Ref No:

SRI KRISHNA INSTITUTE OF TECHNOLOGY BANGALORE

COURSE PLAN

Academic Year 2019-20

Program:	B E – Mechanical Engineering
Semester :	8
Course Code:	15ME81
Course Title:	OPERATIONS RESEARCH
Credit / L-T-P:	04/3-2-0
Total Contact Hours:	50
Course Plan Author:	Dr SV Prakash/Mr. Harendra Kumar H V

Academic Evaluation and Monitoring Cell #29, Hesaraghatta Main road, Chimney Hills, Chikkabanavara P.O., Bengaluru – 560090, Karnataka, INDIA Phone / Fax :+91 80 23721477 -STD- 080 23721315>

http://www.skit.org.in: skit1princi@gmail.com: >

Table of Contents

OPERATIONS RESEARCH	
A. COURSE INFORMATION	
1. Course Overview	
2. Course Content	
3. Course Material	4
4. Course Prerequisites	
5. Content for Placement, Profession, HE and GATE	5
B. OBE PARAMETERS	5
1. Course Outcomes	5
2. Course Applications	6
3. Mapping And Justification	6
4. Articulation Matrix	7
5. Curricular Gap and Content	7
6. Content Beyond Syllabus	8
C. COURSE ASSESSMENT	8
1. Course Coverage	8
2. Continuous Internal Assessment (CIA)	8
D1. TEACHING PLAN – 1	9
Module - 1	9
Module – 2	10
E1. CIA EXAM – 1	11
a. Model Question Paper - 1	11
b. Assignment -1	
D2. TEACHING PLAN - 2	15
Module – 3	15
Module – 4	16
E2. CIA EXAM – 2	17
a. Model Question Paper - 2	
b. Assignment – 2	17
D3. TEACHING PLAN - 3	19
Module – 5	
E3. CIA EXAM – 3	20
a. Model Question Paper - 3	
b. Assignment – 3	
F. EXAM PREPARATION	21
1. University Model Question Paper	21
2. SEE Important Questions	22
G. Content to Course Outcomes	23
1. TLPA Parameters	
2. Concepts and Outcomes:	25

A. COURSE INFORMATION

1. Course Overview

Degree:	ME	Program:	ME
Semester:	VIII	Academic Year:	2019-2020
Course Title:	OPERATIONS RESEARCH	Course Code:	15ME81
Credit / L-T-P:	04/3-2-0	SEE Duration:	180 min
Total Contact Hours:	50 Hrs	SEE Marks:	80 Marks
CIA Marks:	20	Assignment	1 / Module
Course Plan Author:	Dr SV Prakash/Mr. Harendra Kumar H V	Sign	Dt:
Checked By:	Dr.S V Prakash	Sign	Dt:
CO Targets	CIA Target :90%	SEE Target:	85%

Note: Define CIA and SEE % targets based on previous performance.

2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute. Identify 2 concepts per module as in G.

Mod ule	Content	Teachi ng Hours	Identified Module Concepts	Blooms Learning Levels
1	Introduction: Evolution of OR, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study. Characteristics and limitations of OR, models used in	8	scope, need, phases and techniques of operations	L2,L3
	OR,		research.	
	Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. SolutionstoLPP by graphical method(Two Variables).			
2	LPP: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by S implex method, Big-M Method and Two Phase Simplex Method, Degeneracy in LPP. Concept of Duality, writing Dual of given LPP. Solutions to L.P.P by Dual Simplex Method.	12	Different methods of solving OR problems	L3
3	 Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution(MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem. Assignment Problem-Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems. Travelling Salesman Problem (TSP). Difference between assignment and T.S.P, Finding best route by Little's method. Numerical Problems. 	12	Transportation and Assignment problems	L3
4	Network analysis: Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks, determining the probability of completing a project, predicting the completion time of project; Cost analysis in networks. Crashingofnetworks- Problems.	10	critical path, floats for deterministic and PERT networks including crashing of Networks.	L3

	Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), Kendall & Lee's notation of Queuing, empirical queuing models – Numerical on M/M/1 and M/M/ C Queuing models.			
5	Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and Min-Max criteria, Principle of Dominance, Solution of games with Saddle point. Mixed Strategy problems. Solution of 2X2 games by Arithmetic method, Solution of 2Xn m and mX2 games by graphical method. Formulationof games. Sequencing: Basic assumptions, Johnson's algorithm, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing of2 jobs on 'm' machines using graphical method.	8	game theory for pure and mixed strategy	L3
-	Total	50	-	-

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes

2. Design: Simulation and design tools used – software tools used ; Free / open source

3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modul	Details	Chapters	Availability
es		in book	
Α	Text books (Title, Authors, Edition, Publisher, Year.)	-	-
1,2,4,5	Operations Research, P K Gupta and D S Hira,S. Chand and Company	1,2,4,5	In Lib
	LTD.Publications, New Delhi – 2007		
3	Operations Research, An Introduction, Seventh Edition, Hamdy A. Taha,	3	In Lib
	PHI Private Limited, 2006.		
В	Reference books (Title, Authors, Edition, Publisher, Year.)	-	-
3	Operations Research, Theory and Applications, Sixth Edition, J K	3	In dept
	Sharma, Trinity Press, Laxmi Publications Pvt.Ltd. 2016.		
4	Operations Research, Paneerselvan, PHI	4	In dept
1,2,4,5	Operations Research, A M Natarajan, P Balasubramani,	1,2,4,5	In dept
	PearsonEducation, 2005		
С	Concept Videos or Simulation for Understanding		
1	https://www.fmtv.com > operations research		
2	https://www.delta-t.co.uk > LPP		
3	https://www.luminousindia.com > travelling salesman		
4	https://study.com > network analysis		
5	https://www.studentenergy.org >sequencing		

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Studi	ddents must nave teamt the following courses / ropics with described content							
Mod	Course	Course Name	Topic / Description	Sem	Remarks	Blooms		
ules	Code					Level		
4	15ME51	Management	Management programs	V		L2		
		and						
		enterprener						
3	10ME81	Operation	Basic of operations	VIII		L2		
		mangement						

Students must have learnt the following Courses / Topics with described Content

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.

Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

			· · /			
Mod	Topic / Description	Area	R	emarks		Blooms
ules						Level
1	Models used in OR	Industry and	Seminar	on	different	L2
		GATE	management	systems		
4	PERT networks	GATE	NPTEL Videos	5		L2
5	Basic assumptions, Johnson's algorithm,	Industry and	Seminar on	different	jobs of	L3
	sequencing 'n' jobs on single machine	GATE	sequencing.			
	using priority rules, sequencing using					
	Johnson's rule-'n' jobs					

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

Mod	Course	Course Outcome	Teach.	Concept	Instr	Assessme	Blooms'
ules	Code.#	At the end of the course, student	Hours		Method	nt	Level
		should be able to				Method	
1	15ME81.1	Understand the meaning,	8	scope,	Lecture	Chalk	L2
		definitions, scope, need, phases		need,		and board	Understand
		and techniques of operations		phases and			
		research.		techniques			
				of			
				operations			
				research.			
2	15ME81.2	Formulate as L.P.P and derive	12	Different	Lecture	Chalk and	L3
		optimal solutions to linear		methods of		board	Apply
		programming problems by		solving OR			
		graphical method, Simplex		problems			
		method, Big-M method and Dual					
		Simplex method.					
3	15ME81.3	Formulate as Transportation and	12	Transporta			L3
		Assignment problems and derive		tion and			Apply
		optimum solutions for		Assignmen			
		transportation, Assignment and		t problems			
		travelling salesman problems					
4	15ME81.4	Solve waiting line problems for M/	10	critical	Lecture	Chalk and	L3
		M/1 and M/M/K queuing models.		path, floats	/Tutorial	board	Apply

-	-	Total	50	-	-	-	L2,L3
5	121112/1.5	times for sequencing of n jobs-2 machines, n jobs-3machines, n jobs-m machines and 2 jobs-n machines using Johnson's algorithm and analysis of games.	0	theory for pure and mixed strategy	Lecture	board	L3 Apply
		Including crashing of Networks.		PERT networks including crashing of Networks.		Chally and	
		Construct network diagrams and determine critical path, floats for deterministic and PERT networks		for determinist icand			

2. Course Applications

Mod	Application Area	СО	Level
1	Food and Agriculture Farmers apply linear programming techniques to their work. By determining what crops they should grow, the quantity of it and how to use it efficiently, farmers can increase their revenue.	CO1	L2
2	using the simplex Method to solve some accounting problems in order to get optimum allocation of Scarce resources to competing activities under the assumptions of certainty, linearity and constant price. It also considers simplex method as an aid to accounting decision making used to eliminate off-the-cuff decisions based on intuition or experience by using mathematical approach to accounting problem solving	CO2	L3
3	Applications in Engineering Engineers also use linear programming to help solve design and manufacturing problems. For example, in airfoil meshes, engineers seek aerodynamic shape optimization.	CO3	L3
4	Transportation Optimization Transportation systems rely upon linear programming for cost and time efficiency. Bus and train routes must factor in scheduling, travel time and passengers.	CO4	L3
5	Game theory has many applications in subjects such as economics, international relations and politics, and psychology as it can be used to analyze and predict the behavior and decisions of the players	CO5	L3

3. Mapping And Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair. To attain competency required (as defined in POs) in a specified area and the knowledge & ability required to accomplish it.

