Whitney Test – Wilcoxon T Test – Friedman ANOVA-McNemar Test-Cochran's Q Test.

#### **TEXT / REFERENCES:**

1. Richard I. Levin and David S. Rubin, 'Statistics for Management', Prentice Hall of India, 12th edition' 2011
2. Srivatasava, Shenoy and Sharma, 'Quantitative Techniques for Managerial Decision Making', New Age International Pvt. Ltd.,2nd edition, 2002.
3. G C Beri, "Business Statistics", Tata Mc Graw Hill, 3rd edition, 2009.

## **6. OPERATION PLANNING AND CONTROL**

### **Unit I**

Forecasting - Subjective estimate - survey - Delphi method - Regression models - Single variable model  
Two variable model - Econometric models - Input-output model.

### **Unit II**

Facilities Decisions - Measuring capacities of facilities - Determining facility needs – Economies of scale.

### **Unit III**

Aggregate Planning: Planning by Trial and error method - Planning by Transportation method – Planning by Linear Programming - Planning by Linear - Decision rule method - Planning by Heuristic method - Planning by Computer search method.

### **Unit IV**

Scheduling - Single machine sequencing with Independent jobs - Parallel machine models – Flow shop scheduling - Job shop scheduling - Simulation studies of the Dynamic job shop. Dispatching.

### **Unit V**

Process Planning - Group Technology - Classification and coding systems for process planning - Expediting and monitoring

### **TEXT BOOKS:**

1. Narasimhan Sim, et.al, 'Production Planning and Inventory Control', Prentice Hall 2nd Ed., New Jersey, 1995.
2. Knight, W.A. & Gdlagher, C.C., 'Group Technology Production methods in Manufacture', 1996.

## **7. WORK DESIGN AND MEASUREMENT**

### **Unit I**

#### **Method Study**

Introduction to work study - Productivity – scope of motion and time study - Work methods design.

### **Unit II**

#### **Recording Techniques**

Motion study-process analysis – process chart – flow diagram – assembly process chart – man and machine chart – two handed process chart - Micro motion and memo motion study.

### **Unit III**

#### **Work measurement**

Time study: basic procedure, equipment needed, methods of measuring time, selection of jobs, breaking a job into elements; numbers of cycles to be timed; Performance rating, allowances, standard data-machining times for basic operations, learning effect

### **Unit IV**

#### **Applied work measurement**

Methods time measurement (MTM), Work sampling, organization and methods (O & M), Wage incentive plans.

### **Unit V**

#### **Work Sampling**

Work sampling: basic procedure, design of work, sampling study, conducting work sampling study and establishment of standard-time

### **REFERENCES**

1. Barnes, Raeph.m., “Motion and Time Study – Design and Measurement of Work”, John Wiley &sons, New York, 2002.
2. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., Seventh Edition, 2002
3. McCormick, E.J., “Human Factors in Engineering and Design”, McGraw Hill.
4. Introduction to work study, ILO, 3rd edition, Oxford & IBH publishing,

# PYTHON PROGRAMMING

## UNIT-I

### Introduction to Python

Features of Python, Setting up path, Working with Python, Basic Syntax, Variable and Data Types, Operator, If, If- else, Nested if-else, For, While, Nested loops Break, Continue Accessing Strings, Basic Operations, Function and Methods.

## UNIT-II

### Introduction of Sqlite

Database connectivity, Accessing tuples, Executing queries, Transactions, Operations Working, Handling error Functions and Methods, Printing on screen Reading data from keyboard, Opening and closing file, Reading and writing files

## UNIT-III

### Graphics and GUI programming

Drawing using Tkinter and python. Networking and Multithreaded programming –Sockets, Thread and Processes, Chat application.

## UNIT-IV

### Class and object

Attributes, Inheritance, Overloading, Overriding, Data hiding Regular expressions, Match function, Search function, Matching VS Searching, Modifiers ,Patterns, CGI(Introduction, Architecture, CGI environment variable, GET and POST methods, Cookies, File upload.

