RV Institute of Management

Master of Business Administration (MBA)
Batch 2024 – 26

Semester II

23MBA421 – APPLICATION OF OPERATIONS RESEARCH IN BUSINESS

Course Pack

2024–2025

VISION

To become a world-class management institute of eminence.

MISSION

To nurture Universal Thought Leaders by offering holistic management education fostering Business Intelligence, Health Care, Innovation and Entrepreneurship for Inclusive Growth and Sustainable Development

AND

To provide value added services to Business, Government and Society through Staff Empowerment, Joint Research and Collaborative Engagement.

Program Educational Objectives (PEOs)

PEO 1: Graduates will be able to demonstrate effective decision making, cognitive flexibility, and problem-solving capability and adapt to the changing global environment

PEO 2: Graduates will be capable of innovating, starting new entrepreneurial ventures and be a lifelong learner with multidisciplinary research aptitude

PEO 3: Graduates will be able to think critically; communicate effectively; demonstrate analytical skills, team spirit and leadership qualities

PEO 4: Graduates will be able to demonstrate professional values, cultural sensitization, ethical behavior and integrity

PEO 5: Graduates will be responsible global citizens and contribute towards inclusive growth and sustainable development of the society

Program Objectives (POs)

1. Apply knowledge of management theories and practices to solve business problems with required abilities to understand, analyze and communicate global, economic, societal, cultural, legal and ethical aspects of business
2. Foster Analytical and critical thinking abilities for data-driven decision making
3. Ability to develop value based leadership to lead themselves and others in the achievement of organizational goals and contributing effectively to a team environment through effective communication and Negotiation skills
4. Ability to identify business opportunities, frame innovative solutions and launch new business ventures or be an intrapreneur
5. Ability to deal with contemporary issues using multi-disciplinary approach with the help of advanced Management and IT tools and techniques
6. Ability to apply domain specific knowledge and skills to build competencies in their respective functional area
7. Ability to engage in research and consultancy work with cognitive flexibility to create new knowledge and be a lifelong learner
8. Ability to understand social responsibility and contribute to the community for inclusive growth and sustainable development of society through ethical behavior

RV Institute of Management

Course Plan

Program	Master of Business Administration
Course Code & Name	**23MBA421 – APPLICATION OF OPERATIONS RESEARCH IN BUSINESS**
Semester	Semester II
Hours & Credits	48 Hours, 4 Credits (1 Credit = 12 hours)
Course Anchor	Faculty – Department of Operations Management / Quantitative Methods
Course Facilitators	Faculty of Operations Research RV Institute of Management

APPLICATION OF OPERATIONS RESEARCH IN BUSINESS

COURSE DOCKET – INDEX

SEMESTER: II

Course Syllabus

Course Name: APPLICATION OF OPERATIONS RESEARCH IN BUSINESS	Course Code: 23MBA421
Total number of hours: 48 Hrs	Credits: 4
Total Number of Sessions: 48 (including TORA lab sessions)	Hours per Session: 1 hour

Course Description:

Operations Research (OR) is a discipline that deals with the application of advanced analytical methods to help make better decisions. Operations Research arrives at optimal or near-optimal solutions to complex decision-making problems. OR takes tools from different disciplines such as mathematics, statistics, economics, psychology, engineering etc. and combines these tools to make a new set of knowledge for decision making. OR is a professional discipline which deals with the application of scientific methods for making decisions, and especially to the allocation of scarce resources. The main purpose of OR is to provide a rational basis for decision making in the absence of complete information. This course helps students to understand the various OR tools and their importance in Organisational decision making process.

Course Outcomes: Having successfully completed this course the students will be able to:

CO1: Select appropriate Operational Research (OR) techniques for decision making.

CO2: Formulate and solve mathematical model (linear programming problem) for a physical situation like production, distribution of goods and economics, Transportation and assignment models.

CO3: Demonstrate the best strategy using decision making methods under uncertainty using game theory.

CO4: Illustrate the characteristics of different types of decision-making environments.

