

**NEW CURRICULUM WEF 2013**

**M. SC/ PG DIPLOMA IN OPERATIONAL RESEARCH**

**Compulsory Course Module**

Course Code	Name of the Course	Credits	Evaluation %	
			CA	WE
MA 5610	Basic Statistics	3	40 ±10	60 ±10
MA 5620	Operational Research Techniques I	4	40 ±10	60 ±10
MA 5630	Regression Analysis	4	40 ±10	60 ±10
MA 5640	Principles of Management	3	40 ±10	60 ±10
MA 5650	Computer Programming for Operational Research	3	40 ±10	60 ±10
MA 5660	Operational Research Techniques II	4	40 ±10	60 ±10
MA 5670	Multivariate Statistics for Data Mining	4	40 ±10	60 ±10
MA 5680	Time Series Analysis	4	40 ±10	60 ±10
MA 5690	Production and Operation Management	3	40 ±10	60 ±10
MA 5700	Parametric and Non Parametric Statistics	3	40 ±10	60 ±10
MA 5710	Financial Management	2	40 ±10	60 ±10
MA 5800	Project	4		
MA 5810	Research Project	20		

**Elective Course Module**

Course Code	Name of the Course	Credits	Evaluation %	
			CA	WE
MA 5720	Principles of Marketing	3	40 ±10	60 ±10
MA 5730	Numerical Methods	3	40 ±10	60 ±10
MA 5740	Survey Sampling and Estimating	3	40 ±10	60 ±10

**DOCUMENT 3 - SYLLABI OF COURSE MODULES**

**Compulsory Modules**

<b>Module Code</b>	<b>MA 5610</b>	<b>Module Title</b>	<b>Basic Statistics</b>			
<b>Credits</b>	<b>03</b>	<b>Hours/Week</b>	<b>Lectures</b>	<b>04</b>	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	<b>-</b>		

**Learning Objective:**

The purpose of this course is to

- provide students an introductory survey of many business applications of descriptive and inferential statistics.
- utilize probabilistic models in the analysis of managerial decision problems and uses case study approaches.
- train the use of statistical software for explanatory data analysis.

**Learning Outcomes:**

The students will be able to

- get a working knowledge of basic techniques in probability
- analyse data using descriptive statistics and interpret findings in a scientific manner
- look at data more logically, analytically, critically and creatively
- use statistical software

**Outline Syllabus**

**Out line of the syllabus:**

- Concept of probability, conditional probability and Bayes theorem,
- Discrete and continuous random variables,
- Descriptive statistics, inferential statistics,
- Probability and sampling distributions,
- Interval estimation and Hypothesis testing,
- Properties of various distributions (Binomial, Normal, Exponential, Poisson, Uniform etc)
- Statistical inferences on distribution theory,
- Distributions associated with the Poisson process.
- Introduction to decision theory,
- Expected value of perfect and sample information.

**Data Analysis:**

- Many of the ideas will be illustrated by use of the statistical software MINITAB, SPSS and SAS

Module Code	MA 5620	Module Title	Operational Research Techniques I			
Credits	04	Hours/Week	Lectures	04	Pre-Requisites	None
			Lab/Tutorials	-		
<b><u>Learning Objectives:</u></b>						
The purpose of this course is						
<ul style="list-style-type: none"> <li>• to study the basic tools in operational research for decision making. The emphasis is on solution methods and strategies.</li> </ul>						
<b><u>Learning Outcomes</u></b>						
The students will be able to						
<ul style="list-style-type: none"> <li>▪ understand a working knowledge of basic techniques in operational research</li> <li>▪ report and interpret findings in a scientific and concise manner</li> <li>• solve problems independently and collaboratively as part of a team</li> </ul>						
<b><u>Outline Syllabus</u></b>						
<ul style="list-style-type: none"> <li>• Modeling with linear programming,</li> <li>• Geometrical solution to problems with two decision variables,</li> <li>• Simplex method including the two phase method of a solution of problems with mixed constraints</li> <li>• Duality. transportation and assignment problems, theory of zero sum, two person matrix games,</li> <li>• Introduction to network algorithm including minimum connector problems, shortest and longest path algorithms</li> <li>• Critical path analysis.</li> </ul>						