## UNIT-V

### Web Frameworks

server-side Web applications in Python, Web Browse Programming - interfacing with existing browsers and browser technologies

## REFERENCES

- 1 John V Guttag. “Introduction to Computation and Programming Using Python”, Prentice Hall of india
- 2 R. Nageswara Rao, “Core Python Programming”, dreamtech
- 3 Wesley J. Chun. “Core Python Programming - Second Edition”, Prentice Hall
- 4 Kenneth A. Lambert, “Fundamentals of Python – First Programs”, CENGAGE Publication 6 Luke Sneeringer, “Professional Python”, Wrox

## SEMESTER- II

### 8. LOGISTICS – II

#### UNIT -I

**Transportation modes:** Types of transport system in logistics – road, rail, sea and air – combined transport systems – advantages and disadvantages in each system – Transportation forms – carriers /ocean/Air/transport - domestic – interstate – national – international – global – common, contract, exempt and private carriers –selection of transport according to cargo - Nature type of cargo – Unitised/Bulk and Liquid/ Break bulk and ODC - domestic water transport – sea transport – pipe line transports – postal transports –currency transports – transporting interfacing with other functions

#### UNIT II

**Material handling:** Basis of material handling –need – manual handling – Material handling and storages :safe working loads and breaking strength - testing and calibration of equipment and gears - Manual handling Operations: Conditions for manual handling –precautions and safety in manual handling –storage system –pallet storage – bin shelving –gravity flow racks –carousels –overhead handling operations - safe handling of chemicals toxic gases – corrosive materials- Safety handling of radioactive material

#### UNIT - III

**Material handling equipment:** Types of material handling equipment without power- handling m/cs within industry –outside industry in warehousing –fixed handling m/cs – movable handling m/cs – selection of equipment –types of movements – Assessment of loads before starting – Inspection of handling machines for safety work – Towing arrangement for lift trucks – Emergency procedure in undue circumstances

#### UNIT -IV

**Health and safety in material handling:** safety precaution to be followed while loading – precaution to be taken in gangways –safety on moving equipment- loading operations on ship - precautions and safety in manhandling —safety on moving equipment- loading operations on ship- safe handling of chemicals toxic gases – corrosive materials- Safety handling of radioactive material – guarding of m\cs – guarding of premises.- Health and safety measures from storing, handling of goods- Maintaining in premises clean to avoid slip and fall.

#### UNIT -V

**Reverse Logistics:** Meaning of reverse logistics (R.L)- need for reverse logistics –circumstances for R.L – mode of R.L –back haul planning and implementation- freight and other expenses on R.L – return of goods for recycle –returning of goods for market place – logistic and reverse logistics system- difficulty in reverse logistic – economy –disposal of goods in lieu of R.L – settlement of claim in R.L – demurrage on R.L goods – disposal of goods - process to be followed for disposal

#### TEXT / REFERENCES:

1. Richard I. Levin and David S. Rubin, 'Statistics for Management', Prentice Hall of India, 12th edition' 2011

## 9. INVENTORY CONTROL

### **Unit I:**

#### **Forecasting**

Introduction, Demand patterns, Factors affecting demand, Demand Forecasting – Need, Types, Objectives and Steps. Overview of Qualitative and Quantitative methods, Forecasting techniques, Impact of forecasting on inventory management.

### **Unit II:**

#### **Inventory**

Need of Inventory, Importance & Scope of Inventory Control, Costs Associated with Inventory, Profit through Inventory Management. Types of Inventory, Inventory Evaluation: FIFO, LIFO, Average Cost, Specific Cost.

### **Unit III:**

#### **Managing Individual Items**

Order quantities when demand is approximately level: Assumptions of EOQ – derivation – Sensitivity analysis – Quantity discounts - EPQ, Individual items with probabilistic demand: Continuous vs periodic review, types of Inventory/Replenishment policies.

### **Unit IV:**

#### **Managing Special class Items**

Selective Inventory Control techniques – Managing the Most important (class A) Inventories: Nature of Class A items – Guidelines – Inventory policies – Decision rules, managing the Routine (class C) Inventories: Nature – Guidelines - Inventory policies, style goods and perishable items inventory problem and its inventory control.