CO5: Apply CPM and PERT techniques, to plan, schedule, and control project activities.

Pedagogy:

This course uses multiple pedagogies including classroom discussion, TORA lab sessions, project-based learning, experiential learning, workshop from practitioners, and case-based teaching.

Syllabus

Module 1: Linear Programming Problem (LPP) (12 Hrs.)

- Importance, scope, techniques and characteristics of Operations Research
- Different types of models in OR: physical, mathematical, schematic, simulation models
- Linear Programming Problem (LPP): Formulation and solution
- Graphical solution method: Maximization and Minimization problems
- Simplex method: Standard maximization problems
- Formulation of Duality (only formulation)

Module 2: Transportation and Assignment Models (10 Hrs.)

- Meaning and importance of Transportation model; balanced and unbalanced problems
- **Methods for Initial Basic Feasible Solution:** North West Corner Rule (NWCR); Least Cost Method (LCM); Vogel's Approximation Method (VAM)
- Optimal solution using Modified Distribution (MODI) method
- Maximization Problems in Transportation

- **Characteristics and importance of Assignment model:** Hungarian method for minimization and maximization; Travelling Salesman Problem (theory); Crew Assignment problems (theory only)

Module 3: Sequencing and Replacement Problems (10 Hrs.)

- **Sequencing:** Terminology and notations; types of sequencing problems
- Processing n jobs through 2 machines (Johnson's Algorithm)
- Processing n jobs through 3 machines
- Processing N jobs in M machines
- **Replacement Theory:** Assumptions of replacement theory
- Replacement of items which deteriorate with time (Case 1: value does not change with time)
- Replacement of items that fail completely including group replacement

Module 4: Theory of Games and Queuing Theory (8 Hrs.)

- Types of gaming strategies: pure strategy and mixed strategy
- Formula method (algebraic method) for mixed strategy
- Saddle point method for pure strategy
- Graphical method for 2 × n and m × 2 games
- Principle of Dominance
- **Queuing Theory:** Operating characteristics of queuing system
- Single server / single queue model (M/M/1): all formulas and problems

Module 5: Network Analysis and Simulation (8 Hrs.)

- Networking Concepts: terminology, rules for drawing network diagram
- **Critical Path Method (CPM):** Finding Critical Path; Total Float (TF); Free Float (FF); Independent Float (IF)
- PERT Computations: three time estimates (optimistic, most likely, pessimistic)
- Probability of meeting scheduled dates in PERT
- Difference between PERT and CPM; Crashing (theory)
- **Simulation – Monte Carlo:** Concept and steps; using Random Number Table; problems

Teaching Learning Resources:

Recommended Books:

9. K.K Chawla, Vijay Gupta and Bhushan K Sharma, "Operations Research and Quantitative Analysis for Management", Kalyani Publishers.
10. N.D. Vohra (2012), "Quantitative Techniques in Management", Tata McGraw-Hill Publications, 4th Edition.
11. P.C Tulsian and Vishal Pandey (2012), Quantitative Techniques. Pearson Practice Series.
12. J.K. Sharma, Quantitative Methods and Operation Research, Excel Publication, 2012.

Reference Books:

13. David M. Lenine (2012), Quantitative Techniques for Management. Pearson Publication.
14. Fedric S Hiller and Gerald J Lieberman (2012), Introduction to Operation Research, 8th Edition.
15. Er. Prem Kumar Guptha and Dr. D.S. Hira (2014), Operation Research. S. Chand Publications.
16. Anand Sharma (2014), Quantitative Techniques for Decision Making. Himalaya Publishing House.
17. S. Kalavathi (2013), Operation Research. Vikas Publications. 4th Edition.
18. Hamdy A Taha (2013), Operation Research. Pearson Publication. 9th Edition.