<b>Module Code</b>	<b>MA 5630</b>	<b>Module Title</b>	<b>Regression Analysis</b>			
<b>Credits</b>	<b>04</b>	<b>Hours/Week</b>	<b>Lectures</b>	<b>04</b>	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	<b>-</b>		

**Learning Objectives:**

The purpose of this course is to

- familiarize basic statistical modeling using regression
- train the students to use of statistical software in developing linear models

**Learning Outcomes**

The students will be able to

- know the importance of statistical analysis and skills in business and management
- use statistical software with confident
- apply statistical models to solve business problems
- interpret statistical inferences to understand the business people

**Outline Syllabus**

- Introduction to linear models and general linear models.
- Simple linear regressions, model diagnostics, use of different statistical indicators for validation the results
- Multiple linear regression, non linear regression,
- Model building techniques ( $R^2$  statistics, Adj  $R^2$ ,  $C_p$ , forward selection, backward elimination, stepwise method etc)
- Handling multi collinearity in regression,
- Analysis of categorical data (concept of contingency tables, log-linear models for contingency tables,
- Linear models for continuous data, linear models for binary data

**Data Analysis:**

- Real data are analyzed using Minitab, SAS & SPSS software

<b>Module Code</b>	<b>MA5640</b>	<b>Module Title</b>	<b>Principles of Management</b>			
<b>Credits</b>	<b>03</b>	<b>Hours/Week</b>	<b>Lectures</b>	<b>04</b>	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	<b>-</b>		
<b><u>Learning Objectives</u></b>						
The purpose of this course is to						
<ul style="list-style-type: none"> <li>• gain knowledge on the key concepts of marketing</li> <li>• demonstrate an improved understanding of the value of customers and the associated concepts</li> <li>• develop the skills necessary to improve customer satisfaction</li> <li>• to make business organization customer/market oriented.</li> </ul>						
<b><u>Learning Outcomes</u></b>						
The students will be able to						
<ul style="list-style-type: none"> <li>• define and apply knowledge of the key marketing concepts</li> <li>• develop a Market Oriented Strategic Plan</li> </ul>						
<b><u>Outline Syllabus</u></b>						
<b>Management Functions:</b>						
<ul style="list-style-type: none"> <li>• Major functions in the organizations/firm (marketing, human resource management, finance and accounting, production, and information systems)</li> <li>• Perspectives of the organization as a whole and the groups individuals within it, nature of organizations, distribution of power, decision-making and planning (fundamentals of managerial decision making, strategic planning and management)</li> <li>• Managing groups and teams (leadership, motivation and communication), managing organizational change and innovation.</li> </ul>						
<b>Organizational Environment:</b>						
<ul style="list-style-type: none"> <li>• The role of government in the economy and the legal framework</li> <li>• Markets (theory of the firm, oligopoly theory, transaction costs, and product market organizational linkages),</li> <li>• Culture (culture-free versus culture specific perspectives and contrast between Japan and Western Organizations)</li> </ul>						
<b>Management Thought:</b>						
<ul style="list-style-type: none"> <li>• Evolution of Management Thought</li> <li>• Management in 21<sup>st</sup> century</li> <li>• Review of changing organizational environment, ethics in management</li> </ul>						

<b>Module Code</b>	<b>MA 5650</b>	<b>Module Title</b>	<b>Computer Programming for Operational Research</b>			
<b>Credits</b>	<b>03</b>	<b>Hours/Week</b>	<b>Lectures</b>	<b>04</b>	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	<b>-</b>		
<b><u>Learning Objectives</u></b>						
The purpose of this course is to						
<ul style="list-style-type: none"> <li>• provide knowledge on Object Orientation and Object Oriented Concepts programming</li> <li>• use macros in Excel</li> <li>• able to get competency in Data Modeling, Database Systems and Database Applications</li> </ul>						
<b><u>Learning Outcomes</u></b>						
The students will be able to						
<ul style="list-style-type: none"> <li>• learn Applications of Object Orientation</li> <li>• write MACRO programs in Excel</li> <li>• use Object Oriented System Development Process</li> </ul>						
<b><u>Outline Syllabus:</u></b>						
<ul style="list-style-type: none"> <li>• Introduction to Object Oriented Programming</li> <li>• Fundamentals of object orientation; object oriented concepts, object oriented analysis and design patterns,</li> <li>• Exception handling and building GUIs •</li> <li>Principles of data base management</li> <li>• Use of OOP for OR applications</li> <li>• Computer algorithms for OR applications</li> <li>• Use of EXCEL in data management and OR applications</li> </ul>						

<b>Module Code</b>	<b>MA 5660</b>	<b>Module Title</b>	<b>Operational Research Techniques II</b>			
<b>Credits</b>	<b>04</b>	<b>Hours/Week</b>	<b>Lectures</b>	<b>04</b>	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	<b>-</b>		

### Learning Objectives

The purpose of this course is to

- Present and use advanced scientific and mathematical OR approaches for managerial decision making with quantitative and modeling tools.