Mod	Mapping Mappin		Mapping	Justification for each CO-PO pair	Lev
ules			Level		el
-	CO	PO	-	'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'	-
1	CO1	PO1	1.5	The knowledge of mathematical principles will help the students to apply the same to formulate solutions for engineering problems. Like manufacturing problems,	L3
1	CO1	PO2	1.5	Fundamental knowledge in complex analysis will help to analyze the engineering problems easily. To show the use of Linear Programming to evaluate the performance.	L3
1	CO1	PO3	1.5	Thorough understanding mathematical principles & lpp students can give solution to complex engineering problems which may be helpful in health ,safety & societal considerations. Like The objective of these problems is either to minimize resources for a fixed level of performance, or to maximize performance at a fixed level of resources. Among all the mathematical optimization techniques, linear programming is perhaps the most used and best understood by the business and industrial community.	L3
1	CO1	PO4	1.5	Thorough understanding LPP they can conduct investigation of complex problems can be solved on the computer. For example Although many problems in architecture, engineering, construction and urban and regional development can be modeled with linear programming.	L3
1	CO1	PO6	2.5	By understanding mathematical principles and LPP students can apply contextual knowledge to assess solution to complex engineering problems which may be helpful in health ,safety & societal considerations. Like It is used for Artificial Intelligence as part of making machines more intelligent, Among all the mathematical optimization techniques, linear programming is perhaps the most used and best understood by the business and industrial community.Entertainment.finance etc.	L3
1	CO1	PO7	2.5	Thorough understanding lpp they can know the environmental contexts. From the aggregation of indicators, values for each municipality were obtained in a scale from zero to one, being one (highlighted in tables) given to municipalities that were included in "quality estimated frontier" in the respective dimension or sub-dimension. Municipalities distant from the frontier received a zero, indicating less quality.	L3
1	CO1	PO9	2	Student will develop individual knowledge to work in a team or individually as a decision analyst.	L3
1	CO1	PO12	1.5	Study of LPP is required if students want to work in manufacturing ,business based companies.	L4
2	CO2	PO1	1.5	The knowledge of mathematical principles will help the students to apply the same to formulate solutions for engineering problems. Like manufacturing problems,	L3
2	CO2	PO2	1.5	Fundamental knowledge in complex analysis will help to analyze the engineering problems easily. To show the use of Linear Programming to evaluate the performance of Oral Health in Primary Care.	L3
2	CO2	PO3	1.5	Thorough understanding mathematical principles & lpp students can give solution to complex engineering problems which may be helpful in health ,safety & societal considerations. Like The objective of these problems is either to minimize resources for a fixed level of performance, or to maximize performance at a fixed level of resources. Among all the mathematical optimization techniques, linear programming is perhaps the most used and best understood by the business and industrial	L3

				community.	
2	CO2	PO4	1.5	Thorough understanding LPP they can conduct investigation of complex problems can be solved on the computer. For example Although many problems in architecture, engineering, construction and urban and regional development can be modelled with linear programming.	L3
2	CO2	PO6	2.5	By understanding mathematical principles and LPP students can apply contextual knowledge to assess solution to complex engineering problems which may be helpful in health ,safety & societal considerations. Like It is used for Artificial Intelligence as part of making machines more intelligent, Among all the mathematical optimization techniques, linear programming is perhaps the most used and best understood by the business and industrial community, healthcare,Entertainment,finance etc.	L3
2	CO2	PO7	2.5	Thorough understanding lpp they can know the environmental contexts. From the aggregation of indicators, values for each municipality were obtained in a scale from zero to one, being one (highlighted in tables) given to municipalities that were included in "quality estimated frontier" in the respective dimension or sub-dimension. Municipalities distant from the frontier received a zero, indicating less quality.	L3
2	CO2	PO9	2	Student will develop individual knowledge to work in a team or individually as a decision analyst.	L3
2	CO2	PO12	1.5	Study of LPP is required if students want to work in manufacturing ,business based companies.	L4
3	CO3	PO1	1.5	The knowledge of mathematical principles will help the students to apply the same to formulate solutions for engineering problems. Like manufacturing problems,	L3
3	CO3	PO2	1.5	Fundamental knowledge in complex analysis will help to analyze the engineering problems easily. To show the use of Linear Programming to evaluate the performance of Oral Health in Primary Care.	L3
3	CO3	PO3	1.5	Thorough understanding mathematical principles & lpp students can give solution to complex engineering problems which may be helpful in health ,safety & societal considerations. Like The objective of these problems is either to minimize resources for a fixed level of performance, or to maximize performance at a fixed level of resources. Among all the mathematical optimization techniques, linear programming is perhaps the most used and best understood by the business and industrial community.	L3
3	CO3	PO1	1.5	The knowledge of mathematical principles will help the students to apply the same to formulate solutions for engineering problems. Like manufacturing problems,	L3
3	CO3	PO2	1.5	Fundamental knowledge in complex analysis will help to analyze the engineering problems easily. To show the use of Linear Programming to evaluate the performance of Oral Health in Primary Care.	L3
3	CO3	PO3	1.5	Thorough understanding mathematical principles & lpp students can give solution to complex engineering problems which may be helpful in health ,safety & societal considerations. Like The objective of these problems is either to minimize resources for a fixed level of performance, or to maximize performance at a fixed level of resources. Among all the mathematical optimization techniques, linear programming is perhaps the most used and best understood by the business and industrial community.	L3
3	CO3	PO4	1.5	Thorough understanding LPP they can conduct investigation of complex problems can be solved on the computer. For example Although many problems in architecture, engineering, construction and urban and regional development can be modelled with linear programming.	L3
3	CO3	PO5	-	No content tool, no mapping	L2
3	CO3	P06	2.5	By understanding mathematical principles and LPP students can apply	L3

				problems which may be helpful in health ,safety & societal considerations. Like It is used for Artificial Intelligence as part of making machines more intelligent, Among all the mathematical optimization techniques, linear programming is perhaps the most used and best understood by the business and industrial community, healthcare,Entertainment,finance etc.	
3	CO3	PO7	2.5	Thorough understanding lpp they can know the environmental contexts. From the aggregation of indicators, values for each municipality were obtained in a scale from zero to one, being one (highlighted in tables) given to municipalities that were included in "quality estimated frontier" in the respective dimension or sub-dimension. Municipalities distant from the frontier received a zero, indicating less quality.	L3
3	CO3	PO8	2.5	Students can formulate the complex problem as linear programming model ,can apply all methods obtain solution to give some conclusion.	L3
3	CO3	PO9	2.5	Students can formulate the complex problem as linear programming model ,can apply all methods obtain solution to give some conclusion.	L3
3	CO3	PO10	2.5	Thorough understanding optimizing techniques they can know the environmental contexts.	L3
3	CO3	PO11	2.5	Student will develop individual knowledge to work in a team or individually as a decision analyst.	L3
3	CO3	PO12	2.5	Study of optimizing techniques is required if students want to work in manufacturing ,business based companies.	L3
4	CO4	PO1	1.5	The knowledge of game theory and decision analysis is required to find the solution of complex engineering problems like manufacturing.	L3
4	CO4	PO2	1.5	Students can formulate the complex problem as game theory model and obtain solution often used in political, economic, and military planning.	L3
4	CO4	PO3	1.5	Design solutions for complex engineering problems using game theory,solution often used in political, economic, and military planning.	L3
4	CO4	PO4	1.5	Thorough understanding game theory method they can conduct investigation of complex problems can be solved for example much progress has been made in applying game theoretic models to a wide range of economic problems.	L3
4	CO4	PO6	2.5	It has hardly been used to tackle safety management in multi-plant chemical industrial settings.	L3
4	CO4	PO7	2.5	Thorough understanding game theory they can know the environmental contexts. Problems related to game theory arise in a range of fields, for example, health care, transportation and military planning.	. L3
4	CO4	PO12	1.5	Study of game theory is required if students want to progress in analytics field.	L3
5	CO5	PO1	1.5	The knowledge of game theory and decision analysis is required to find the solution of complex engineering problems like manufacturing.	L3
5	CO5	PO2	1.5	Students can formulate the complex problem as game theory model and obtain solution often used in political, economic, and military planning.	L3
5	CO5	PO3	1.5	Design solutions for complex engineering problems using game theory,solution often used in political, economic, and military planning.	L3
5	CO5	PO4	1.5	Thorough understanding game theory method they can conduct investigation of complex problems can be solved for example much progress has been made in applying game theoretic models to a wide range of economic problems.	L3
5	CO5	PO6	2.5	It has hardly been used to tackle safety management in multi-plant chemical industrial settings.	L3
5	CO5	PO7	2.5	Thorough understanding game theory they can know the environmental contexts. Problems related to game theory arise in a range of fields, for example, health care, transportation and military planning.	L3
5	CO5	P012	1.5	Study of game theory is required if students want to progress in analytics field	L3

4. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Course Outcomes	Program Outcomes				-											
Mod	CO.#	At the end of the course	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PS	PS	PS	Lev
ules		student should be able to	1	2	3	4	5	6	7	8	9	10	11	12	O1	02	03	el
1	15ME81.1	Understand the meaning,	1.5	1.5	1.5	1.5		2.5	2.5		2			1.5				L2
		definitions, scope, need, phases																Und
		and techniques of operations																erst
		research.																and
2	15ME81.2	Formulate as L.P.P and derive	1.5	1.5	1.5													L3
		optimal solutions to linear																App
		programming problems by																ly
		graphical method, Simplex																
		method, Big-M method and Dual																
		Simplex method.						0 -	0 -		-							
3	15ME81.3	Formulate as Transportation and	1.5	1.5	1.5	1.5		2.5	2.5		2			1.5				L3
		Assignment problems and																App
		transportation Assignment and																LY
		travelling salesman problems																
	15MF81 /	Solve waiting line problems for	1 5	15	15	15		25	25					15				12
4	15101201.4	M/M/1 and M/M/K queuing	1.5	1.5	1.5	1.0		2.5	2.5					1.5				Ann
		models. Construct network																IV
		diagrams and determine critical																
		path, floats for deterministic and																
		PERT networks including																
		crashing of Networks.																
5	15ME81.5	Determine minimum processing	1.5	1.5	1.5													L3
		times for sequencing of n jobs-2																App
		machines, n jobs-3machines, n																ly
		jobs-m machines and 2 jobs-																
		n machines using Johnson's																
		algorithm and analysis of games.																
-	15ME81	Average attainment (1, 2, or 3)	1.5	1.5	1.5	1.5	-	2.	2.		2	-	-	1.5				
								50	5									

5. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Mod	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
ules					
2	Simplex method, Big-M method	NPTEL Videos	11/03/2020	Self	PO2
3	Assignment and traveling salesman	NPTEL Videos	15/04/2020	Self	PO2
4	Deterministic and PERT networks	NPTEL Videos	13/05/2020	Self	PO2

6. Content Beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

Mod	Gap Topic	Area	Actions Planned	Schedule	Resources	PO Mapping
ules				Planned	Person	
3	PHP Simplex Tool	Placement,	01/03/2020		Self	PO1
		GATE,				
		Higher				
		Study, .				

