

UNIVERSITY OF MUMBAI

No. UG/90 of 2015-16

CIRCULAR:-

A reference is invited to the Syllabi relating to the Post Graduate Diploma in Operation Research for Management **vide** this office Circular No. UG/376 of 1997 dated 10th October, 1997 and the Director, Jamanalal Bajaj Institute of Management Studies, the Directors of recognized Institutions of Management Studies and Professor-cum-Director, Institute of Distance and Open Learning are hereby informed that the recommendation made by the Faculty of Commerce at its meeting held on 22nd June, 2015 has been accepted by the Academic Council at its meeting held 26th June, 2015 **vide** item No. 4.37 and subsequently approved by the Management Council at its meeting held on 27th June, 2015 **vide** item No.18 and that in accordance therewith, the revised syllabus for the Post Graduate Diploma in Operations Research for Management, which is available on the University's web site (www.mu.ac.in) and that the same has been brought into force with effect from the academic year 2015-16.

MUMBAI – 400 032
30th September, 2015


REGISTRAR

To,

The Director, Jamanalal Bajaj Institute of Management Studies, the Directors of recognized Institutions of Management Studies and Professor-cum-Director, Institute of Distance and Open Learning.

A.C/4.37/26.06.2015

No. UG/90-A of 2015 -16

MUMBAI-400 032 30th September, 2015

Copy forwarded with Compliments for information to:-

- 1) The Deans, faculties of Commerce & Management.
- 2) The Director, Board of College and University Development,
- 3) The Co-Ordinator, University Computerization Centre,
- 4) The Controller of Examinations.


REGISTRAR

Post Graduate Diploma in Operations Research for Management

Course Details

Name of the Course	Post Graduate Diploma in Operations Research for Management
Duration of the Course	1 year
Pattern of the Course	2 semesters spread over one year
Structure of the Course	Semester I – 4 Papers Semester II – 3 Papers + 1 Project
Evaluation of the Course	Each paper shall be assessed over 100 marks as below: <ul style="list-style-type: none"> ✓ 40 marks of internal assessment ✓ 60 marks of end semester examination

Course Structure

Semester I		Semester II	
Code	Paper	Code	Paper
1.1	Applied Mathematics for Management	2.1	Applied Statistics for Management
1.2	Basic Statistics for Management	2.2	Optimisation Models II
1.3	Optimisation Models I	2.3	Advanced Linear Programming
1.4	Linear Programming	2.4	Project

Syllabus Details

1.1	Applied Mathematics
No.	Topic
1	<p><u>Simultaneous Linear Equations and Quadratic Equations</u></p> <p>Preliminaries, Solving Pure Quadratic Equations, Solving Affected Quadratic Equations, Nature of Roots, Symmetric Expressions of Roots of Quadratic Equations, Equations in Two Unknowns, Equations in Three or more Unknowns</p>
2	<p><u>Determinants and Matrices</u></p> <p>Definition of a Matrix, Different Types of Matrices, Algebra of Matrices, Multiplication of Matrices, Transpose of Matrices, Determinants, Properties of Determinants, Various orders of Determinants, Multiplication of Two Determinants, Minors and Co-Factors, Cramer's Rule for solution of Linear Equation, Adjoint of a Matrix, Input-Output Analysis, Rank of a Matrix</p>
3	<p><u>Compound Interest and Annuities Certain</u></p> <p>Introduction, Interest, Simple Interest, Compound Interest, Nominal and effective Rate of Interest, Force of Interest, Present value, Equation of Value, Nominal Rate of Discount, Effective Rate of Discount, Force of discount, Annuity, Type of Annuity, Amount of Ordinary Annuity, Present value of Ordinary Annuity, Amortization of Loan, Leasing, Capital Expenditure and Bonds, Annuity Due, Present Value of Annuity Due, Deferred Annuity, Present value of Deferred Annuity, Sinking Fund, General Annuity.</p>
4	<p><u>Limits and Functions</u></p> <p>Introduction and Concept of Function, Types of Function, Special Types of Function, Functions related to Business & Economics, Introduction to Limits, Evaluation of Limits</p>
5	<p><u>Derivatives, Application of Derivatives & Partial Differentiation</u></p> <p>Introduction to Derivatives, Explanation of Derivatives, Physical Meaning, Geometrical Meaning, Computation of Derivatives, Chain Rule, Maxima and Minima, Market Equilibrium, Cost Function, Revenue Function, Marginal Revenue Product, Marginal Propensity to Consume, Marginal Propensity to save, Concavity and Convexity, Point of Profit Function – Maximisation, Optimal Trade in Time, Effect of Taxation and Subsidy Monopoly, Effect of Excise Tax, Imposition of Sales Tax, Inventory Control</p> <p>Introduction, Partial Derivative, Total differentiation, second order partial derivative, Homogeneous function and Euler's Theorem, Implicit function, Maxima and Minima, Demand analysis, Partial Elasticities of Demand, Application of Partial Differentiation, Direct and Cross Partial Elasticities of demand, Production function, Marginal Productivity of Labour and Capital, Average Product of Labour and Capital, Linear Homogeneous Production Function, Marginal Rate of Technical Substitution, Isoquants, Properties of Isoquants, Elasticity of Substitution, Utility Function, Indifference Curve, Properties of Indifference of Curve, Marginal Rate of Substitution, Lagranges Method, Hessain determinant, Budget Line, Optimization Problems.</p>
6	<p><u>Integration and Application of Integration</u></p> <p>Introduction, Fundamental Formulae, Properties, Method of Integration, Substitution Method, Integration by parts, Integration by Partial Fraction, Special Integral, Definite Integral, Marginal Cost, Marginal Revenue, Maximisation of Profit, Optimum Time, Demand Function, Consumption Function, Total Saving, Consumer Surplus, Producer Surplus, Rate of Sales, Learning Curve</p>