Supplementary Reading:

19. https://www.udemy.com/course/operations-research
20. https://orc.mit.edu/impact/moocs
21. https://www.edx.org/course/operations-research-an-active-approach
22. Pearson e-library: https://elibrary.in.pearson.com/bookshelfDashboard
23. EBSCO: https://www.ebsco.com/search?search=supplychainmodel
24. Jgate: https://jgateplus.com/home/resources/ | www.capitaline.com

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	3	1	2	-	1	-	-
CO2	1	3	-	1	1	-	1	-
CO3	1	3	-	1	-	-	-	-
CO4	-	3	-	1	1	1	-	-
CO5	1	2	2	2	-	1	1	-
Contribution **3-Substantial** **2-Moderate** **1-Slight** **- No Co-relation**								

Application of Operations Research in Business – Session Plan (48 Sessions)

Mod.	Sess.	Coverage	Pedagogy / Activities	Resource / Reference	Video Link (Scan QR)
1	1	Overview of course; Introduction to Operations Research: definition, scope, and importance in business decision-making	Interactive class discussion	Vohra Ch.1 Pg. 1-14	Intro to OR
1	2	Characteristics, techniques and scope of OR; Different types of models in OR: physical, mathematical, schematic, simulation	Discussion	Vohra Ch.1 Pg. 15-28	OR Scope & Models
1	3	Linear Programming Problem: concept and formulation; decision variables, objective function, constraints; LPP formulation examples	Discussion + Formulation	Vohra Ch.2 Pg. 30-46	LPP Formulation
1	4	LPP Formulation: practice problems — production planning, product mix, diet problem, media planning	Discussion + Numericals	Vohra Ch.2 Pg. 47-62	LPP Formulation Problems
1	5	Graphical Solution Method: maximization problems — corner point method, iso-profit line method	Discussion + Numericals	Vohra Ch.2 Pg. 63-78	Graphical Method Max
1	6	Graphical Solution Method: minimization problems; unbounded solutions; infeasible solutions; multiple optimal solutions	Discussion + Numericals	Vohra Ch.2 Pg. 79-94	Graphical Method Min
1	7	Simplex Method: introduction; converting LPP to standard form; slack and surplus variables; initial solution	Interactive class discussion	Vohra Ch.3 Pg. 96-112	Simplex Method Intro
1	8	Simplex Method: maximization — pivot element; entering and departing variables; optimality test	Discussion + Numericals	Vohra Ch.3 Pg. 113-128	Simplex Maximization
1	9	Simplex Method: maximization problems continued; Big-M method introduction	Discussion + Numericals	Vohra Ch.3 Pg. 129-144	Simplex Problems

1	10	TORA Lab Session 1: Solving LPP using TORA software — graphical and simplex methods	TORA Lab	TORA Software	Simplex Continued
1	11	Formulation of Duality: concept of dual problem; primal and dual relationship; economic interpretation	Discussion	Vohra Ch.4 Pg. 146-160	Duality Formulation
1	12	Duality: formulation problems; Case Discussion: LPP for Production Planning at a Manufacturing Firm	Case Discussion + Numericals	Industry Case Study	Duality Problems
2	13	Transportation Model: meaning, importance and assumptions; balanced and unbalanced problems; introduction to Initial Basic Feasible Solution	Interactive class discussion	Vohra Ch.5 Pg. 164-178	Transportation Intro
2	14	Initial BFS: North West Corner Rule (NWCR) — method, steps and numerical problems	Discussion + Numericals	Vohra Ch.5 Pg. 179-192	NWCR Method
2	15	Initial BFS: Least Cost Method (LCM) / Matrix Minima method — steps and numerical problems; comparison with NWCR	Discussion + Numericals	Vohra Ch.5 Pg. 193-206	Least Cost Method
2	16	Initial BFS: Vogel's Approximation Method (VAM) — penalty method; steps and numerical problems	Discussion + Numericals	Vohra Ch.5 Pg. 207-222	VAM Method
2	17	VAM continued: practice problems; comparison of NWCR, LCM and VAM; choosing the best initial solution	Discussion + Numericals	Vohra Ch.5 Pg. 223-236	VAM Problems
2	18	Optimal Solution: Modified Distribution (MODI) method — stepping stone path; u-v method; optimality test	Discussion + Numericals	Vohra Ch.5 Pg. 237-252	MODI Method
2	19	MODI method: numerical problems; degenerate transportation problems; Case Discussion: Transportation Optimisation	Case Discussion + Numericals	Industry Case Study	MODI Problems