4	Sequencing problems, N-jobs and one	Placement, GATE, Higher Stud	22/04/2020	Self	PO5
	machine				

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Mod	Title	Teach.		No. o	f quest	ion in	Exam		CO	Levels
ules		Hours	CIA-1	CIA-2	CIA-3	Asg	Extra	SEE		
1	Understand the meaning, definitions, scope, need, phases and techniques of operations research.	8	2	-	-	1	ASG 1	2	CO1	L2, L3
2	Formulate as L.P.P and derive optimal solutions to linear programming problems by graphical method, Simplex method, Big-M method and Dual Simplex method.	12	2	_	-	1	1	2	CO2	L2, L3
3	Formulate as Transportation and Assignment problems and derive optimum solutions for transportation, Assignment and travelling salesman problems	12	_	2	-	1	1	2	CO3,	L3
4	Solve waiting line problems for M/ M/1 and M/M/K queuing models. Construct network diagrams and determine critical path, floats for deterministic and PERT networks including crashing of Networks.	10	-	2	-	1	1	2	CO4	L2, L3
5	Determine minimum processing times for sequencing of n jobs-2 machines, n jobs-3machines, n jobs-m machines and 2 jobs-n machines using Johnson's algorithm and analysis of games.	8	-	-	4	1	1	2	CO5	L3
-	Total	50	4	4	4	5	5	10	-	-

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Mod	Evaluation	Weightage in	CO	Levels
ules		Marks		
1, 2	CIA Exam – 1	15	CO1, CO2	L2, L3
3, 4	CIA Exam – 2	15	CO3,CO4	L2,L3
5	CIA Exam – 3	15	CO5	L3
1, 2	Assignment - 1	05	CO1, CO2	L2, L3,
3, 4	Assignment - 2	05	CO3,CO4	L2,L3
5	Assignment - 3	05	CO5	L3
1, 2	Seminar - 1	00		
3, 4	Seminar - 2	00		
5	Seminar - 3	00		
	-			

Final CIA Marks	20	CO1 to Co9	L2, L3

D1. TEACHING PLAN – 1

Module - 1

Title:	INTRODUCTION	Appr Time:	9 Hrs
a	Course Outcomes		Blooms
-	The student should be able to:	-	Level
1	Understand the meaning, definitions, scope, need, phases and techniques of operations research.	CO1	L2
h	Course Schedule	_	
Class No	Module Content Covered	CO	Level
1	Introduction: Evolution of OR, Definitions of OR,	C01	L2
2	Scope of OR,	C01	L2
3	Applications of OR, Phases in OR study.	C01	L2
4	Characteristics and limitations of OR, models used in OR.	C01	L2
5	Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P.	CO1	L3
6	SolutionstoLPP by graphical method(Two Variables).	CO1	L3
7	Numerical problems	CO1	L3
8	Numerical problems	CO1	L3
С	Application Areas	СО	Level
1	Among all the mathematical optimization techniques, linear programming is perhaps the most used and best understood by the business and industrial community, healthcare,Entertainment,finance etc.Food and Agriculture	CO1	L3
2	Farmers apply linear programming techniques to their work. By determining what crops they should grow, the quantity of it and how to use it efficiently, farmers can increase their revenue.	CO1	L3
d	Review Questions	-	-
-		-	-
1	Discuss the scope of Operations Research.	CO1	L2
2	What is operation research? Explain origin and the six phases of operation research.	CO1	L3
3	A retail store stocks two types of shirts A and B. These are packed in attractive cardboard boxes. During a week the store can sell a maximum of 400 shirts of type A and a maximum of 300 shirts of type B. The storage capacity, however, is limited to a maximum of 600 of both types combined. Type A shirt fetches a profit of Rs. 2/- per unit and type B a profit of Rs. 5/- per unit. How many of each type the store should stock per week to maximize the total profit? Formulate a mathematical model of the problem.	CO1	L2
4	Old hens can be bought at Rs. 50/- each but young ones cost Rs. 100/- each. The old hens lay 3 eggs/week and young hens 5 eggs/week. Each egg costs Rs. 2/ A hen costs Rs. 5/- per week to fee. If a person has only Rs. 2000/- to spend for hens, formulate the problem to decide how many of each kind of hen should he buy ? Assume that he cannot house more than 40 hens.	CO1	L2
5	A computer company manufactures laptops & desktops that fetches profit of Rs. 700/- & 500/- unit respectively. Each unit of laptop takes 4 hours of assembly time & 2 hours of testing time while each unit of desktop requires 3 hours of assembly time & 1 hour for testing. In a given month the total number of hours available for assembly is 210 hours & for inspection is 90 hours. Formulate the problem as LPP in such a way that the total profit is maximum.	CO1	L3

6	A toy company manufactures two types of dolls, a basic version-doll A and a deluxe version- doll B. Each doll of type B takes twice as long to produce as one of type A and the company would have time to make maximum of 2000 dolls per day. The supply of plastic is sufficient to produce 1500 dolls per day(Both A & B combined). The deluxe version requires a fancy dress of which there are only 600 per day available. If the company makes a profit of Rs. 10/-& Rs. 18/- per doll on doll A & B respectively, then how many of each doll should be produced per day in order to maximize the total profit. Formulate the problem as LPP.	CO1	L3
7	A company manufactures two products A & B. Theses products are processed in the same machine. It takes 10 minutes to process one unit of product A and 2 minutes for each unit of product B and the machine operates for a maximum of 35 hours in a week. Product A requires 1 kg and B 0.5 kg of raw material per unit the supply of which is 600 kg per week. Market constraint on product B is known to be 800 unit every week. Product A costs Rs. 5/- per unit and sold at Rs. 10/ Product B costs Rs. 6/- per unit and can be sold in the market at a unit price of Rs. 8/ Determine the number of units of A & B per week to maximize the profit	CO1	L3
8	A person requires 10,12 and 12 units chemicals A,B,C respectively for his garden. One unit of liquid product contains 5,2 and 1 units of A,B and C respectively. One unit of dry product contains 1,2 and 4 units of A,B,C. If the liquid product sells for Rs. 3/- and the dry product sells for Rs. 2/-, how many of each should be purchased, in order to minimize the cost and meet the requirements.	CO1	L2
9	A paper mill produces two grades of paper namely X and Y. Because of raw material restrictions, it cannot produce more than 400 tons of grade X and 300 tons of grade Y in a week. There are 160 production hours in a week. It requires 0.2 and 0.4 hours to produce a ton of products X and Y respectively with corresponding profits of Rs. 200/- and Rs. 500/- per ton. Formulate the above as a LPP to maximize profit and find the optimum product mix.	CO1	L2
10	Use graphical method to solve Min z=20x1+10x2 ; x1+2x2<=40; 3x1+x2>=30:4x1+3x2>=60 x1 x2>=0	CO1	L3
е	Experiences	-	_

Module – 2

Title:	LINEAR PART PROGRAMMING	Appr	7Hrs
		Time:	
a	Course Outcomes	СО	Blooms
-		-	Level
1	Formulate as L.P.P and derive optimal solutions to linear programming problems by graphical method, Simplex method, Big-M method and Dual Simplex method.	CO2	L2
b	Course Schedule	-	-
Class No	Portion covered per hour	-	-
11	LPP: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables,	CO2	L2
12	Numerical problems	CO2	L2
13	Numerical problems	CO2	L2
14	Numerical problems	CO2	L2
15	Solutions to LPP by Simplex method,	CO2	L3
16	Big-M Method	CO2	L3
17	Numerical problems	CO2	L3
18	Two Phase Simplex Method,	CO2	L3

19	Degeneracy in LPP. Concept of Duality, writing Dual of given LPP.	CO2	L3
20	Solutions to L.P.P by Dual Simplex Method.	CO2	L3
21	Numerical problems	CO2	L3
22	Numerical problems	CO2	L3
С	Application Areas	СО	Level
3	Food and Agriculture Farmers apply linear programming techniques to their work. By determining what crops they should grow, the quantity of it and how to use it efficiently, farmers can increase their revenue.	CO2	L3
4	Among all the mathematical optimization techniques, linear programming is perhaps the most used and best understood by the business and industrial community, healthcare, Entertainment,finance etc.	CO2	L4
d	Review Questions	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Define lpp	CO2	L2
2	A toy company manufactures two types of dolls, a basic version-doll A and a deluxe version- doll B. Each doll of type B takes twice as long to produce as one of type A and the company would have time to make maximum of 2000 dolls per day. The supply of plastic is sufficient to produce 1500 dolls per day(Both A & B combined). The deluxe version requires a fancy dress of which there are only 600 per day available. If the company makes a profit of Rs. 10/- & Rs. 18/- per doll on doll A & B respectively, then how many of each doll should be produced per day in order to maximize the total profit. Formulate the problem as LPP.	CO2	L3
3	The standard weight of a special purpose brick is 5Kg and it contains two ingredients B1 & B2. B1 cost Rs. 5/- per kg & B2 costs Rs. 8/- per kg. Strength considerations dictate that the brick contains not more than 4 kg of B1 & a minimum of 2 kg of B2, since the demand for the product is likely to be related to the price of the brick. Formulate the above problem as LP model.	CO2	L3
4	A marketing manager wishes to allocate his annual advertising budget of Rs. 20,000 in two media group M & N. The unit cost of the message in the media 'M' is Rs. 200 & 'N' is Rs. 300. The media M is monthly magazine & not more than two insertions are desired in one issue. At least five messages should appear in the media N. The expected effective audience per unit message for media M is 4,000 & for N is 5,000. Formulate the problem as Linear Programming problem.	CO2	L3
5	A manufacturer produces two types of models M1 & M2. Each M1 model requires 4 hours of grinding & 2 hours of polishing, whereas each M2 model requires 2 hours of grinding & 5 hours of polishing. The manufacturer has 2 grinders & 3 polishers. Each grinder works for 40 hours a week & each polisher works for 60 hours a week. Profit of M1 model is Rs. 3/- & on M2 model is Rs. 4/ How should the manufacturer allocate his production capacity to the two types of models so as to make maximum profit in a week. Formulate the above problem as LPP.	CO2	L3
6	A company produces two types of Hats. Each hat of the first type requires twice as much labour time as the second type. The company can produce a total of 500 hats a day. The market limits daily sales of the first & second type to 150 & 250 hats. Assuming that the profits/hat are Rs. 8/- for type A & Rs. 5 for type B. Formulate the problem as LP model in order to determine the number of hats to be produced of each type so as to maximize the profit.	CO2	L3
7	An agriculturist has a farm with 126 acres. He produces Tomato, Mango and Potato. Whatever he raises is fully sold in the market. He gets Rs. 5/- for tomato/kg, Rs. 4/- for mango/kg and Rs. 5/- for potato/kg. The average yield is 1,500 kg of tomato/acre, 1800 kg of mango/acre and 1200 kg of potato/acre. To produce each 100 kg of tomato and mango and to produce each 80 kg of potato a sum of Rs. 12.50 has to be used for manure. Labour required for each acre to raise the crop is 6 man-days for tomato and potato	CO2	L3