1.2	Basic Statistics for Management
No.	Topic
1	<u>Introduction to Statistics</u> Statistics and Rational, Frequency Distribution, Classification and Tabulation, Diagrammatical and Graphical Presentation
2	<u>Measures of Central Tendency</u> Introduction to Central Tendency, Mathematical Averages, Positional Averages, Partition Values like Quartiles, Deciles and Percentiles
3	<u>Measures of Dispersion</u> Introduction to Measures of Dispersion, Various methods of Dispersion like Range, Mean Deviation, Variance, Standard Deviation and Coefficient of Variation, Measures of Shape like Skewness and Kurtosis
4	<u>Probability & Probability Distribution</u> Introduction to Probability, Concept of Probability, Counting Rules, Combinations and Permutations, Probability Assigning Techniques, Types of Probability, Some basic Probability Rules, Baye's Theorem and its Application, Introduction to Probability Distributions, Various Probability Distributions, Emphasis on Normal Probability Distributions
5	<u>Sampling & Sampling Distribution</u> Introduction to Sampling, Reason for Sampling, Sampling Design Process, Random Sampling vs Non Random Sampling, Sampling Types & Methods, Sampling Distribution, Central Limit Theorem
6	<u>Testing of Hypothesis – One Sample</u> Introduction to Hypothesis Testing, Hypothesis Testing Procedure, Two tail and One tail of Hypothesis, Type I and Type II Errors, Concept of t-test and z-test, Hypothesis testing for Population proportion <u>Testing of Hypothesis – Two Samples (Related and Independent)</u> Introduction, Hypothesis testing for difference between Two Population Means using z-statistic, Hypothesis testing for difference between Two Population Means using t-statistic, Statistical Inferences about the difference between the Means of Two-related Populations, Hypothesis testing for the difference in Two Population Proportions

1.3	Optimisation Models I
No.	Topic
1	<u>Optimisation Models</u> Introduction to Optimisation Models, Definition, Features and Approaches to Optimisation Models, Models and Modeling in Operations Research, Advantages and Applications of Optimisation Models
2	<u>Sequencing Models</u> Introduction to Sequencing, Sequencing Problem, Solution to Sequencing Problem – Processing n-jobs through one machine, processing n-jobs through two machines, processing n-jobs through three machines, processing two through m-machines, processing n-jobs through m-machines
3	<u>Replacement Models</u> Introduction to Replacement Models, Replacement of items that deteriorate, Replacement of items that fail suddenly, Mortality and Staffing Problem
4	<u>Inventory Models</u> Introduction to Inventory Models, Inventory Costs, Inventory Control Problem, Classification of Fixed Order Quantity Inventory Models, Inventory Models with Deterministic Demand, Inventory Models with Probabilistic Demands, Selective Inventory Control techniques – ABC Analysis, VED Analysis, FSN Analysis etc.
5	<u>Simulation Techniques</u> Introduction to Simulation, Process of Simulation, Monte Carlo Simulation, Simulation of an Inventory System, Simulation of a Queuing System, Application of Simulation
6	<u>Queuing Theory</u> Introduction to Queuing Models, Application of Queuing Models, Elements of a Queuing System, Operating Characteristic of a Queuing System, Classification of Queuing Models, Single Channel Queuing Theory, Multiple Channel Queuing Theory