2	20	Maximization transportation problems; unbalanced transportation problems (dummy row/column)	Discussion + Numericals	Vohra Ch.5 Pg. 253-264	Maximization Transport
2	21	Assignment Model: characteristics and importance; Hungarian method for minimization — step-by-step	Discussion + Numericals	Vohra Ch.6 Pg. 266-280	Hungarian Method Min
2	22	Assignment: maximization problems; unbalanced assignment; multiple optimal solutions	Discussion + Numericals	Vohra Ch.6 Pg. 281-294	Assignment Max
2	23	TORA Lab Session 2: Transportation and Assignment problems using TORA; Travelling Salesman Problem (theory); Crew Assignment (theory)	TORA Lab + Theory	TORA Software + Vohra Ch.6	TSP & Crew Assignment
3	24	Sequencing: terminology and notations; introduction to job scheduling; assumptions of sequencing	Interactive class discussion	Vohra Ch.7 Pg. 298-312	Sequencing Intro
3	25	Processing n jobs through 2 machines: Johnson's Algorithm — steps, conditions and numerical problems	Discussion + Numericals	Vohra Ch.7 Pg. 313-326	n Jobs 2 Machines
3	26	Processing n jobs through 3 machines: conversion to 2-machine equivalent; Johnson's rule application	Discussion + Numericals	Vohra Ch.7 Pg. 327-340	n Jobs 3 Machines
3	27	Processing N jobs in M machines: general sequencing; introduction to branch and bound approach	Discussion	Vohra Ch.7 Pg. 341-354	N Jobs M Machines
3	28	Sequencing: practice problems; make span, idle time, elapsed time calculations; Case Discussion: Job Scheduling	Case Discussion + Numericals	Industry Case Study	Sequencing Problems
3	29	Replacement Theory: introduction and assumptions; reasons for replacement; types of replacement decisions	Interactive class discussion	Vohra Ch.8 Pg. 356-368	Replacement Theory Intro

3	30	Replacement of items that deteriorate with time: Case 1 — capital cost and running cost; optimal replacement period when value does not change with time	Discussion + Numericals	Vohra Ch.8 Pg. 369-382	 Individual Replacement
3	31	Replacement of items that fail completely: individual replacement policy; group replacement policy	Discussion + Numericals	Vohra Ch.8 Pg. 383-396	 Group Replacement
3	32	Replacement: numerical problems — individual vs group replacement comparison; decision criteria	Discussion + Numericals	Vohra Ch.8 Pg. 397-410	 Replacement Problems
3	33	TORA Lab Session 3: Replacement problems using TORA; Case Discussion: Machine Replacement at an Engineering Firm	TORA Lab + Case	Industry Case Study	 Replacement Case
4	34	Theory of Games: introduction; two-person zero-sum game; game matrix; pure strategy and mixed strategy	Interactive class discussion	Vohra Ch.9 Pg. 414-428	 Game Theory Intro
4	35	Saddle Point Method: minimax and maximin criteria; saddle point existence; pure strategy solution	Discussion + Numericals	Vohra Ch.9 Pg. 429-442	 Saddle Point Method
4	36	Mixed Strategy: algebraic formula method (2×2 games); expected value calculation	Discussion + Numericals	Vohra Ch.9 Pg. 443-456	 Mixed Strategy Formula
4	37	Graphical Method: 2×n and m×2 games — finding optimal mixed strategy graphically; principle of dominance	Discussion + Numericals	Vohra Ch.9 Pg. 457-470	 Graphical Method Games
4	38	Principle of Dominance: row and column dominance; simplifying game matrices; Case Discussion: Game Theory in Competitive Pricing	Case Discussion + Numericals	Industry Case Study	 Dominance Principle
4	39	Queuing Theory: introduction; queuing system components; arrival and service	Interactive class discussion	Vohra Ch.10 Pg. 472-486	