	each and 5 man-days for mango. A total of 500 man-days of labour at a rate of Rs. 40/- per man day are available. Formulate this as a LP model to maximize the agriculturist's total profit.		
8	A company manufactures two products A & B. Theses products are processed in the same machine. It takes 10 minutes to process one unit of product A and 2 minutes for each unit of product B and the machine operates for a maximum of 35 hours in a week. Product A requires 1 kg and B 0.5 kg of raw material per unit the supply of which is 600 kg per week. Market constraint on product B is known to be 800 unit every week. Product A costs Rs. 5/- per unit and sold at Rs. 10/ Product B costs Rs. 6/- per unit and can be sold in the market at a unit price of Rs. 8/ Determine the number of units of A & B per week to maximize the profit	CO2	L3
9	A person requires 10,12 and 12 units chemicals A,B,C respectively for his garden. One unit of liquid product contains 5,2 and 1 units of A,B and C respectively. One unit of dry product contains 1,2 and 4 units of A,B,C. If the liquid product sells for Rs. 3/- and the dry product sells for Rs. 2/-, how many of each should be purchased, in order to minimize the cost and meet the requirements.	CO2	L3
е	Experiences	-	-

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs (Code	15ME81	Sem:	8	Marks:	20	Time:	75 r	75 minutes			
Cour	rse:	Operations	s Researcl	า								
-	-	Note: Ansy	wer all qu	estions, ea	ach carry equa	al marks. M	odule : 1, 2	1	Marks	СО	Level	
1	а	Discuss th	e scope o	f Operatior	is Research.				5	1	L2	
	b	A retail stu attractive of of 400 sh storage ca combined. profit of R per week of the prot	d in num The /pes B a tock odel	10	1	L3						
					OR							
2	а	What is op operation	eration re research.	search? Ex	plain origin an	d the six pł	nases of		5	1	L2	
	b	Old hens can be bought at Rs. 50/- each but young ones cost Rs. 100/- each. The old hens lay 3 eggs/week and young hens 5 eggs/week. Each egg costs Rs. 2/ A hen costs Rs. 5/- per week to fee. If a person has only Rs. 2000/- to spend for hens, formulate the problem to decide how many of each kind of hen should he buy ? Assume that he cannot house more than 40 hens.							10	1	L3	
3	a	An agricult and Potatc for tomato average yi 1200 kg of and to pro manure. La tomato and days of lak this as a Lf	turist has a b. Whateve /kg, Rs. 4, eld is 1,50 potato/ad duce each abour requ d potato e pour at a ra P model to	a farm with er he raises /- for mang 0 kg of tom cre. To proc n 80 kg of p uired for ea ach and 5 ate of Rs. 40 o maximize	126 acres. He is fully sold in go/kg and Rs. hato/acre, 1800 duce each 100 botato a sum o ch acre to rais man-days for r D/- per man da the agriculturi	produces 1 the marke 5/- for pota 0 kg of mar kg of toma f Rs. 12.50 h e the crop i mango. A to ay are avail ist's total pr	Tomato, Manget. He gets Rs. g ato/kg. The ngo/acre and to and mange nas to be usec is 6 man-days otal of 500 ma able. Formula rofit.	o 5/- I for for n- te	7	3	L3	
	b	A compan	y manufac	tures two	oroducts A & E	3. Theses pr	roducts are		8	3	L3	

		processed in the same machine. It takes 10 minutes to process one unit of product A and 2 minutes for each unit of product B and the machine operates for a maximum of 35 hours in a week. Product A requires 1 kg and B 0.5 kg of raw material per unit the supply of which is 600 kg per week. Market constraint on product B is known to be 800 unit every week. Product A costs Rs. 5/- per unit and sold at Rs. 10/ Product B costs Rs. 6/- per unit and can be sold in the market at a unit price of Rs. 8/ Determine the number of units of A & B per week to maximize the profit			
		OR			
4	a	The standard weight of a special purpose brick is 5Kg and it contains two ingredients B1 & B2. B1 cost Rs. 5/- per kg & B2 costs Rs. 8/- per kg. Strength considerations dictate that the brick contains not more than 4 kg of B1 & a minimum of 2 kg of B2, since the demand for the product is likely to be related to the price of the brick. Formulate the above problem as LP model.	7	4	L3
	b	A person requires 10,12 and 12 units chemicals A,B,C respectively for his garden. One unit of liquid product contains 5,2 and 1 units of A,B and C respectively. One unit of dry product contains 1,2 and 4 units of A,B,C. If the liquid product sells for Rs. 3/- and the dry product sells for Rs. 2/-, how many of each should be purchased, in order to minimize the cost and meet the requirements.	8	4	L3

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

	Model Assignment Questions										
Crs C	Code:	15ME81	Sem:	VIII	Marks:	5	Time:	90 – 120	0 – 120 minutes		
Cour	se:	Operatio	ons Research			Modu	le : 1, 2				
Note	: Each	student	to answer 2-	3 assignr	nents. Each as	ssignme	nt carries equal m	ark.			
SNo	l	JSN		As	ssignment De	scription	า	Marks	СО	Level	
1			Discuss the s	scope of	Operations Re	esearch.		5	CO1	L2	
2			What is oper of operation	ration res research	search? Explai n.	n origin a	and the six phases	5 5	CO2	L3	
3			A retail store packed in at can sell a ma 300 shirts of to a maximu fetches a pro per unit. How week to ma model of the	e stocks tractive of aximum type B. um of 60 ofit of Rs w many ximize th probler	two types of cardboard box of 400 shirts of The storage of 00 of both typ . 2/- per unit a of each type ne total profit? n.	shirts A ses. Durin of type A apacity, bes com and type the stor Formul	A and B. These and a week the store and a maximum of however, is limited bined. Type A shi B a profit of Rs. 5/ re should stock per ate a mathematic	re 5 re of rd rt - er al	CO2	L3	
4			Old hens car Rs. 100/- ea hens 5 eggs, per week to hens, formul of hen shoul than 40 hens	n be bou ch. The c /week. E fee. If a p ate the p d he buy 5.	ght at Rs. 50/ old hens lay 3 (ach egg costs person has onl problem to dec (? Assume tha	- each b eggs/we s Rs. 2/ y Rs. 200 cide how it he can	ut young ones cos eek and young A hen costs Rs. 5, 00/- to spend for many of each kin not house more	t 5 /- d	CO1	L3	
5			A computer fetches profi of laptop tak time while ea time & 1 hou hours availal hours. Formu total profit is	company t of Rs. 7 es 4 hou ach unit r for testi ole for as ulate the maximu	y manufacture 00/- & 500/- rs of assembly of desktop rec ing. In a given sembly is 210 problem as L m.	es laptop unit resp / time & quires 3 h month tl hours & PP in suc	s & desktops that bectively. Each uni 2 hours of testing hours of assembly he total number of for inspection is 9 ch a way that the	5 t 0	CO2	L3	
6			A toy compa version-doll takes twice a	ny manu A and a d as long to	Ifactures two t deluxe versior o produce as c	ypes of - doll B. one of ty	dolls, a basic Each doll of type pe A and the	В 5	CO2	L3	

7	company would have time to make maximum of 2000 dolls per day. The supply of plastic is sufficient to produce 1500 dolls per day(Both A & B combined). The deluxe version requires a fancy dress of which there are only 600 per day available. If the company makes a profit of Rs. 10/- & Rs. 18/- per doll on doll A & B respectively, then how many of each doll should be produced per day in order to maximize the total profit. Formulate the problem as LPP. The standard weight of a special purpose brick is 5Kg and it contains two ingredients B1 & B2. B1 cost Rs. 5/- per kg & B2 costs Rs. 8/- per kg. Strength considerations dictate that the	5	CO2	L3
	brick contains not more than 4 kg of B1 & a minimum of 2 kg of B2, since the demand for the product is likely to be related to the price of the brick. Formulate the above problem as LP model.			
8	A marketing manager wishes to allocate his annual advertising budget of Rs. 20,000 in two media group M & N. The unit cost of the message in the media 'M' is Rs. 200 & 'N' is Rs. 300. The media M is monthly magazine & not more than two insertions are desired in one issue. At least five messages should appear in the media N. The expected effective audience per unit message for media M is 4,000 & for N is 5,000. Formulate the problem as Linear Programming problem.	5	CO2	L3
9	A manufacturer produces two types of models M1 & M2. Each M1 model requires 4 hours of grinding & 2 hours of polishing, whereas each M2 model requires 2 hours of grinding & 5 hours of polishing. The manufacturer has 2 grinders & 3 polishers. Each grinder works for 40 hours a week & each polisher works for 60 hours a week. Profit of M1 model is Rs. 3/- & on M2 model is Rs. 4/ How should the manufacturer allocate his production capacity to the two types of models so as to make maximum profit in a week. Formulate the above problem as LPP.	5	CO2	L2
10	A company produces two types of Hats. Each hat of the first type requires twice as much labour time as the second type. The company can produce a total of 500 hats a day. The market limits daily sales of the first & second type to 150 & 250 hats. Assuming that the profits/hat are Rs. 8/- for type A & Rs. 5 for type B. Formulate the problem as LP model in order to determine the number of hats to be produced of each type so as to maximize the profit.	5	CO2	L3
11	An agriculturist has a farm with 126 acres. He produces Tomato, Mango and Potato. Whatever he raises is fully sold in the market. He gets Rs. 5/- for tomato/kg, Rs. 4/- for mango/ kg and Rs. 5/- for potato/kg. The average yield is 1,500 kg of tomato/acre, 1800 kg of mango/acre and 1200 kg of potato/acre. To produce each 100 kg of tomato and mango and to produce each 80 kg of potato a sum of Rs. 12.50 has to be used for manure. Labour required for each acre to raise the crop is 6 man-days for tomato and potato each and 5 man- days for mango. A total of 500 man-days of labour at a rate of Rs. 40/- per man day are available. Formulate this as a LP model to maximize the agriculturist's total profit.	5	CO2	L3
12	A company manufactures two products A & B. Theses products are processed in the same machine. It takes 10 minutes to process one unit of product A and 2 minutes for each unit of product B and the machine operates for a maximum of 35 hours in a week. Product A requires 1 kg and B 0.5 kg of raw material per unit the supply of which is 600 kg	5	CO2	L3