### Learning Outcomes

The students will be to

- get a broader understand of the advanced thoery of operational research
- get working knowledge of advance techniques in opeartational research
- develop new methods to solve some problems independently

### Outline Syllabus:

- Revised simplex algorithm. Dual Simplex algorithm, sensitivity analysis and parametric programming.
- Integer programming,
- Gomory's cutting plane, branch and bound, the knapsack problem.
- Delayed column generation, the cutting stock problem.

### **Decision Theory:**

- Introduction, Structuring the Decision Situations
- Decision Making Under Uncertainty, Decision Tree, Utility Theory.

### **Dynamic Programming:**

- Introduction to Dynamic Programming under certainty and under uncertainty
- Infinite State Dynamic Programming.

### **Waiting Line Theory:**

- Waiting Line Situations in Practical life,
- Arrival Distribution, Service Distribution, Queue Discipline
- Introduction to Stochastic Processes, M/m/1, M/M/m Systems with Finite & Infinite Population
- Queuing models and Queuing networks.
- An introduction to stochastic processes and their applications
- Difference equations
- Markov chains. Introduction to simulation

<b>Module Code</b>	<b>MA 5670</b>	<b>Module Title</b>	<b>Multivariate Statistics for Data Mining</b>			
<b>Credits</b>	<b>04</b>	<b>Hours/Week</b>	<b>Lectures</b>	<b>04</b>	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	<b>-</b>		

**Learning Objectives:**

The purpose of this course is to

- focus basic theory of multivariate analysis
- focus on the analysis of multivariate data in business environment

**Learning Outcomes**

The students will be able to

- use various multivariate statistical data mining methods
- identify the most suitable multivariate techniques for a given data
- interpret the results and apply for decision making
- use Minitab, SPSS and SAS for multivariate data analysis

**Outline Syllabus:**

- Introduction to multivariate and repeated data, multivariate statistics, concept of statistical data mining,
- Multivariate normal distribution,
- Basic concept, theory and applications in multivariate regression
- Principal component analysis,
- Factor analysis
- Cluster analysis
- Discriminant analysis
- Multivariate analysis
- Canonical correlation analysis
- Correspondence analysis,

**Data Analysis:**

- Real data are analyzed using Minitab, SPSS and SAS

<b>Module Code</b>	<b>MA 5680</b>	<b>Module Title</b>	<b>Time Series Analysis</b>			
<b>Credits</b>	<b>04</b>	<b>Hours/Week</b>	<b>Lectures</b>	<b>04</b>	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	<b>-</b>		
<b><u>Learning Objectives</u></b>						
The purpose of this course is to						
<ul style="list-style-type: none"> <li>• focus the various classical techniques in analysis of time series data</li> <li>• focus on the analysis of financial time series data</li> <li>• train the students to use Eviews and Minitab software in time series analysis</li> </ul>						
<b><u>Learning Outcomes</u></b>						
The students will be able to						
<ul style="list-style-type: none"> <li>▪ understand the various times series forecasting models</li> <li>▪ select the best fitted forecasting model for a given set of data series</li> <li>▪ develop ARIMA/ARCH/GARCH models for financial time series data</li> <li>▪ use software such as Eviews, Minitab and SPSS with confident</li> </ul>						
<b><u>Outline Syllabus</u></b>						
<ul style="list-style-type: none"> <li>• Basic concepts of time series, ,autocorrelation and correlation</li> <li>• Type of moving averages, trend analysis, smoothing techniques</li> <li>• Decomposition techniques, theory of linear process related to time series</li> <li>• Model building using ARMA models</li> <li>• Seasonal ARIMA models</li> </ul>						
<b>Modeling Financial Time Series:</b>						
<ul style="list-style-type: none"> <li>• Concept of financial time series,</li> <li>• Econometrics models,</li> <li>• Heterosedacity; measurement errors</li> <li>• ARCH and GRACH models.</li> <li>• Co-integration &amp; VAR models</li> </ul>						
<b>Data analysis:</b>						
<ul style="list-style-type: none"> <li>• Real data are analyzed using Minitab, EViews, SAS and SPSS.</li> </ul>						