		process; performance measures			Queuing Theory Intro
4	40	Single Server / Single Queue Model (M/M/1): all operating characteristics formulae; numerical problems	Discussion + Numericals	Vohra Ch.10 Pg. 487-500	M/M/1 Model Problems
4	41	TORA Lab Session 4: Game theory and Queuing problems using TORA; Queuing problems practice	TORA Lab + Numericals	TORA Software + Vohra	Queuing Problems TORA
5	42	Network Analysis: networking concepts; rules for drawing network diagram (AOA and AON); dummy activities	Interactive class discussion	Vohra Ch.11 Pg. 504-518	CPM Network Drawing
5	43	Critical Path Method (CPM): forward pass; backward pass; critical path identification; floats: TF, FF, IF	Discussion + Numericals	Vohra Ch.11 Pg. 519-534	Critical Path & Floats
5	44	PERT: three time estimates (t_o, t_m, t_p); expected time (te); variance; network construction	Discussion + Numericals	Vohra Ch.11 Pg. 535-548	PERT Three Estimates
5	45	PERT Computations: probability of meeting scheduled dates; Z-score calculation; Case Discussion: CPM/PERT for Construction	Case Discussion + Numericals	Industry Case Study	PERT Probability
5	46	Difference between PERT and CPM; crashing (theory); TORA Lab Session 5: CPM/PERT using TORA	Discussion + TORA Lab	TORA Software + Vohra	CPM vs PERT Crashing
5	47	Simulation: concept and steps; Monte Carlo simulation; random number generation and assignment	Interactive class discussion	Vohra Ch.12 Pg. 550-564	Monte Carlo Simulation
5	48	Monte Carlo Simulation: problems using random number table; Case Discussion: Simulation for Inventory Demand; Course Wrap-up	Case Discussion + Numericals	Industry Case Study	Simulation Problems

Course Evaluation Plan

Component	Description	Units	Marks	Timeline
End Term	End Term Exam – All Modules 1–5	All Modules	50	End of semester
CIA-I (Mid-Term)	Mid-Term Test – Modules 1, 2 & 3	Modules 1–3	20	After 2–3 modules
CIA-II	Attendance and Class Participation	NA	5	End of semester
CIA-III	Quiz – Modules 1–5	All Modules	5	After each module
CIA-IV	Remaining assignments (Quiz, Individual assignment, CapStone project, Major or minor project, Group assignments etc.)	All Modules	25	Full Semester
Total			**100**	-

EVALUATION DESCRIPTION

CIA-I – Mid-Term Test (CO1, CO2, CO3) – 20 Marks

Mid Term Exam Syllabus: Module I, II and III

Pattern:

- Evaluation through numerical problems, LPP formulation, short theory questions and case-based analytical questions
- Duration: 1.5 hours | Closed book | Scientific calculator and TORA formula sheet permitted
- Total of 50 marks converted to 20

CIA-II – Attendance and Class Participation – 5 Marks

- Active participation in classroom discussions, TORA lab sessions, and case-based activities
- Consistent attendance throughout the semester

CIA-III – Quiz – 5 Marks

- 10 questions from each module carrying 1 mark each. Total of 50 marks will be converted to 5 marks.

CIA-IV – Capstone Project – 25 Marks

Capstone Project: OR Application for Business Decision-Making

- Students select a real-world business problem and apply at least two OR techniques to analyse and solve it
- Problem must be formulated mathematically, solved using appropriate OR algorithms, and verified using TORA software
- Report must include problem formulation, solution procedure, TORA output screenshots, sensitivity analysis, and business recommendations

Rubrics:

S.No.	Parameters	Marks
1	Problem Identification and Selection of Appropriate OR Technique	5
2	Accuracy of Formulation, Computation and Application of OR Algorithm	8
3	Interpretation of Results, Sensitivity Analysis and Business Decision Insights	7
4	Quality of Report / Presentation and TORA/Software Output	5
	Total	**25**

Prepared by

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