	per week. Market constraint on product B is known to be 800 unit every week. Product A costs Rs. 5/- per unit and sold at Rs. 10/ Product B costs Rs. 6/- per unit and can be sold in the market at a unit price of Rs. 8/ Determine the number of units of A & B per week to maximize the profit			
13	A person requires 10,12 and 12 units chemicals A,B,C respectively for his garden. One unit of liquid product contains 5,2 and 1 units of A,B and C respectively. One unit of dry product contains 1,2 and 4 units of A,B,C. If the liquid product sells for Rs. 3/- and the dry product sells for Rs. 2/-, how many of each should be purchased, in order to minimize the cost and meet the requirements.	5	CO3	L3
14	A paper mill produces two grades of paper namely X and Y. Because of raw material restrictions, it cannot produce more than 400 tons of grade X and 300 tons of grade Y in a week. There are 160 production hours in a week. It requires 0.2 and 0.4 hours to produce a ton of products X and Y respectively with corresponding profits of Rs. 200/- and Rs. 500/- per ton. Formulate the above as a LPP to maximize profit and find the optimum product mix.	5	CO2	L3
15	Farmer furniture makes chairs, arm-chairs and sofas, the profits are \$ 50 per chair, \$60 per arm-chair and \$ 80 per sofa. The material used to manufacture these items are fabric and wood. A supplier can provide a maximum of 300 meters of fabric and 350 units of wood each week. Each item requires a certain amount of wood and fabric as well as certain assembly time. These are the following given in tabl	5	CO2	L3
	WoodAss. TimeItemFabricChair2m6 units8 hoursArmchair5m4 units4 hoursSofa8m5 units5 hoursAvail./Wk300m350 units480 hours			
16	Use graphical method to solve Min z=20x1+10x2 ; x1+2x2<=40; 3x1+x2>=30 ;4x1+3x2>=60 ; x1,x2>=0	5	CO2	L3
17	Define the following (i)solution (ii)feasible solution (iii)basic solution (iv)basic feasible solution (v)degenerate basic feasible feasible solution (vi)optimal basic feasible solution (vii)unbounded solution (viii)feasible region.	5	CO2	L3
18	Solve the following using BIG-M method Max z=2x+y _3x+y=3 _ x+2y<=3, _4x+3y>=6	5	CO2	L3
19	Solve the following using BIG-M method Max z=3x+y_,2x+y<=12_, 3x+4y>=12.	5	CO2	L3
20	Solve the following using BIG-M method Min 7=3x1+2x2+x3 x1+x2=7 3x1+x2+x3>=10	5	CO2	L3
21	Solve the following using BIG-M method Min p=2x+yx+4y<=24, x-y<=-3x+2y<=142x-y<=8	5	CO2	L3
22	Solve the following using BIG-M method Min z=2x1+9x2+x3, x1+4x2+2x3>=5, 3x1+x2+2x3>=4.	5	CO2	L3
23	Solve the following using Two Phase method Max z=5x1+8x2 ,3x1+2x2>=3 , x1+4x2>=4 x1+x2<=5.	5	CO2	L3
24	Solve the following using Two Phase method Max z=2x1+x2+x3 ,4x1+6x2+3x3<=8 , 3x1-6x2-4x3<=1 , 2x1+3x2- 5x3>=4	5	CO2	L3

D2. TEACHING PLAN - 2

Module – 3

Title:	Transportation, Assignment and travelling salesman										Appr Time:	8 Hrs
	probler	ns										
a	Course Ou	itcom	es	41a a a 4.				4 -			CO	Blooms
-	At the end	$\frac{1}{2}$ of the	e topic	the stu	adent s	snoula	be able		d dorivo	ontimum	-	Level
	solutions	for trai	nsport <i>;</i>	ation A	ssianr	nent ar	id trave	lling sale	esman pr	oplimum	03	L3
b					sergri			ung sau				
Class No	Portion co	overed	d per h	our							-	-
1	Find initial	l Basic	Feasik	ole solu	ution fo	or the fo	ollowing	g T.P. Usi	ing all me	thods .	CO5	L2
	-								-			
			1	2		3	Suppl					
	-	1		1		7	<u>y</u>	_				
	-	2	6	1		/	80					
		3	3	2		5	15					
		Dema	an 75	5 2	0	50						
		d										
2	Define de	genera	acy in ⁻	T.P.Fin	d optir	nal solı	ution fo	r the foll	owing T.F	8	CO5	L3
	formulate	as a n	nathen	natical	methc	od.						
		1		2	3			5	6	Supply		
	1)	12	9	6	<u>н</u> Э	9	10	5		
	2	7	7	3	7	7	7	5	5	6		
	3	6	6	5	9	1	1	3	11	2]	
	4	6	6	8	11	2	2	2	10	9		
	Demand	4	1	4	6	2	2	4	2			
5	month .the units pe Rs.8,7 & 9 transpo optimum	e requ er mor at thre ortation solutio	iremer nth.the ee fact n costs on to m	e per ur oris.the from t naximize	n the c nit retu follow he fac e the t	lealers Irn (exc ving tak tories to oatl ret	are 900 luding t ble give o the de urns.	s,700,90 ,800,500 ;ransport s unit ealers.de	0 & 400 tation cos	t) are he	005	L3
				1 2		2 1						
			A	2 2	2	2 4						
			B	3 5		3 2						
			C .	4 3	ź	2 1						
4	A product are Rs. 2,3 requireme momimize	is pro 1,85.u ents ar e the c	duced init cos e givei cost.	by 4 fa sts of tr n below	actorie anspo v find d	s f1f,2,f rtation optimur	3 &f4 .T ,produ n soluti	heir unit ction cap ion for th	producti bacity & ne given T	on costs .P to	CO5	L4
				51	<u>S2</u>	53	54	-				
			F2	10	8	7	5	-				
			F3	13	3	9	12	-				
			F4	4	6	8	3					
5	Explain various steps involved in Hungarian algorithm with example.									ample.	CO5	L4
6	Find	d the a	ssignn	nent of	jobs t	o mach	ines tha	at will res	sult in the	maximum	CO5	L4
	prot	NT.		N/1	Ma	Mo	Ν/ 4	Mr	1			
			1	62	7.8	*	101	82				
			J2	7.0	8.4	6.5	7.5	6.0				
			J3	8.7	9.2	11.1	7.0	8.2				
			J4	*	6.4	8.7	7.7	8.0				

7	Find the assignme J 1 A 2 B 6 C 4 D 4 E 5	ent of m J J J J 2 3 4 9 2 7 8 7 6 6 5 3 2 7 3 3 9 5	en to jo 5 1 1 1 1 1 1	bs that	t will mi	nimize	e the total time tak	en. CC	D5	L4
8	A company productive as much lab total of 500 hats a to 150 & 250 hats. A for type B. Formula number of hats to	ces two our time day. The Assumir ate the proc	types e as the e markeng that probler luced c	of Hats e secor et limits the pro n as LF of each	. Each h nd type. s daily s ofits/hai P model type sc	at of t The c ales c t are F in orc as to	he first type requir ompany can produ of the first & second ts. 8/- for type A & ler to determine th maximize the prof	es CC Ice a I type Rs. 5 e t.	05	L4
•	Application Areas									
- -	Students should b	» De able é	mnlov	/ annl	ly the M	odule	learnings to			-
1	Demonstrate skills	s in form	ning and	d solvir	ng assig	nmen	t problems.	CC)5	L3
	Transportation pro	oblems.	5		5	_			0	0
d	Review Questions	5								-
-	Deverente al ille	- : C		-1 1!			+	-		-
1	Transportation pro	s in form bloms	ling and	a solvir	ng assig	nmen	it problems,		5	L3
2		Jotems.						CC)5	13
3	Review Questions	5						CC)5	 L4
	1 2 3 Deman d	1 5 6 3 75	2 1 4 2 20	3 7 6 5 50	Sup y 10 80 15	opl				
5	Define degenerac	y in T.P	Find o	otimal	solution	for th	e following T.P &	CC)5	L4
6	formulate as a ma	1 9 7 6 6 4	cal me 2 12 3 5 8 4	3 9 7 9 11 6	4 6 7 11 2 2	5 9 5 3 2 4	6 Suppl y 10 5 5 6 11 2 10 9 2			
6	The production ca month .the require units per momt Rs.8,7 & 9 at three transportation co optimum solution	apacities ements the per- factoris costs fro to maxi 1 2 3	s of the from th er unit r the fol om the mize th 2 5	factori e deale eturn (lowing factorie e toatl 3 2 3	es are 1 ers are 9 excludir 1 table g es to the returns 4 4 2	000,7 900,80 ives u e deal	00,900 units per 00,500 & 400 nsportation cost) an init ers.determine the	e	5	L3
	С	4	3	2	1					
7	A product is produ are Rs. 2,3,1,&5.uni	uced by t costs o	4 facto of trans	pries f1f portati	,2,f 3 &f on ,prc	4 .The ducti	ir unit production c on capacity &	costs CC	05	L3

	requirements ar momimize the c	e given ost.	below	find op	otimum	n solutio	on for th	e given T.P to		
			S1	S2	S3	S4				
		F1	2	4	6	11			1	
		F2	10	8	7	5				
		F3	13	3	9	12				
		F4	4	6	8	3				
8	Explain va	rious st	teps in\	/olved	in Hun	garian a	algorithi	n with example.	CO5	L3
9	Find the a	ssignm	ient of j	obs to	machi	nes tha	t will res	sult in the maximum	CO5	L3
	profit.				1	1	1	I		
			M1	M2	M3	M4	M5			
		J1	6.2	7.8	*	10.1	8.2			
		J2	7.0	8.4	6.5	7.5	6.0			
		J3	8.7	9.2	11.1	7.0	8.2			
		J4	*	6.4	8.7	7.7	8.0			
10	Find the assign J A 2 B 6 C 4 D 4 E 5	nent of J J 2 3 3 9 2 3 8 7 6 5 6 5 2 7 3 9	men to J J 4 5 7 1 6 1 3 1 5 1	o jobs t	hat will	l minim	ize the t	otal time taken.	CO5	L4
е	Experiences									-