<b>Module Code</b>	<b>MA5690</b>	<b>Module Title</b>	<b>Production and Operation Management</b>			
<b>Credits</b>	<b>03</b>	<b>Hours/Week</b>	<b>Lectures</b>	<b>04</b>	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	<b>-</b>		

**Learning Objectives**

Te students will be able

- to learn about and understand the role of Production/Operations Management in any business environment

**Learning Outcomes**

The students will be able to

- know how Production and Operations Management would help to improve the efficient of a system

**Outline Syllabus:**

- The role of marketing at the corporate and business level
- Marketing information and marketing research: marketing intelligence
- Marketing research process, junctions, design and analysis of market survey
- Application of analytical techniques and computer software
- Analyzing the marketing environment
- Consumer markets and buyer behavior.
- Industrial markets and organizational buyer behavior.
- Market segmentation, targeting and positioning.
- New product development.
- Managing the product line. Selecting and managing marketing channels.
- Design of marketing communication and sales promotion.
- Marketing services.
- International marketing
- Organization implementation and control of marketing programs

<b>Module Code</b>	<b>MA5700</b>	<b>Module Title</b>	<b>Parametric &amp; Non Parametric Analysis</b>			
<b>Credits</b>	<b>03</b>	<b>Hours/Week</b>	<b>Lectures</b>	<b>04</b>	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	<b>-</b>		

**Learning Objectives:**

The purpose of the course is to

- introduce the students an overview of nonparametric techniques in business environment
- introduce the students an overview of parametric techniques in business environment

**Learning**

The students will be able

- To decide to use parametric or non parametric statistical analysis for a given data set • Interpret the results to convince the clients

**Course Content**

- Concept of design and analysis of experiments in business applications
- Basic theory and applications in CRD, RCBD
- Simple Factorial Designs; Covariance analysis
- Use of rank correlation
- Application of Non parametric tests such as Sign test; Wilcoxon Ranked Sum Test
- Mann Whitney U test ; Kruskal Wallies H test; Friedman F Test

**Data analysis:**

- Real data are analyzed using Minitab, SAS and SPSS.

<b>Module Code</b>	<b>MA5710</b>	<b>Module Title</b>	<b>Financial Management</b>			
<b>Credits</b>	<b>2</b>	<b>Hours/Week</b>	<b>Lectures</b>	<b>04</b>	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	<b>-</b>		
<b><u>Learning Objectives</u></b>						
The purpose of this course is						
<ul style="list-style-type: none"> <li>To give an overview of the financial management basics that are use in business/financial environment.</li> </ul>						
<b><u>Learning Outcomes</u></b>						
The students will be able						
<ul style="list-style-type: none"> <li>to acquire a sound knowledge of the fundamentals economic theory and its applications.</li> <li>to formulate the fundamentals for basic solutions to economic problems</li> </ul>						
<b><u>Outline Syllabus</u></b>						
<ul style="list-style-type: none"> <li>Introduction to finance</li> <li>Financial statements and cash flow</li> <li>Time value of money; discounted cash flow valuation; bond valuation; stock valuation; NPV and other investments</li> <li>Introduction to Risk, Return and Security market</li> <li>Cost of capital; Capital structure policy</li> <li>Dividend Policy</li> <li>Working capital management</li> <li>Portfolio Theory</li> </ul>						

<b>Module Code</b>	<b>MA5800</b>	<b>Module Title</b>	<b>Project</b>			
<b>Credits</b>	<b>04</b>	<b>Hours/Week</b>	<b>Lectures</b>	-	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	-		
<b><u>Learning Objectives</u></b>						
The purpose of this is						
<ul style="list-style-type: none"> <li>to use the theory and practical knowledge gained from the courses to solve a practical problem and to document in proper way</li> </ul>						
<b><u>Learning Outcome</u></b>						
The students will be						
<ul style="list-style-type: none"> <li>able to tackle a industry application with scientific validation</li> </ul>						