### **Unit V:**

#### **Managing multiple items inventory**

Coordinated Replenishments at a single stocking point: deterministic and probabilistic demand cases – Quantity discounts, Multi-echelon Inventories: deterministic and probabilistic demand cases

### **References:**

1. Silver, E. A., Pyke, D. F., & Peterson, R. (1998). *Inventory management and production planning and scheduling* (Vol. 3, p. 30). New York: Wiley.
2. Principle of Inventory and Materials Management: Richard J. Tersine, Prentice Hall; 4th edition (11 August 1993)
3. Inventory Control and Management: Donald Waters, Wiley; 2nd edition (October 10, 2003)

## 10. DATA SCIENCE

### Unit-I

#### Introduction

Definition, Applications of Data Science, Workflow, Industry examples – Terminologies – Structured Data, Unstructured Data, Semi Structured Data, Streaming Data, Real-Time Data, Meta Data, data at rest, Data science Applications relevant logistics, Challenges and Process.

### Unit -2

#### Data Preparation

Define Problem, Specify Inputs & Outputs, Understanding of data format, Exploratory Data Analysis, Data Collection, Data Pre-processing, Data Cleaning, Analyze your data with descriptive statistics, Handling missing values, Feature Selection, Feature Engineering, Selecting data sources for Analysis - Eliminating Redundant Data, Data Plotting, Statistical Charts

### Unit-3

#### Model Development

Model Design, Training, and Offline Evaluation, Model Deployment, Online Evaluation, and Monitoring, Model Maintenance, Diagnosis, and Retraining.

### Unit-IV

#### Model Evaluation

Measuring Accuracy Score, Loss Function, Confusion Matrix, Regularization, Precision-Recall Trade-off, ROC Curve, Over fitting and Under fitting

### Unit-V

#### Model Deployment

Saving the Model, Retraining Model, Tool and Technologies to deploy model for web and App.  
API development.

#### Books and References:

1. Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, 2016
2. Joel Grus - Data Science from Scratch First Principles with Python-O'Reilly Media (2019)
3. Ted Dunning, Ellen Friedman, Machine Learning Logistics, October 2017 O'Reilly Media, Inc.



## 11. OPTIMISATION TECHNIQUES – I

### Unit I

#### Linear Programming and Network problem

Formulation - Graphical, simplex solution, Karmarkar's method, Duality - Dual simplex - Sensitivity Analysis - Network representation, shortest path, minimum spanning tree, maximum flow and minimum cost network flow problems

### Unit II

#### Transportation, Network Optimisation & Assignment problems

Transportation model - initial solution - NW corner rule, least cost method, Vogel's approximation method, Improved solution - MODI method - Degeneracy - Unbalanced problem - Assignment problem - Traveling Salesman problems - Examples of problems to be covered –shortest path, minimum spanning trees, maximum flow, minimum cost flow, facility location,

**Software:** Application of Python + Gurobito solve linear and integer programs

### Unit III

#### Integer programming, Goal programming & Game theory

Integer Programming pure Mixed, Cutting plane, Goal Programming (Linear Function Formulation only), Game theory — Pure, Mixed Strategy - Problem examples and formulations, either-or and if-then else constraints, branch and bound method, Lagrangian relaxation, Heuristics and metaheuristics: solution methods for “hard” network problems

### Unit IV

#### Mathematical modelling, Queuing Theory & Simulation

Math problem formulation of resource-constrained problems using decision variables, objective function, constraints and parameters. Queuing Theory: Single Channel, Multi-channel, Queuing models. Simulation: Scope – Types Discrete approaches - Inventory simulation - Queuing Simulation.

### Unit V

#### Dynamic Programming and Np Completeness

Dynamic Programming - Concepts and notations and Application of DP in Business problems - Principles of optimality Introduction, Problem Reductions and Transformations, Problem Classes P,  $Np$ ,  $Np$ ,  $Np$ -Complete, and  $Np$ - Hard, Proving  $Np$ - Completeness Results.