Module – 4

Title:	Network analysis and Oueuing theory	Appr	8 Hrs
		Time:	
a	Course Outcomes	СО	Blooms
-	At the end of the topic the student should be able to	-	Level
1	Solve waiting line problems for M/M/1 and M/M/K queuing models.	CO4	L3
	Construct network diagrams and determine critical path, floats for		
	deterministic and PERT networks including crashing of Networks.		
b	Course Schedule		
Class No	Portion covered per hour	-	-
1	Network analysis: Introduction, Construction of networks,	CO4	L2
2	Fulkerson's rule for numbering the nodes, AON diagrams;	CO4	L3
3	Fulkerson's rule for numbering the nodes, AOA diagrams;	CO4	L2
4	Critical path method to find the expected completion time of a project,	CO5	L3
5	determination of floats in networks, PERT networks, determining the	CO5	L3
	probability of completing a project,		
6	predicting the completion time of project; Cost analysis in networks.	CO5	L2
	Crashingofnetworks- Problems.		
7	Queuing Theory: Queuing systems and their characteristics,	CO5	L2
8	Pure-birth and Pure-death models (only equations),	CO5	L3
9	Kendall & Lee's notation of Queuing,empirical queuing models –	CO5	
10	Numerical on M/M/1 and M/M/C Queuing models	CO4	
d	Review Questions	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Old hens can be bought at Rs. 50/- each but young ones cost Rs. 100/- each.	CO4	L3
	The old hens lay 3 eggs/week and young hens 5 eggs/week. Each egg costs		
	Rs. 2/ A hen costs Rs. 5/- per week to fee. If a person has only Rs. 2000/- to		
	spend for hens, formulate the problem to decide how many of each kind of		

	hen should he buy ? Assume that he cannot house more than 40 hens.		
2	A computer company manufactures laptops & desktops that fetches profit of Rs. 700/- & 500/- unit respectively. Each unit of laptop takes 4 hours of assembly time & 2 hours of testing time while each unit of desktop requires 3 hours of assembly time & 1 hour for testing. In a given month the total number of hours available for assembly is 210 hours & for inspection is 90 hours. Formulate the problem as LPP in such a way that the total profit is maximum. CO4	CO4	L3
3	A toy company manufactures two types of dolls, a basic version-doll A and a deluxe version- doll B. Each doll of type B takes twice as long to produce as one of type A and the company would have time to make maximum of 2000 dolls per day. The supply of plastic is sufficient to produce 1500 dolls per day(Both A & B combined). The deluxe version requires a fancy dress of which there are only 600 per day available. If the company makes a profit of Rs. 10/- & Rs. 18/- per doll on doll A & B respectively, then how many of each doll should be produced per day in order to maximize the total profit. Formulate the problem as LPP.	CO4	L3
4	The standard weight of a special purpose brick is 5Kg and it contains two ingredients B1 & B2. B1 cost Rs. 5/- per kg & B2 costs Rs. 8/- per kg. Strength considerations dictate that the brick contains not more than 4 kg of B1 & a minimum of 2 kg of B2, since the demand for the product is likely to be related to the price of the brick. Formulate the above problem as LP model.	CO4	L3
5	A marketing manager wishes to allocate his annual advertising budget of Rs. 20,000 in two media group M & N. The unit cost of the message in the media 'M' is Rs. 200 & 'N' is Rs. 300. The media M is monthly magazine & not more than two insertions are desired in one issue. At least five messages should appear in the media N. The expected effective audience per unit message for media M is 4,000 & for N is 5,000. Formulate the problem as Linear Programming problem.	CO4	L3
6	A manufacturer produces two types of models M1 & M2. Each M1 model requires 4 hours of grinding & 2 hours of polishing, whereas each M2 model requires 2 hours of grinding & 5 hours of polishing. The manufacturer has 2 grinders & 3 polishers. Each grinder works for 40 hours a week & each polisher works for 60 hours a week. Profit of M1 model is Rs. 3/- & on M2 model is Rs. 4/ How should the manufacturer allocate his production capacity to the two types of models so as to make maximum profit in a week. Formulate the above problem as LPP.	CO4	L2
8	A company produces two types of Hats. Each hat of the first type requires twice as much labour time as the second type. The company can produce a total of 500 hats a day. The market limits daily sales of the first & second type to 150 & 250 hats. Assuming that the profits/hat are Rs. 8/- for type A & Rs. 5 for type B. Formulate the problem as LP model in order to determine the number of hats to be produced of each type so as to maximize the profit.	CO4	L3
9	An agriculturist has a farm with 126 acres. He produces Tomato, Mango and Potato. Whatever he raises is fully sold in the market. He gets Rs. 5/- for tomato/kg, Rs. 4/- for mango/kg and Rs. 5/- for potato/kg. The average yield is 1,500 kg of tomato/acre, 1800 kg of mango/acre and 1200 kg of potato/acre. To produce each 100 kg of tomato and mango and to produce each 80 kg of potato a sum of Rs. 12.50 has to be used for manure. Labour required for each acre to raise the crop is 6 man-days for tomato and potato each and 5 man-days for mango. A total of 500 man-days of labour at a rate of Rs. 40/- per man day are available. Formulate this as a LP model to maximize the agriculturist's total profit.	CO4	L3
10	A company manufactures two products A & B. Theses products are processed in the same machine. It takes 10 minutes to process one unit of product A and 2 minutes for each unit of product B and the machine operates for a maximum of 35 hours in a week. Product A requires 1 kg and B 0.5 kg of raw material per unit the supply of which is 600 kg per week. Market constraint on product B is known to be 800 unit every week. Product A costs Rs. 5/- per unit and sold at	CO4	L3

	Rs. 10/ Product B cos unit price of Rs. 8/ De maximize the profit	the market at a per week to									
11	A person requires 10,12 garden. One unit of liqu respectively. One unit of liquid product sells for of each should be purc requirements.	tively for his f A,B and C s of A,B,C. If the Rs. 2/-, how many and meet the	CO4	L3							
12	A paper mill produces two grades of paper namely X and Y. Because of raw material restrictions, it cannot produce more than 400 tons of grade X and 300 tons of grade Y in a week. There are 160 production hours in a week. It requires 0.2 and 0.4 hours to produce a ton of products X and Y respectively with corresponding profits of Rs. 200/- and Rs. 500/- per ton. Formulate the above as a LPP to maximize profit and find the optimum product mix										
13	Farmer furniture make chair, \$60 per arm-cha these items are fabric a meters of fabric and 35 certain amount of woo These are given in Item Chair Armchair Sofa Avail./Wk	ofits are \$ 50 per ed to manufacture naximum of 300 m requires a ably time. Ass. Time 8 hours 4 hours 5 hours 480 hours	CO4	L3							
		-		•							

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs (Code:	15ME71 Se	em:	VII	Μ	larks:	30	Time: 7	5 minute	S	
Cour	rse:	Operations Re	search.								
-	-	Note: Answer	all quest	ions, ea	ach ca	rry equ	ual ma	rks. Module : 3, 4	Marks	СО	Level
1	а	The productio month .the rec units per m Rs.8,7 & 9 at th transportati optimum solu	, 7 ,	3	L3						
			1	2	3	4					
			A 2	2	2	4					
			B 3	5	3	2					
			C 4	3	2	1					
	b	A product is p costs are Rs. 2 requirements momimize the	roduced k 2,3,1,&5.uni are given e cost.	by 4 fac it costs below	tories of trar find op	f1f,2,f 3 Isporta Istimum	; &f4 .T tion ,j i soluti	heir unit production production capacity & on for the given T.P to	8	3	L3
				S1	S2	S3	S4				
			F1	2	4	6	11				
			F2	10	8	7	5				
			F3	13	3	9	12				
			_ F4	4	6	8	3				
2	a	Find the assignment of jobs to machines that will result in the maximum profit.								3	L3

				M1	M2	M3	M4	M5						
			J1	6.2	7.8	*	10.1	8.2						
			J2	7.0	8.4	6.5	7.5	6.0						
			J3	8.7	9.2	11.1	7.0	8.2						
			J4	*	6.4	8.7	7.7	8.0						
	b	Find the assignr	nent of	^f men to	o jobs t	hat will	minimi	ize the t	otal time	8	3	L3		
		taken. A 2 B (C 2 D 2 E (J J J 2 9 2 6 8 7 4 6 5 4 2 7 5 3 9	J J 4 5 7 1 6 1 3 1 5 1										
3	a	A company mar processed in the product A and 2 operates for a m and B 0.5 kg of 1 week. Market co Product A costs 6/- per unit and Determine the r	company manufactures two products A & B. Theses products are rocessed in the same machine. It takes 10 minutes to process one unit of roduct A and 2 minutes for each unit of product B and the machine perates for a maximum of 35 hours in a week. Product A requires 1 kg and B 0.5 kg of raw material per unit the supply of which is 600 kg per eek. Market constraint on product B is known to be 800 unit every week roduct A costs Rs. 5/- per unit and sold at Rs. 10/ Product B costs Rs. /- per unit and can be sold in the market at a unit price of Rs. 8/ etermine the number of units of A & B per week to maximize the profit											
	b	A person require garden. One uni respectively. On the liquid produ how many of ea and meet the re	es 10,12 t of liqu e unit c ct sells ch sho equirem	and 12 aid proc of dry p for Rs. uld be p nents.	units c luct co roduct 3/- and ourchas	themica ntains g contair d the d sed, in d	als A,B,0 5,2 and 1,2 ar ry prod order to	C respe 1 units (nd 4 uni uct sell o minim	ctively for his of A,B and C ts of A,B,C. If s for Rs. 2/-, ize the cost	7	4	L3		
					0	R								
4	a	A manufacturer requires 4 hours model requires manufacturer ha hours a week & model is Rs. 3/- allocate his proo maximum profit	ach M1 model s each M2 The orks for 40 Profit of M1 manufacturer s so as to make is LPP.	7	4	L3								
	b	A company proc twice as much l produce a total & second type t for type A & Rs. to determine the maximize the pr	duces t abour t of 500 o 150 & 5 for ty e numb rofit.	wo type ime as hats a c 250 ha pe B. Fo per of ha	es of Ha the sec day. The dts. Assi prmulat ats to b	ats. Eac cond ty e marke uming 1 ce the p e produ	th hat o pe. The at limits that the problem uced of	f the firs compa daily sa profits. as LP r each ty	st type requires any can ales of the first /hat are Rs. 8/- model in order ype so as to	8	4	L3		