<b>Module Code</b>	<b>MA5810</b>	<b>Title</b>	<b>Research Project</b>			
<b>Credits</b>	<b>20</b>	<b>Hours/Week</b>	<b>Lectures</b>	-	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	-		
<b><u>Learning Objectives</u></b>						
The purpose of this is						
<ul style="list-style-type: none"> <li>To provide an opportunity of further practicing in analyzing a set of data in the Operational Research Environment and interpretation results in order to make the students more comfortable to tackle the analytical problem with a guidance of a supervisor</li> </ul>						
<b><u>Learning Outcomes</u></b>						
The students will be						
<ul style="list-style-type: none"> <li>able to solve an industrial problem using statistical / mathematical techniques and convince any stake holders</li> </ul>						

Module Code	MA5720	Module Title	<b>Principles of Marketing</b>			
Credits	3	Hours/ Week	Lectures	4	Pre- Requisites	None
			Lab/Tutorials	-		
<b><u>Learning Objectives:</u></b>						
The purpose of this course is to						
<ul style="list-style-type: none"> <li>• to gain knowledge on the key concepts of marketing</li> <li>• to demonstrate an improved understanding of the value of customers and the associated concepts</li> <li>• to develop the skills necessary to improve customer satisfaction</li> <li>• to make business organization customer/market oriented.</li> </ul>						
<b><u>Learning Outcomes</u></b>						
The students will be able to						
<ul style="list-style-type: none"> <li>• define and apply knowledge of the key marketing concepts</li> <li>• develop a Market Oriented Strategic</li> </ul>						
<b><u>Outline Syllabus</u></b>						
<ul style="list-style-type: none"> <li>• The role of marketing at the corporate and business level</li> <li>• Marketing information and marketing research</li> <li>• Marketing intelligence</li> <li>• Marketing research process, junctions, design and analysis of market survey, • Application of analytical techniques and computer software</li> <li>• Analyzing the marketing environment, consumer markets and buyer behavior,</li> <li>• Industrial markets and organizational buyer behavior, market segmentation, targeting and positioning,</li> <li>• New product development, managing the product line.</li> <li>• Selecting and managing marketing channels, design of marketing communication and Sales promotion, marketing services,</li> <li>• International marketing and organization implementation • Control of marketing programs</li> </ul>						

<b>Module Code</b>	<b>MA5730</b>	<b>Module Title</b>	<b>Numerical Methods</b>			
<b>Credits</b>	<b>3</b>	<b>Hours/Week</b>	<b>Lectures</b>	<b>4</b>	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	<b>-</b>		
<b><u>Learning Objectives</u></b>						
<p>The aim of the course is</p> <ul style="list-style-type: none"> <li>• To develop an awareness of the scope and complexity of issues related to the Management of Technology</li> <li>• to solve such problems with the help numerical techniques</li> <li>• to develop skills for critical technology judgment</li> <li>• to provide the student with principles and tools for technology evaluation and manage</li> </ul>						
<b><u>Learning Outcomes</u></b>						
<p>The students will be to</p> <ul style="list-style-type: none"> <li>• understand basic tools in numerical analysis</li> <li>• to choose most appropriate numeric method to solve the problem</li> </ul>						
<b><u>Outline Syllabus</u></b>						
<ul style="list-style-type: none"> <li>• Introduction to numerical analysis including the theory of finite differences</li> <li>• Numerical integration and differentiation</li> <li>• Solution of initial valued ordinary differential equations</li> <li>• Solution of simultaneous linear algebraic equations by direct and iterative method, Solution of non-linear equations and elementary ideas of curve fitting</li> <li>• Numerical solution of partial differential equations</li> <li>• Finite Element Methods.</li> </ul>						
<b>Practical Work:</b>						
<ul style="list-style-type: none"> <li>• Use of published algorithms and packages for solving numerical problems.</li> </ul>						