1.4	Linear Programming
No.	Topic
1	Introduction to Linear Programming
2	Linear Programming – Formulation
3	Linear Programming Solution – Graphical Method
4	Linear Programming Solution – Simplex
5	Linear Programming – Special Properties, Interpretation of Final Tableau, Concept of Shadow Price, Concept of Primal Dual Analysis
6	Sensitivity Analysis

2.1	Applied Statistics for Management
No.	Topic
1	<u>Co-relation Analysis and Regression Analysis</u> Introduction to Measures of Association, Correlation – Meaning, Use and Types, Scatter Diagram, Karl Pearson’s Coefficient of Correlation, Spearman’s Rank Correlation
2	<u>Regression Analysis</u> Introduction to Regression, Simple Linear Regression Models, Determining the Equation of a Regression Line, Application of Simple Linear Regression, Introduction to Multiple Regression, Multiple Linear Regression Models, Determining the Multiple Linear Regression Model with two Independent Variables, Standard Error and Probable Error of Coefficient of Correlation, Coefficient of Determination
3	<u>Forecasting Techniques</u> Introduction to Forecasting Techniques, Types of Forecasting Techniques, Qualitative Methods of Forecasting, Quantitative Methods of Forecasting, Times Series Analysis, Smoothing Techniques – Moving Averages, Exponential Smoothing Method
4	<u>Decision Theory and Decision Trees</u> Decision Making under conditions of Certainty, Decision Making under conditions of Uncertainty, Decision Making under conditions of Risk, Concept of Decision Tree, Decision Tree Analysis
5	<u>Statistical Quality Control</u> Introduction to Statistical Quality Control, Causes of Variation in Quality, Techniques of SQC, Control Charts, Control Charts for Variables, Control Charts for Attributes, Acceptance Sampling, Introduction to Six Sigma
6	<u>ANOVA & Chi-Square Test</u> Introduction to ANOVA, One Way ANOVA, Two Way ANOVA without replication, Two Way ANOVA with replication Introduction to Chi Square, Defining Chi-Square Statistics, Chi-Square Goodness of Fit Test, Chi-Square Test of Independence: Two Way Contingency Analysis

2.2	Optimisation Models II
No.	Topic
1	<u>Assignment Techniques</u> Definition of Assignment Model, Mathematical Representation of Assignment Model, Hungarian Method of Solution of Assignment Model, Variation of the Assignment Model
2	<u>Transportation Techniques - I</u> Introduction to Transportation Model, Definition of Transportation Model, Matrix Terminology, Formulation and Solution of Transportation Model, Variants in Transportation Model
3	<u>Transportation Techniques - II</u> Variation in Transportation Problem, Trans Shipment Model, Time Minimisation Problems
4	<u>Network Analysis</u> Concept of Project Planning, Scheduling and Controlling, Work Break Down Structure, Basic Tools and Techniques of Project Management, Role of Network Technique in Project Management, Concept of Network or Arrow Diagram, Activity on Node Diagram, Critical Path Method, Concept of PERT, Concept of CPM, Cost Analysis and Crashing the Network
5	<u>Game Theory</u> Introduction to Theory of Games, Characteristics of Games, Game Models, Rules for Game Theory, Concept of Pure Game, Mixed Strategies – 2x2 Games, Mixed Strategies – 2xN or Mx2, Mixed Strategies – MxN Games
6	<u>Markov Chains</u> Introduction to Markov Chains, Brand Switching Examples, Markov Process, Markov Analysis – Input and Output

2.3		Advanced Linear Programming	
No.		Topic	
1	<u>Dynamic Programming</u>	Introduction to Dynamic Programming, Dynamic Programming Approach, Formulation of Dynamic Programming, Optimal Sub-division Problem, System Reliability	
2	<u>Integer Programming</u>	Introduction to Integer Programming, Types of Integer Programming, Gomory's Integer Cutting Plane Method, Gomory's Mixed Integer Cutting Plane Method, Branch and Bound Method	
3	<u>Goal Programming</u>	Introduction to Goal Programming, Concept of Goal Programming, General Goal Programming Method, Modified Simplex Method of Goal Programming	
4	<u>Parametric Programming</u>	Introduction to Parametric Programming, Variation in the Objective Function Coefficient, Variability in the availability of Resources	
5	<u>Non Linear Programming Methods</u>	Introduction, General Non Linear Programming Problem, Graphical Solution Method, Quadratic Programming	
6	<u>Software Applications in OR</u>	Introduction to various Softwares used in OR, Understanding of the solver add-in to solve OR problems, Understanding of various other Softwares like SPSS, Lindo etc. for Optimisation	