COURSE PLAN - CAY 2019-20

b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

	Model Assignment Questions											
Crs C	rs Code: 15ME81 Sem: VIII Marks: 5 Time:						Time:	90 – 120 minutes				
Course: Operations Research. Module : 3, 4												
Note:	Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.											
SNo	l	USN		Assig	nment Desc	ription		Marks	СО	Level		
1			A toy compar	ny manufac ⁻	tures two ty	pes of dolls,	a basic	5	CO4	L3		
			version-doll A	A and a delu	ixe version-	doll B. Each	doll of type E	3				
takes twice as long to produce as one of type A and the												
company would have time to make maximum of 2000 dolls												

	per day. The supply of plastic is sufficient to produce 1500 dolls per day(Both A & B combined). The deluxe version requires a fancy dress of which there are only 600 per day available. If the company makes a profit of Rs. 10/- & Rs. 18/- per doll on doll A & B respectively, then how many of each doll should be produced per day in order to maximize the total profit. Formulate the problem as LPP.			
2	The standard weight of a special purpose brick is 5Kg and it contains two ingredients B1 & B2. B1 cost Rs. 5/- per kg & B2 costs Rs. 8/- per kg. Strength considerations dictate that the brick contains not more than 4 kg of B1 & a minimum of 2 kg of B2, since the demand for the product is likely to be related to the price of the brick. Formulate the above problem as LP model.	5	CO4	L2
3	A marketing manager wishes to allocate his annual advertising budget of Rs. 20,000 in two media group M & N. The unit cost of the message in the media 'M' is Rs. 200 & 'N' is Rs. 300. The media M is monthly magazine & not more than two insertions are desired in one issue. At least five messages should appear in the media N. The expected effective audience per unit message for media M is 4,000 & for N is 5,000. Formulate the problem as Linear Programming problem.	5	CO4	L3
4	A manufacturer produces two types of models M1 & M2. Each M1 model requires 4 hours of grinding & 2 hours of polishing, whereas each M2 model requires 2 hours of grinding & 5 hours of polishing. The manufacturer has 2 grinders & 3 polishers. Each grinder works for 40 hours a week & each polisher works for 60 hours a week. Profit of M1 model is Rs. 3/- & on M2 model is Rs. 4/ How should the manufacturer allocate his production capacity to the two types of models so as to make maximum profit in a week. Formulate the above problem as LPP.	5	CO4	L3
5	A company produces two types of Hats. Each hat of the first type requires twice as much labour time as the second type. The company can produce a total of 500 hats a day. The market limits daily sales of the first & second type to 150 & 250 hats. Assuming that the profits/hat are Rs. 8/- for type A & Rs. 5 for type B. Formulate the problem as LP model in order to determine the number of hats to be produced of each type so as to maximize the profit.	5	CO4	L3
6	An agriculturist has a farm with 126 acres. He produces Tomato, Mango and Potato. Whatever he raises is fully sold in the market. He gets Rs. 5/- for tomato/kg, Rs. 4/- for mango/ kg and Rs. 5/- for potato/kg. The average yield is 1,500 kg of tomato/acre, 1800 kg of mango/acre and 1200 kg of potato/acre. To produce each 100 kg of tomato and mango and to produce each 80 kg of potato a sum of Rs. 12.50 has to be used for manure. Labour required for each acre to raise the crop is 6 man-days for tomato and potato each and 5 man- days for mango. A total of 500 man-days of labour at a rate of Rs. 40/- per man day are available. Formulate this as a LP model to maximize the agriculturist's total profit.	5	CO4	L3
7	A company manufactures two products A & B. Theses products are processed in the same machine. It takes 10 minutes to process one unit of product A and 2 minutes for each unit of product B and the machine operates for a maximum of 35 hours in a week. Product A requires 1 kg and B 0.5 kg of raw material per unit the supply of which is 600 kg per week. Market constraint on product B is known to be 800	5	CO4	L3

	unit every week. Product A costs Rs. 5/- per unit and sold at Rs. 10/ Product B costs Rs. 6/- per unit and can be sold in the market at a unit price of Rs. 8/ Determine the number of units of A & B per week to maximize the profit			
8	A person requires 10,12 and 12 units chemicals A,B,C respectively for his garden. One unit of liquid product contains 5,2 and 1 units of A,B and C respectively. One unit of dry product contains 1,2 and 4 units of A,B,C. If the liquid product sells for Rs. 3/- and the dry product sells for Rs. 2/-, how many of each should be purchased, in order to minimize the cost and meet the requirements.	5	CO4	L3
9	A paper mill produces two grades of paper namely X and Y. Because of raw material restrictions, it cannot produce more than 400 tons of grade X and 300 tons of grade Y in a week. There are 160 production hours in a week. It requires 0.2 and 0.4 hours to produce a ton of products X and Y respectively with corresponding profits of Rs. 200/- and Rs. 500/- per ton. Formulate the above as a LPP to maximize profit and find the optimum product mix.	5	C03	L3
10	The production capacities of the factories are 1000,700,900 units per month .the requirements from the dealers are 900,800,500 & 400 units per momth.the per unit return (excluding transportation cost) are Rs.8,7 & 9 at three factoris.the following table gives unit transportation costs from the factories to the dealers.determine the optimum solution to maximize the toatl returns. $\boxed{\begin{array}{c c c c c c c c c c c c c c c c c c c$	5	Co3	L3
11	C03 A product is produced by 4 factories f1f,2,f 3 &f4 .Their unit	5	C03	L3
	production costs are Rs. 2,3,1,&5.unit costs of transportation ,production capacity & requirements are given below find optimum solution for the given T.P to momimize the cost. $\begin{array}{c c c c c c c c c c c c c c c c c c c $			
12	Explain various steps involved in Hungarian algorithm with example.	5	C03	L3
13	Find the assignment of jobs to machines that will result in the maximum profit.M1M2M3M4M5J16.27.8*10.18.2J27.08.46.57.56.0J38.79.211.17.08.2J4*6.48.77.78.0	5	C03	L3
14	Find the assignment of men to jobs that will minimize the total time taken.	5	Co3	L3

	C 4 6 5 3 1 D 4 2 7 3 1 E 5 3 9 5 1			
15	A company produces two types of Hats. Each hat of the first type requires twice as much labour time as the second type. The company can produce a total of 500 hats a day. The market limits daily sales of the first & second type to 150 & 250 hats. Assuming that the profits/hat are Rs. 8/- for type A & Rs. 5 for type B. Formulate the problem as LP model in order to determine the number of hats to be produced of each type so as to maximize the profit.		Co3	L3
16		5	C03	L3
17	Application Areas	5	C03	L3
18	Students should be able employ / apply the Module learnings to	5	C03	L3
19				
20				
	Review Questions			

D3. TEACHING PLAN - 3

Module – 5

Title:	Game theory and sequencing	Appr	8Hrs
		Time:	
a	Course Outcomes	-	Blooms
-	The student should be able to:	-	Level
1	Apply game theory, decision analysis for decision support system to construct decision tree	CO5	L2
2		CO5	L2
b	Course Schedule	-	-
Class No	Portion covered per hour	-	-
1	Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and	CO5	L2
	Min-Max criteria, Principle of Dominance,		
	CO5		
2	Solution of games with Saddle point. Mixed Strategy problems.	CO5	L2
3	Solution of 2X2 games by Arithmetic method, Solution of 2Xn m and mX2 games by graphical method.	CO5	L2
4	Formulation of games.	CO5	L2
5	Sequencing: Basic assumptions, Johnson's algorithm,	CO5	L2
6	sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, '	CO5	L2
7	n' jobs on 'm' machines. Sequencing of2 jobs on 'm' machines using graphical method.	CO5	L2
8	sequencing 'n' jobs on single machine using priority rules,	CO5	L2
С	Application Areas	CO5	-
-	Students should be able employ / apply the Module learnings to .	CO5	-
1	Problems related to game theory arise in a range of fields, for example, healthcare, transportation and military planning	CO5	L2
2		CO5	L2
		CO5	
d	Review Questions	CO5	-
-	The attainment of the module learning assessed through following questions	CO5	-
1	Define the following a)pure strategy b)mixed strategy c)saddle point d)pay-off matrix	CO5	L2
	e)two person zero sum game f)strategy g)minimax & maximin		