<b>Module Code</b>	<b>MA5740</b>	<b>Module Title</b>	<b>Sampling Surveys</b>			
<b>Credits</b>	<b>3</b>	<b>Hours/Week</b>	<b>Lectures</b>	<b>4</b>	<b>Pre-Requisites</b>	<b>None</b>
			<b>Lab/Tutorials</b>	<b>-</b>		
<b><u>Learning Objectives</u></b> The aim of the course is						
<ul style="list-style-type: none"> <li>• To provide sound knowledge in conducting and analyzing a survey for business/marketing project.</li> </ul>						
<b><u>Learning Outcomes</u></b>						
The students will be able						
<ul style="list-style-type: none"> <li>▪ to design a survey depending on the conditions</li> <li>▪ to design a questionnaire to acquire information for the survey</li> <li>▪ to analyze data from a survey and write a report</li> <li>• to interpret findings in a scientific and concise manner</li> </ul>						
<b><u>Outline Syllabus</u></b>						
<ul style="list-style-type: none"> <li>• Probability sampling and inference for finite populations: basic principles</li> <li>• Sampling frames; Simple random sampling;</li> <li>• Stratified simple random sampling;</li> <li>• Unequal probability sampling;</li> <li>• Cluster sampling and multi-stage sampling;</li> <li>• Basic survey weighting</li> <li>• Survey inference for descriptive targets;</li> <li>• Survey data analysis using SPSS and interpretation;</li> </ul>						



### **Introduction to Statistics (MA 5001)**

Concept of probability, conditional probability and Bayes theorem, discrete and continuous random variables, descriptive statistics, inferential statistics, probability and sampling distributions, interval estimation and hypothesis testing, properties of various distributions (Binomial, Normal, Exponential, Poisson, Uniform etc) and their applications for operational research, statistical inferences on distribution theory, distributions associated with the Poisson process. introduction to decision theory, expected value of perfect and sample information.

**Data Analysis:** Many of the ideas will be illustrated by use of the statistical software MINITAB, SPSS and SAS

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### **Operational Research Techniques I (MA 5002)**

Modeling with linear programming, geometrical solution to problems with two decision variables, Simplex method including the two phase method of a solution of problems with mixed constraints, duality. transportation and assignment problems, theory of zero sum, two person matrix games, introduction to network algorithm including minimum connector problems, shortest and longest path algorithms and critical path analysis.

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### **Linear Models in Data Analysis (MA 5003)**

Introduction to linear models and general linear models, simple linear regressions, least square techniques, model diagnostics, use of different statistical indicators for validation the results, various linear transformations, multiple linear regression, non linear regression, model building techniques ( $R^2$  statistics, Adj  $R^2$ ,  $C_p$ , forward selection, backward elimination, stepwise method etc), handling multi collinearity in regression, Analysis of categorical data (concept of contingency tables, log-linear models for contingency tables, linear models for continuous data, linear models for binary data

**Data Analysis:** Real data are analyzed using Minitab, SAS & SPSS software.

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### **Principles of Management (MA 5004)**

**Management Functions:** Major functions in the organizations/firm (marketing, human resource management, finance and accounting, production, and information systems), perspectives of the organization as a whole and the groups individuals within it, nature of organizations, distribution of power, decision-making and planning (fundamentals of managerial decision making, strategic planning and management), managing groups and teams (leadership, motivation and communication), managing organizational change and innovation.

**Organizational Environment:** government and politics (the role of government in the economy and the legal framework). Markets (theory of the firm, oligopoly theory, transaction costs, and product market organizational linkages), Culture (culture-free versus culture specific perspectives and contrast between Japan and Western Organizations)

**Management Thought:** evolution of Management Thought (outline of development of the main approaches to organization and management, encompassing the classical, human relations, system and contingency approaches), management in 21<sup>st</sup> century, review of changing organizational environment, ethics in management.

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### **Computer Programming for Operational Research (MA 5007)**

Introduction to Object Oriented Programming (OOP): Fundamentals of object orientation; object oriented concepts, object oriented analysis and design patterns, exception handling and building GUIs; Principles of data base management, Use of OOP for OR applications; Computer algorithms for OR applications. Use of EXCEL in data management and OR applications

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### **Operational Research Techniques II (MA 5008)**

Revised simplex algorithm, dual simplex algorithm, sensitivity analysis and parametric programming. integer programming, Gomory's cutting plane, branch and bound, the knapsack problem, delayed column generation, the cutting stock problem. dynamic programming, the inventory model, non-linear optimization.