#### References:

1. Ravindran, Philips, Soldberg. *Operations research: Principles and practices*. Second edition.
2. Introduction to Operations Research, F. S. Hiller, G. J. Lieberman, B. Nag and P. Basu (10th edition, Special India Edition, McGraw Hill Education, 2017).
3. Network Flows: Theory, Algorithms and Applications, R. K. Ahuja, T. L. Magnanti and J. B. Orlin (Prentice Hall, 1993)

## **12. DISTRIBUTION MANAGEMENT**

### **Unit I**

#### **Concept**

Marketing channels — Structures, flows and functions. Conceptual understanding of channel management. Market logistics and logistics objectives and decisions.

### **Unit II**

#### **Customer driven distribution system**

Customer service levels, designing customer driven distribution system- Assess opportunities - evaluate the alternatives (Direct vs. Indirect), design optimal channels, Managing Hybrid System

### **Unit III**

#### **Factors selecting in channel partners**

Factors in selecting channel partners – Types of channel partners: C&F agent, Wholesaler/dealer, Retailer, Agents, Stockists, Brokers, VARs, Stocking agents – Selection of Channel partners, Related Strategic issues.

### **Unit IV**

#### **Conflict management**

Channel conflicts and cooperation, conflict management techniques, channel policies.

### **Unit V Cost and risk factors**

DCA: C

Cost of Distribution, impact on profit, concept of total cost analysis, cost of providing customer service, principles of distribution costing, customer profitability. Risk Analysis: Types of risks, causes of risks and analysis, controlling risk, Minimising and shifting risk

#### **TEXT BOOKS:**

1. Louis W Stern, Adel El. Ansary and Anne T Coughlan. “Marketing Channels”, 5th ed., Prentice Hall of India, New Delhi, 1996.
2. Lou E Pelton, David Strutton, James R Lumpkin, “Marketing Channels- Relationship Management”, Irwin Publishers.

## **13. REVENUE MANAGEMENT**

### **Unit I**

#### **Quantity-based RM:**

Intro to dynamic programming; capacity allocation and protection levels for a single leg with single and multiple fare classes; overbooking.

### **Unit II**

#### **Price-based RM:**

Basic pricing theory; dynamic pricing

### **Unit II:**

#### **Network RM:**

Decomposition methods, approximate dynamic programming; stochastic approximation techniques.

### **Unit IV:**

#### **Choice-based RM:**

Choice models; assortment optimization.

### **Unit V:**

#### **Joint demand estimation and RM:**

Dynamic pricing with demand learning; the multi-armed bandit paradigm; contextual bandits

#### **Text books:**

1. The Theory and Practice of Revenue Management by Talluri and van Ryzin
2. Pricing and Revenue Optimization by Robert Phillips •
3. Principles of Pricing by Vohra and Krishnamurthi

## **14.BASIC DATA ANALYTICS**

### **Unit I**

#### **Multiple Regression**

Assumptions for General Linear Regression Model, Ordinary Least Square (OLS) Approach – measures of fit, statistical inferences – Hypothesis testing and interval estimation

### **Unit II**

#### **Dummy and Logistic Regression**

Dummy regressions and conjoint analysis, multi collinearity, Logistic regression- Grouped Data-Weighted Least square (WLS), Individual Data-Estimation of parameters using Newton Raphson method- Error rate estimation.

### **Unit III**

#### **Discriminant Analysis – I**

Introduction, The Two Group problem – Variable contribution – The case of discrete - Variables

### **Unit IV**

#### **Discriminant Analysis – II**

The K groups problem, Error rate estimate in multiple groups, Interpretation of multiple discriminant analysis solution- step wise selection of variables- Wilk's Lambda - Partial F

### **UNIT V**

#### **Factor Analysis**

The basic model, Extraction of factors – Principal factor – maximum likelihood method, factor rotation – orthogonal, oblique rotations, Factor score, interpretations of factor analysis solutions.

#### **Text books and References:**

1. Damodar, N. Gujarathi, 'Basic Econometric', Tata McGraw Hill, 4 ed. 2004.
2. Naresh K Malhotra, 'Marketing Research', Pearson Prentice Hall, 4 ed. 2006.
3. Johnson, R. A., & Wichern, D. W. (2002). Applied multivariate statistical analysis (Vol. 5, No. 8). Upper Saddle River, NJ: Prentice hall.