2.4		Project	
1		<p>The student shall pick up an industry or sector of his or her choice. The project shall comprise of applying any of the three techniques stated in the curriculum for Optimisation to the domain so selected. The project shall elaborate on</p> <ol style="list-style-type: none"> a. The selected sector / industry b. The area of problem c. Disadvantages due to the problem d. Selection of the technique e. Reason for the technique f. Application of the technique g. Advantages post application h. Proof of Optimisation 	

References

Sr. No.	Book	Author	Publication
1	Quantitative Techniques in Management	N.D. Vohra	McGraw Hill
2	Operations Research	Premkumar Gupta D.S. Hira	S Chand
3	Operations Research	J.K. Sharma	MacMillan
4	Business Statistics	Naval Bajpai	Pearson
5	Business Mathematics	Zameeruddin Kazi Vijay Khanna S.K. Bhambri	Vikas Publication
6	Business Statistics	J.K. Sharma	Pearson

Evaluation

Continual Assessment – 40 Marks

- ✓ Every paper shall have a continual assessment component of 40 marks.
- ✓ This continual assessment shall be done in the form of assignments for each paper.
- ✓ The continual assessment shall comprise of two assignments in each paper.
- ✓ Each assignment shall carry a weightage of 20 marks.
- ✓ The assignments must be submitted before the prescribed date.
- ✓ A student is required to score a minimum of 20 out of 40 in each paper to clear the exams.
- ✓ The final paper on project shall not carry any continual assessment.
- ✓ The final paper on project shall be evaluated over 100 marks.

End Semester Examination – 60 Marks

- ✓ Every paper shall have an End Semester Evaluation of 60 marks.
- ✓ Each paper shall be of a 3 hour duration.
- ✓ Each paper shall have two sections.
- ✓ Section I
 - Shall be of 30 marks
 - Shall have two compulsory questions.
 - The two compulsory questions can have internal choices.
- ✓ Section II
 - Shall be of 30 marks.
 - Shall have five questions of which the students have to attempt three questions.
 - Each question shall be of 10 marks

Ordinance and Regulations Relating to the Diploma Course in Operations Research for Management

0.3518	<p>A candidate for being eligible for admission to the Diploma Course in Operations Research for Management:</p> <p>[A] Must hold a University degree in any Faculty with two year's working experience in any organization.</p> <p style="text-align: center;">OR</p> <p>Must have recognized professional qualification and at least five year's professional experience.</p> <p style="text-align: center;">And</p> <p>[B] Must be residing within India.</p>
0.3519	Notwithstanding anything contained in .1791, the Defense service Personnel may be admitted to the course even if they are not degree holders.
0.3520	The duration of the Diploma course in Operations Research Management shall be of one year comprising of two semesters.
0.3521	There shall be University Examination for the Diploma Course Operations Research for Management at the end of each semester. No student shall be admitted to the examination unless the student has paid in full all dues.
0.3522	The tuition fees for the Diploma Course in Operation Researchers for Management shall be Rs.12,000/- per year.
0.3523	The examination for the Diploma Course in Operations Research for Management shall be held twice in a year on such dates as may be fixed in that behalf.
0.3524	A candidate must forward his application for admission to the examination to the Controller of examination on or before the date fixed for the purpose under the Ordinance.
0.3525	<p>A student who has once registered himself for the Diploma Course in Operations Research for Management but had not appeared at the said examination or has appeared and failed thereat and desires to reappear at a subsequent examination shall renew his registration for the examination at least three months prior to the date of commencement of the examination. The fee renewal of such registration shall be</p> <ul style="list-style-type: none"> ✓ Rs. 500/- for registration ✓ Rs. 250/- as examination fee per paper
R.3982	The Institute of Distance Education will keep record of each student registered for the Diploma Course in Operations Research for Management in regard to the assignments submitted by the students in each of the subjects and the number of marks obtained by him thereat.
0.3526	On payment of a fresh fee a candidate who fails to pass the examination in a subject / subjects will be allowed to reappear thereat on a subsequent occasion.
R.3983	A candidate will be examined in the subjects mentioned in the Diploma course in Operations Research for Management at the end of the year.