**Simulation and Stochastic Models:** Introduction to stochastic processes and their applications, difference equations, Markov chains. Introduction to simulation, queues and queue networks

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### **Applications of Multivariate Statistics in Data Mining (MA 5009)**

Introduction to multivariate and repeated data, multivariate statistics, concept of statistical data mining, multivariate normal distribution, use of eigen values in multivariate analysis, Basic concept, theory and applications in multivariate regression, principal component analysis, factor analysis, cluster analysis; discriminant analysis; multivariate analysis, canonical correlation analysis and correspondence analysis,

**Data Analysis:** Real data are analyzed using Minitab, SPSS and SAS

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### **Time Series Analysis (MA 5010)**

Basic concepts of time series, autocorrelation and correlation, type of moving averages, trend analysis, smoothing techniques, decomposition techniques, theory of linear process related to time series; Autocorrelation and partial autocorrelation function, model building using univariate Box Jenkins Approach (AR, MA, and ARMA models), Seasonal ARIMA models, Seasonal adjustment, Adjustment of prior factors, Bivariate Time Series. Kalman filtering, state space

**Modeling Financial Time Series:** Concept of financial time series, Co-Integration and Present Value Modeling: Econometrics models, Heteroscedasticity; measurement errors and the Permanent Income Hypothesis; simultaneous equation bias, indirect least squares, ARCH and GARCH models.

**Data analysis:** real data are analyzed using Minitab, EViews, SAS and SPSS.

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### **Production and Operation Management (MA 5011)**

**Management concepts and issues:** The relationship of production and operations management to cooperate objectives. The evolution of management principles and their applications in the production function, and in the provision of services, job designs, work measurement, quality management, operation management as a competitive tool and world class manufacture

**Models tools and Techniques:** The role of forecasting, production planning techniques such as Material Requirement Planning (MRP), MRP II, Just-in-Time (JIT), Optimal Production Technology (OPT). Design for Manufacture and services. Facility location, layout and process design, scheduling, dispatching and distribution, material and inventory management, capacity and aggregate planning, maintenance, facility acquisition and replacement

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### **Parametric and Non parametric Analysis in Experimentation (MA 5012)**

Concept of design and analysis of experiments in business applications; Basic theory and applications in CRD, RCBD, Simple Factorial Designs; Covariance analysis, Use of rank correlation; Application of Non parametric tests such as Sign test; Wilcoxon Ranked Sum Test; Mann Whitney U test ; Kruskal Wallies H test; Friedman F Test

### **Financial Management: (MA 5013)**

Introduction to finance; Financial statements and cash flow; Time value of money; discounted cash flow valuation; bond valuation; stock valuation; NPV and other investments;; Introduction to Risk, Return and Security market; ; Cost of capital; Capital structure policy; Dividend Policy; Working capital management; Portfolio Theory

### **MA 5290 Project on Operational Research**

The aim of the project is to provide an opportunity of further practicing in analyzing a set of data in the Operational Research Environment and interpretation results in order to make the students more comfortable to tackle the analytical problem independently. The students have to write a short report on the data analysis of which consists of minimum of 20 pages.

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### **MA 5291 Dissertation for M Sc**

The aim of this is to students to get involved in the development of research methodology appropriate to the practice of any problem in Operational Research environment that have some real significance value. The work should usually relates to the any subject/s area on Operation Research Course content and requires knowledge and skill acquired in the course.

### **Elective Modulus**

#### **Principles of Marketing (MA 5005)**

The role of marketing at the corporate and business level; Marketing information and marketing research: marketing intelligence, marketing research process, junctions, design and analysis of market survey, application of analytical techniques and computer software, analyzing the marketing environment, consumer markets and buyer behavior, industrial markets and organizational buyer behavior, market segmentation, targeting and positioning, new product development, managing the product line. Selecting and managing marketing channels, design of marketing communication and sales promotion, marketing services, international marketing and organization implementation and control of marketing programs

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#### **Numerical Methods (MA 5006)**

Introduction to numerical analysis including the theory of finite differences, numerical integration and differentiation, solution of initial valued ordinary differential equations, solution of simultaneous linear algebraic equations by direct and iterative methods, solution of non-linear equations and elementary ideas of curve fitting. numerical solution of partial differential equations, Finite Element Methods.

**Practical Work:** Use of published algorithms and packages for solving numerical problems.

#### **Survey Sampling and Estimation (MA 5014)**

Probability sampling and inference for finite populations: basic principles; Sampling frames

Simple random sampling; Stratified simple random sampling; Unequal probability sampling  
Cluster sampling and multi-stage sampling; Basic survey weighting; Survey inference for  
descriptive targets; survey data analysis using SPSS and interpretation;