## SEMESTER-III

### 15. OPTMIZATION TECHNIQUES – II

#### Unit – I

##### Non-linear programming -I

First and second order conditions - Iterative methods and associated issues. Line search methods: Stationarity of limit points of steepest decent, successive step-size reduction algorithms, etc. Direct methods: The complex method, cutting plane method, methods of feasible directions, Conjugate directions. Indirect methods: Transformation technique, change variables and elimination of variables, penalty function methods- interior and exterior penalty function.

#### Unit II

##### Non-linear programming -II

Gradient based algorithms: Cauchy's method, Newton's method, Marquardt's method, Conjugate gradient method, Quasi-Newton methods, and Trust Regions.

#### Unit –III

##### Constrained optimization problems:

Lagrange variables, Economic interpretation of Lagrangian variables, Karush-Kuhn-Tucker conditions, Sensitivity analysis - Quadratic programming - Convex problems

#### Unit – IV

##### Meta-heuristics based optimization

Introduction to Meta-heuristics – Genetic Algorithm – Ant colony optimization – Particle Swarm optimization – Simulated Annealing – Tabu Search

#### Unit V

##### Markov chains

Definition – Absolute and n-step probabilities – classification of states – steady state probabilities – Mean Return times – analysis of absorbing states – applications

#### References:

1. Rao, S. S. (2009). *Engineering optimization: theory and practice*. John Wiley & Sons.
2. Ravindran, A., Reklaitis, G. V., & Ragsdell, K. M. (2006). *Engineering optimization: methods and applications*. John Wiley & Sons.
3. Taha, H. A. (2007). *Operations research: an introduction*.
4. K Deb. (2001). *Multi-objective optimization using Evolutionary Algorithms*.

## 16. MACHINE LEARNING

### Unit I

Introduction: Definition, Applications of machine learning, Machine Learning Workflow, Define Problem, Specify Inputs & Outputs, Exploratory Data Analysis, Data Collection, Data Pre-processing, Data Cleaning, Visualization, Model Design, Training, and Offline Evaluation, Model Deployment, Online Evaluation, and Monitoring, Model Maintenance, Diagnosis, and Retraining.

### Unit II

**Supervised Learning:** Bayesian Classification: Bayes Theorem- Priori and posteriori Probabilities-Naive Bayes Classification- K-NN- Theoretical Background -Determination of 'K' - Performance Measures for Supervised Learning Techniques- Confusion Matrix-Accuracy- Recall-Precision- F-Measure-Receiver Operating Curve (ROC)-Area Under Curve (AUC)-Rand Index-Jaccard Index

### Unit III

**Unsupervised Learning:** Types of Data in Cluster Analysis, Clustering Methods- Partitioning Methods: k-Means, k-Medoids, Hierarchical Methods: Agglomerative and Divisive, Decision Tree Induction: C4.5, Random Forests and ID3. Rule Based Classification. Fuzzy Clustering Methods: Fuzzy set approaches. Fuzzy C-Means, Possibilistic C-Means, Fuzzy Possibilistic C-Means, Possibilistic Fuzzy C-Means, Introduction- Structure- Forward and backward algorithm- Viterbi algorithm- Identification of best path and Sequence-Applications

### Unit IV

**Deep Learning:** Introduction, Application, Deep neural network, Single Layer Perceptron Model (SLP), Multilayer Perceptron Model (MLP), Fully Connected (FC) Layer, Convolutional neural networks, recurrent neural networks, Activation Function, Sigmoid, Rectified Linear Units (ReLU), tanh, SoftMax, Pooling Layer, Bias, Variance, Hyperparameters, Data Augmentation

### Unit V

**Convolutional Neural Networks:** Terminologies: Channels, pooling, Padding, Stride, Preparing the image, Generate filters, Convolve using filters Measuring performance, CNN models: LeNet, AlexNet, ResNet, MobileNet, YoLo Algorithm, Recurrent Neural Networks, Generative Adversarial Networks.

