INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**:**	**OPERATIONS RESEARCH**			
Course Code	**:**	**A70352**			
Regulations		**R15-JNTUH**			
Course Structure	**:**	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	:	4	-	-	4
Course Coordinator	**:**	**Mrs. T. Vanaja, Asst. Professor, Dept. of Mechanical Engineering.**			
Team of Instructors	**:**	**Mr. A. Somaiah, Assistant Professor, Dept. of Mechanical Engineering.** **Mrs. T. Vanaja, Assistant Professor, Dept. of Mechanical Engineeering.**			

I. COURSE OVERVIEW

Operation Research is also called OR for short and it is a scientific approach to decision making which seeks to determine how best to design and operate a system under conditions requiring allocation of scarce resources. Operations research as a field, primarily has a set or collection of algorithms which act as tools for problems solving in chosen application areas. OR has extensive applications in engineering, business and public systems and is also used by manufacturing and service industries to solve their day to day problems. This course is titled in Fundamentals of Operations Research. This course facilitates to learn various models to optimize a problem.

II. PREREQUISITE(S)

Level	Credits	Periods	Prerequisite
UG	4	4	Mathematics-I

III. MARKS DISTRIBUTION

Sessional Marks (25)	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective type and Objective type tests. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each midterm exam shall contain 4 questions. The student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks with duration of 20 minutes. It consists of 10 Multiple choice and 10 fill in the blanks. The student has to answer all the questions and each carries half a mark. First midterm examination shall be conducted for the first 2½ units of syllabus and second midterm examination shall be conducted for the remaining 2½ units. Five marks are earmarked for assignments.	75	100

IV. EVALUATION SCHEME

S.No	Component	Duration	Marks
1	I Mid examination	80 minutes	20
2	I Assignment	--	05
3	II Mid examination	80 minutes	20
4	II Assignment	--	05
5	External examination	3 hours	75

V. COURSE OBJECTIVE:

The objectives of the course are to enable the student to:

I. Knowledge in solving industrial engineering problems like transportation, assignment etc.
II. Understand Linear Programming (LP), LP and allocation of resources, LP definition, Linearity requirement Maximization Then Minimization problems.
III. Understand Feasible Solution: The Northwest Method, The Lowest Cost Method.
IV. Understand different optimization techniques in manufacturing areas.
V. Apply in research and development in caring out the projects

VI. COURSE OUTCOMES

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the characteristics of different types of decision making environments and the appropriate decision making approaches and tools to be used in each type.
2. Apply to build and solve transportation models and assignment models.
3. Design new simple models, like: CPM to improve decision –making and develop critical thinking and objective analysis of decision problems.
4. Apply to solve industrial engineering problems like transportation, assignment etc. Do research and development in carrying out the projects.
5. Understand the mathematical tools that are needed to solve optimization problems.
6. Identify and develop operational research models from the verbal description of the real system.
7. Develop a report that describes the model and the solving technique, analyze the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.
8. Solve multi-level decision problems using dynamic programming method.
9. Understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand.
10. Solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
11. Understand the relationship between a linear program and its dual, including strong duality and complementary slackness.
12. Understand the basic ideas behind each analytical tool, which is important for the reality check and sensitivity analysis of the obtained solution.
13. Analyze markets and design customer driven strategies, communicate the decisions towards business development with superior customer value.
14. Understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.
15. Understand the mathematical tools that are needed to solve optimization problems. Use mathematical software to solve the proposed models.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED

Program outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge:** Capability to apply the knowledge of Mathematics, science and Engineering in the field of Mechanical Engineering	H	Assignments and Exams
PO2	**Problem Analysis:** An Ability to analyze complex engineering problems to arrive at relevant conclusions using knowledge of Mathematics, Science and Engineering.	H	Assignments and Exams
PO3	**Design/ Development of Solutions:** Competence to design a system, component or process to meet societal needs within realistic constraints.	S	Assignments and Exams
PO4	**Conduct investigations of complex problems:** To design and conduct research oriented experiments as well as to analyze and implement data using research methodologies.	N	--
PO5	**Modern tool usage:** An ability to formulate solve complex engineering problem using modern engineering and Information technology tools.	H	Assignments and Exams
PO6	**The Engineer and society:** To utilize the engineering practices, techniques, skills to meet needs of the health, safety, legal, cultural and societal issues.	N	--
PO7	**Environment and society**: To understand impact of engineering solutions in the societal context and demonstrate the knowledge for sustainable development.	N	--
PO8	**Ethics:** An understanding responsibilities and implementation of professional and Ethical	N	--
PO9	**Individual and Team work:** To function as an effective individual and as a member or leader in Multi- disciplinary environment and adopt in diverse teams.	N	--
PO10	**Communication:** An ability to assimilate, comprehends, communicate, give and receive instructions to present effectively with engineering community and society.	N	--
PO11	**Project management and finance**: An ability to provide leadership in managing complex engineering projects at multi-disciplinary environment and to become a professional engineer.	N	--
PO12	**Life-Long learning**: Recognition of the need and an ability to engage in lifelong learning to keep abreast with technological changes.	S	Assignments and Exams

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		Level	Proficiency Assessed by
PSO 1	**Professional Skills**: To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	H	Lectures, Assignments
PSO 2	**Design/Analysis:** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	S	Projects
PSO 3	**Successful Career and Entrepreneurship:** To build the nation, by imparting technological inputs and managerial skills to become Technocrat.	H	Guest Lectures

N - None **S - Supportive** **H – Highly Related**

IX. SYLLABUS

UNIT-I

Development – Definition– Characteristics and Phases – Types of models - Operations Research models – applications.

Allocation: Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method.

UNIT-II

Transportation Problem - Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.

Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem- Traveling Salesman problem.