### Text Books and References:

1. Michael Bowles, Machine Learning in Python, John Wiley & Sons, Inc., 2015
2. Jason Brownlee, Machine Learning Mastery With Python, 2016.
3. Machine Learning with TensorFlow, Version 10, 2017, Manning Publications
4. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2015).

## 17. RISK MANAGEMENT

### Unit-1

Basics of probability – I -Basics of probability – II - Multiple random variables, Bayes' rule

### Unit-2

Fitting data to distributions – I - Fitting data to distributions – II -Methods of risk analysis; event trees

### Unit-3

Monte Carlo simulation- issues in generating price process (Brownian Motion, Ito Process), Project planning-supply chain management -Maintenance scheduling -Taguchi loss function analysis Portfolio Optimization-Estimating Value at Risk-Estimating Value at Risk – II-Option pricing and hedging

### Unit-4

RISK MODELING: Fundamentals Different approaches for risk modelling, Binomial Logistic, Multinomial Logistic, Survival Analysis, Penalized Models, Hazard Models, ARIMA

### Unit-5

Decision Trees, Clustering, Build Model to Predict Probability of Default (PD), Rare Event Modelling, Business case studies using industry relevant datasets on almost all the models, Advanced Modelling Techniques – Neural Networks (Pros/Cons), Support Vector Machines and how they are used in Risk Analytics

### Text Book & References:

1. Jorion, Philippe (2011): Financial Risk Manager Handbook, Wiley.
2. McNeil, Alexander, Rüdiger Frey, and Paul Embrechts (2005): Quantitative Risk Management – Concepts, Techniques and Tools, Princeton UP.
3. Merton, Robert C. (1974): On the Pricing of Corporate Debt: The Risk Structure of Interest Rates, The Journal of Finance, 29(2), 449-470
4. Leland, Hayne E., and Klaus Bjerre Toft (1996): Optimal Capital Structure, Endogenous Bankruptcy, and the Term Structure of Credit Spreads, The Journal of Finance, 51(3), 987-1019.
5. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques” Morgan Kaufmann publication, 2006.

# **19. LOGISTICS DOCUMENTATION, UCP, INCO, CUSTOMS, TAXATION (GST) AND INSURANCE**

## **UNIT I:**

### **Documentation**

Requirement and frame work of documentation- DGFT requirements- Aligned documentation system – Principal document used in Export - Principal auxiliary document used in Export – Important document used in Import – Terms used in Export and Import – Negotiation of documents – processing an export order – EDI ( Electronic Data Interchange )

## **UNIT II:**

### **Uniform Customs Practices (UCP) & INCO.**

Incoterms2010: The Role in International Trade, The Eleven Incoterms 2010 Identifying the Buyer and Sellers Responsibilities, Choosing the Correct one for International Trade Transaction and Packing Implications – The Import Procedure: Classification of Imports and Tariff book – Import Regimes: Import Licences, Tariff Quotas and Anti-Dumping Duties —

## **UNIT III:**

Customs Management:

Role of the Clearing agent, Selection of Clearing Agent, Benefits of Preferential Trading, Importing Goods at Reduced Rates of Duties, Rules of Origin, Certificate of Origin, Role of Certificate of Origin in the International Trade and Types of Certificates of Origin, SAD document, Rejected Imports and Reclaiming Duty, Deferred VAT and Duty, Inward Processing Relief and Bonded Warehousing

## **UNIT IV:**

Bills of Lading, Airwaybill, Freight Rates (Air & Sea) and Warehouse Cost

Bills of Lading: Definition, Liner Bills of Lading, Seaway Bills of Lading, generation of Bills of Lading and Instructions-, Air Waybill : Instructions, Issuing Flight Details and Airfreight Documentation - and Air Freight Rates: Instructions, consolidator the Role of the Consolidator and Air Waybill, Sea freight rates : Conference Line, Independent Line and Containerisation - major warehouse to warehouse costs: warehouse to warehouse costs for air and sea, Identifying Cost Centres From Sellers Warehouse to Buyers Warehouse via Sea and Air- Freight Forwarder : Role and selection



## **UNIT V:**

### **Taxation and Insurance**

Cargo Insurance sea : Examination of sea freight ( Clause A, B and C ), Knowledge on Insurance cover, selection of proper insurance cover – Insurance premium, Insurance certificate and marine insurance

Cargo Insurance air : Examination of air freight ( Clause A, B and C ), Knowledge on Insurance cover, selection of proper insurance cover – Insurance premium and Insurance certificate – Taxation: GST

### **References:**

1. Justin paul & Rajiv A, Export and Import Management, Oxford publication
2. R.M Joshi, International Business, Oxford publication
3. [Jayaram Hiregange](#) and [Deepak Rao](#) - India GST for beginners White Falcon Publishing

## **20. BLOCK CHAIN**

### **Unit-1**

#### **Basics**

Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete.

### **Unit-2**

#### **Cryptography**

Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

### **Unit-3**

#### **Blockchain**

Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

### **Unit-4**

#### **Distributed Consensus**

Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

### **Unit-5**

#### **Blockchain Applications**

Internet of Things, Medical Record Management System, Do-main Name Service and future of Blockchain.

#### **Text Books and References:**

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2. Wattenhofer, The Science of the Blockchain
3. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
4. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
5. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
6. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

## 21. INTERNET OF THINGS

### UNIT I

#### INTRODUCTION

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

### UNIT II

#### ARCHITECTURE

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

### UNIT III

#### PROTOCOLS

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security

### UNIT IV

#### BUILDING IoT WITH RASPBERRY PI & ARDUINO

Building IOT with RASPBERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

### UNIT V

#### CASE STUDIES AND REAL-WORLD APPLICATIONS

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

#### REFERENCES:

1. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
2. Michael Berthold, David J. Hand, —Intelligent Data Analysis, Springer, Second Edition, 2007.
3. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
4. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
5. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis,, O'Reilly Media, 2013.

## **22. ADVANCED DATA ANALYTICS**

### **Unit-I**

#### **Introduction to DBMS and RDBMS**

Introduction to DBMS and RDBMS: Database objects, Database tables, table records types of Database management system, Relational database management SQL, Database installation (MS SQL server or Oracle or MySQL Database Engine)

### **Unit II**

#### **Introduction to SQL**

SQL data type (Numeric, Date, Time, Char, String and miscellaneous), Sql Operators:(Arithmetic, Comparison, Logical & Bitwise), Sql expression (Boolean, Numeric, Date).

### **Unit-III**

#### **SQL Commands & Operation**

DDL commands (Create, Alter, Drop, Truncate, Rename). DML Commands (Select, Insert, Update, Delete). DCL Commands, SQL queries and Sub Queries, Clauses, Joins, SQL views, Indexes, SQL transaction, SQL Injections Relational Database Management system (Oracle, MS Access, MS SQL Server, MYSQL SyBaseDB, DB/400).

### **Unit IV**

#### **Tableau-I**

Introduction to Tableau, Connection: to text file, to Excel file , to Microsoft SQL Server and Microsoft analytic service Creation and removal of hierarchies ,Bins ,Data blending ,Sets, Combined Sets, Creation of Data Labels ,Create Folders ,Sorting Data ,Introduction to Charts: Area chart ,Bar chart ,Box plot ,Bump chart ,Dual combination chart ,Gantt chart ,Heat Map, Histogram Lollipop chart .Implementation of Map Tree Map, Geographic Map, Cross Map, Filled map

### **Unit-V**

#### **Advance Tableau:**

Report Generation: Dual axis reports, Blended axis ,Individual Axis ,Reference bends, reference distribution ,Symbol Map ,Google Maps ,Map box Maps ,Background Map, introduction to Filters: Quick filters ,Filters on dimension, Conditional filter, Context filter ,Slicing filter ,Data source filter ,Extract Filter. Tableau Dashboard: Create a Dashboard, Dashboard Layout formatting, Creation of device preview on Dashboard, Create filter on Dashboard, Dashboard objects, Create a story.

**Text Book & References:**

1. Petkovic, Dusan. (2016). Microsoft SQL Server 2016: A Beginner's Guide.
2. McDaniel, Eileen, and Stephen McDaniel. The Accidental Analyst: Show Your Data Who's Boss. Seattle, WA: Freakalytics, LLC, 2012.