UNIT-III

Sequencing - Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines.

Replacement: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely, Group Replacement.

UNIT-IV

Theory Of Games: Introduction – Terminology - Solution of games with saddle points and without saddle points – 2×2 games - dominance principle – m X 2 & 2 X n games - Graphical method.

Inventory: Introduction – Single item – Deterministic models – Purchase inventory models with one price break and multiple price breaks – Stochastic models – demand may be discrete variable or continuous variable – Single period model and no setup cost.

UNIT-V

Waiting Lines: Introduction – Terminology - Single Channel – Poisson arrivals and exponential service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

Dynamic Programming: Introduction –Terminology - Bellman's Principle of optimality –Applications of dynamic programming - shortest path problem – linear programming problem.

Simulation: Introduction, Definition, types of simulation models, steps involved in the simulation process - Advantages and Disadvantages – Application of Simulation to queuing and inventory.

TEXT BOOKS:

T1. Operations Research /J. K.Sharma 4 Edition /MacMilan,
T2. Introduction to O. R /Hiller and Libermann/TMH/7th Edition.

REFERENCE BOOKS:

R1. Operations Research /S.D.Sharma, 15th Edition/Kedar Nath Ram Nath, 2010
R2. Operations Research / R.Pannerselvam 2 Edition.,PHI Publications
R3. OperationsResearch/A.M.Natarajan,P.Balasubramani,A.Tamilarasi/Pearson Education.
R4. Introduction to O.R /Taha 8 Edition/PHI
R5. Operations Research / Wagner/ PHI Publications/2 Edition

X. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1-2	Explain operation Research models	**UNIT-I** Development– Definition– Characteristics and Phases – Types of operation Research models	T1, R3
3-4	Outline applications and formulations.	**Allocation :** Linear Programming Problem Formulation	T1, R3
5-8	Explain Simplex method	Graphical solution – Simplex method	T1, R2
8-10	Define Artificial variables	Artificial variables techniques	T1, R1
10-12	Derive Two–phase method	Two–phase method	T1, R4
12-14	Solve Big-M method	Big-M method	T1, R2, R3
15-18	Describe unbalanced Transportation problem	**UNIT-II** Formulation-Optimal solution unbalanced	R1, R2

		transportation problem	
19-20	Solve degeneracy problems	Degeneracy	R1, R2
21-23	Analyze Assignment Problem	Assignment problem- Formulation – Optimal solution	T1, R2, R3
24-25	Identify Variants of AP	Variants of Assignment Problem, travelling salesman problem	T1, R2
26-28	Derive sequencing problems	**UNIT-III** Introduction-Flow-Shop sequencing-n jobs through two machines-n jobs through three machines	T1, R2
29-30	Determine Job shop sequencing	Job shop sequencing – two jobs through "m: machines	T1, R2
31-35	Describe replacement	**Replacement:** Introduction	T1, R2,R3
36-38	Design Replacement of items that deteriorate with time	Replacement of items that deteriorate with time-when money value is not counted and counted	T1, R3
39-41	Derive and Analyze replacement of items that fail completely	Replacement of items that fail completely, group replacement. Group replacement	T1, R3, R2
42	Discuss Minimax (maximin) Criterion	**UNIT-IV** **Theory Games:** Introduction terminology	T1, R3
43-44	Discuss saddle points	Solution of games with saddle points	T1, R2, R3
45-46	Construct Rectangular games without saddle points	Rectangular games without saddle points-2 x 2 games	T1, R2, R3
47-50	Analyze dominance Principle	dominance principle – m X 2 & 2 X n games - graphical method	T1, R2, R3
51-52	Derive the formula for Inventory models	Inventory: Introduction-Single item	T1, R2, R3
53-54	Derive the formula for inventory models	Purchase inventory models with one price break and multiple price breaks	T1, R2, R3
55-56	Derive the formula for stochastic models	Stochastic Models	T1, R2, R3
57-58	Determination of Models	Demand may be discrete variable or continuous variable – Single period model and no setup cost	T1, R2, R3
59-60	Derive single channel-poisson arrivals	**UNIT-V** Waiting Lines: Introduction-Single Channel-Poisson arrivals	T1, R4
61-63	Determine service times – with infinite population and finite population models	Exponential service times – with infinite population and finite population	T1, R2
64-65	Determine and discuss Multichannel-Poisson arrivals	Multichannel-Poisson arrivals	T1, R4, R5
66-67	Derive Poisson arrivals – exponential service times with infinite population.	Poisson arrivals-exponential service times with infinite population	T1, R4, R5
68-69	Derive the formula for Dynamic Programming	**Dynamic Programming:** Introduction-Terminology- Bellman's Principle of optimality – Applications of dynamic programming	T1, R4
70	Derive the formula for shortest path problem	**Shortest** path problem-linear programming proble	T1,R4
71	Discuss simulation models	**Simulation-**Defination-Types of Simulation models-phases of simulation-applications of simulation	T1,R4
72-74	Derive the formula for Inventory models	**Advantages** and Disadvantages-application of simulation to queuing and inventory.	T1,R4

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	H		S		H						H		S		H
II		H	S											H	S
III	S			S				S	H				S		H
IV					H							S			S
V	H		S		H				H				S	H	

N = None **S = Supportive** **H = Highly related**

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H		S	S	H								S	H	
2	H		S								H				S
3			S										S		H
4	H			S	H				H					H	
5		H	S									S			
6				S	H								S	H	
7	H	H										S			S
8												S	S		H
9	H			S					H		H			H	
10			S										S	S	
11	H			S									S		
12		H									H	S		H	S
13	H				H							S	S		H
14			S	S					H		H			H	
15	H	H	S		H						H	S	S	S	

N = None **S = Supportive** **H = Highly related**

Prepared by:
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