	principlesh)dominance principleSolve the following game by applying a) graphical methodb)dominance ruleCO5L3													
2	Solve the follow	wing game	by applying	a) graphi	cal m	ethod k	o)dominance rule	CO5	L3					
	a)	B1 B2	B3	D)	З	-2	4							
	A1	3 -3			-1	4	2							
	Δ2	-1 1	-2		2	2	6							
	<u></u>	<u> </u>	-3	<u>.</u>		·		00-	1 -					
3	I wo player A &	B are playı	ng a game o boro aro	tossing	a coir	i simulta nothing	aneously player A	CO5	L3					
	two tails and loc	oses ½ unit	of value whe	en there i	is one	head a	nd one tail.							
	Determine the p	bay-off mat	rix , the best	strategie	es for	each pl	ayer & value of							
	the game.													
4	In A Game Of I	wins one unit o	f CO5	L3										
	value when the													
	wins nothing w	ue when there are	è											
	one head & one	tail . navoff mat	riv the best o	tratagias	for o	ach pla	ver and the value							
	of the game	ραγθιί Πιαι	nx, the best s	strategies		acripia	yei and the value							
5	Explain briefly t	CO5	L3											
	annealing techr													
6	Solve the follow	ing game/	by applying o	dominand	ce rule	9		CO5	L.3					
	4			5			8							
	6			4		6								
	4			2		4								
7	Solve the follow	/ing game	by applying (dominand	ce rule	Э		CO5	L3					
-	2	4		3		8	4		-					
	5	6		3		7	8							
	6	7		9 9		8								
	1	2		9 8										
8	Solve the follow	/ing game	by applying (lominanc	e rule	- -	5	C:05	3					
Ū	1	ing game		7		<u> </u>	2		-5					
	6			,			-	-						
	0			2			/	-						
	5			2			6							
9	Solve the follow	/ing game	by applying (graphical	rule			CO5	L3					
	2		2		3		-1							
	4		3		2		6							
10	Solve the follow	/ing game	by applying (graphical	rule			CO5	L3					
	2	-1		5		-2	6	_						
	-2	4	-	-3		1	0							
11	Solve the follow	olve the following game by applying						CO5	L3					
		1				2								
		5		6										
		-7		-9										
		, _/												
		4				-3		-						
		2					1							

E3. CIA EXAM – 3

a. Model Question Paper - 3

Sem:

Crs Code: 15ME71

Marks:

VII

Time:

75 minutes

30

Cour	se: Operations Research.													
-	-	Note: Ai	nswer	any 2 (questic	ns, eac	h carry e	qual	l marks	5.		Marks	CO	Level
	a	In A Gar of value wins no there are Determ value of	me Of I when thing e one h ine the the ga	Match there when head & payot me	ing coir are two there a one ta ff matrix	ns with t heads, are two il . <, the be	two play tails & est strate	ers, s losse gies	suppos es ½ ui for eac	se A nit d h pl	wins one unit of value when layer and the	7	5	L2
	b	Explain	briefly	the fol	llowing	a) tabu	ı search	b)g	enetic a	algo	prithm	8	5	L2
		c)simula	ited an	neaun	g techr	lique.	OR							
2	а	Define tl point d e)twc principle	he follo)pay-o) perso es h)o	owing ff matr n zero domin	a)pure ix sum g ance pi	e strateg ame f inciple	gy b)rr f)strategy	nixed y	l strate(g)minir	gy max	c)saddle & maximin	7	5	L2
	b	Solve th rule b)	Solve the following game by applying a) graphical method b)dominance the following game by applying a) graphical method b)dominance b) $3 -2 4$ b) $3 -2 4$ A1 $3 -3 4$ A2 -1 1 -3									8	5	L2
2	a	Solve th	e follo	wina c	iame hi	<u>, annlvir</u>	na domir	nanci				8	5	12
3		20100 11		wing g			2 2		8		1	0	Э	L3
								-						
		6			7		0		8		7			
					2		8		1		, ,	-		
	b	Solve th	e follo	wing c	jame b	/ applyir	ng domir	nanco	e rule			7	5	L2
			1	0			7				2		-	
			6				2				7			
			5				2				6			
		Solve th	e follo	wing g	jame by	, applyir	ng graph	ical I	rule					
			2		2			3			-1			
			4		3			2			6			
			<u> </u>			(OR .							
4	a	Solve th	e follo	wing g	jame by	/ applyir	ng graph -	ical I	rule			8	5	L2
		2			-1		5		-2		6	-		
		-2	2		4		-3		1		0			
	b	Solve th	e follo	wing g	jame by	/ applyir	ng graph	iical i	rule			7	5	L2
				-						-				
				5					C) 				
				-7					-(9				
				-4					-`	ځ ا				
				2					1	L				

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions											
Crs Code:	15ME81	Sem:	VIII	Marks:	5	Time:	90 – 120 minutes				
Course:	Operation	s Research.			Module : 5						

Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.																
SNo	USN			A	ssigi	nment	Desc	riptic	on					Marks	CO	Level
1		Solve th	ne foll	owing	gam	e by ap	plyin	g a) g	graphic	al m	eth	od		5	CO5	L3
		b)domin	ance	rule				Ы								
		0		B1	B2	B3		D)		3	-	2	4			
			A1	3	-3	4				-1		4	2			
			A2	-1	1	-3	_			2		2	6			
			/ =	-	-	5										
2														5	CO5	L3
3		Solve th	e follo	wing g	jame	e by ap	olying	g dor	ninance	e rule	e			5	CO5	L3
		2		4		3			8		4	4				
		5		6		3			7		8	3				
		6		7		9			8		-	7				
		4		2		8			4			3				
4		Solve th	e follo	wina a	iame	e by ap	olvino	dor	ninance	e rule	e ,			5	C05	L3
		1 7 2							Ŭ		0					
		6				2				7						
		5				2				6						
5		Solve th	e follo	wing a	lame	e by ap	olyina	g gra	phical r	ule			_	5	CO5	L3
							Ũ		Ű							
			1		3			2			6		_			
6			4 3 2 0						Б	COF	12					
7		Solve th	e follo	wing a	iame	me by applying graphical rule					5	CO5	L3			
		2		-1		5			-2		(5		Ũ	Ū	Ũ
		-2		4		-3			1		(2				
8		Solve th	e follo	lowing game by applying graphical rule					ule				5	CO5	L3	
				1					2							
				5			6									
				-7	7 -9								_			
				-1					-3							
				т 2					1							
0		Solve th			nam	e hv ar	nlvin	n a) (- araphic	al m	⊳th	nd	_	F	COF	10
3		b)domin	ance	rule	garn	շ թյ սի	Prynn	g u/ (Jupine	aciii	CUI	Ju		5	005	<u>د</u> ے
		d)		R1	Ro	Ro			b)	C		2				
			Δ1	2	-2					-1	_	4	4 2			
			Δ2	د _ا		4				2		2	6			
				-1	1	-3									00-	
10		Solva th	o follo	wing	iamo	huan	Juine	n dor	ninance	יוויז ב	2			5 E		
		2010		ywnig g ۸	junit	s by ap	JUNIC	1 001	8		<u> </u>	1		5	005	j
						3			-			+ >				
		5				3	3 / 0									
				~												
				6						_						
		6		7		9			8		-	7				
		4		2		8			4			3				
12		Solve the following game by applying dominance rule									5	CO5	L3			

	1		7				2					
	6		2				7					
	5		2				6					
13	Solve the fol	lowing	game	by ap	plying	g grap	ohica	l rul	le	5	CO5	L3
	2	2			3			-1				
	4	3			2			6				
14				С	R					5	CO5	L3
15	Solve the fol	lowing	game	by ap	plying	g grap	ohica	l ru	le	5	CO5	L3
	2	-1		5		-2			6			
	-2	4		-3		1			0			
16	Solve the fol	lowing	game	by ap	plying	g grap	ohica	l rul	le	5	CO5	L3
	1				2							
	5				6							
	-7				-9							
	-4				-3							
	2				1							

F. EXAM PREPARATION

1. University Model Question Paper

Cours	se:	Operations	Research.				Month J	/ Year	May /	2019
Crs C	ode:	15ME71	Sem:	VII	Marks:	80	Time:		180 m	inutes
Mod	Note	Answer all	FIVE full que	stions. All q	uestions carry ec	jual marks.		Marks	CO	Level
ule										
1	а	Discuss the	e scope of Op	erations Re	search.			6	CO1	L2
	b	What is operation r	eration reseal esearch.	rch? Explair	n origin and the s	ix phases of		5	CO2	L2
2	a	A compute profit of Rs. hours of as desktop rea month the inspection the total pro	r company m . 700/- & 500 sembly time quires 3 hours total number is 90 hours. F ofit is maximu	anufactures /- unit resp & 2 hours of s of assemb of hours av ormulate th ım.	s laptops & deskt ectively. Each un f testing time whi oly time & 1 hour f ailable for assem ie problem as LP	ops that fetc it of laptop ta le each unit o for testing. In ibly is 210 ho P in such a w	hes akes 4 of a given urs & for ray that	5	CO1	L2
	b	A toy comp and a delux produce as maximum of produce 15 requires a f company n respectivel order to ma	oany manufac xe version- do of 2000 dolls 00 dolls per o ancy dress of nakes a profit y, then how n aximize the to	tures two ty oll B. Each d A and the co per day. The day(Both A f which ther of Rs. 10/- nany of eacl tal profit. Fo	ypes of dolls, a ba loll of type B take ompany would ha e supply of plasti & B combined). 1 e are only 600 pe & Rs. 18/- per do h doll should be ormulate the prof	asic version- es twice as lo ave time to n c is sufficient The deluxe ve er day availab oll on doll A & produced pe olem as LPP.	doll A ng to nake to ersion ble. If the B r day in	6	CO2	L3
3	a	A marketing Rs. 20,000 media 'M' is not more th messages audience p Formulate	g manager wi in two media s Rs. 200 & 'N han two insert should appea ber unit messa the problem a	ishes to allo group M & ' is Rs. 300. tions are de ar in the med age for med as Linear Pr	ocate his annual a N. The unit cost of The media M is n sired in one issue dia N. The expect ia M is 4,000 & fo ogramming prob	advertising bu of the messay nonthly maga e. At least five ted effective or N is 5,000. lem.	udget of ge in the azine & e	5	Co3	L3
	b	A manufact	turer produce	es two types	s of models M1 &	M2. Each M1	model	5	CO3	L3

		requires 4 hours of model requires 2 h manufacturer has 2 hours a week & eac model is Rs. 3/- & allocate his produc maximum profit in	grinding & 2 hour ours of grinding & 2 grinders & 3 poli ch polisher works on M2 model is R ction capacity to th a week. Formulate	rs of polishing, v 5 hours of poli ishers. Each grir for 60 hours a s. 4/ How sho he two types of e the above pro	whereas each M2 shing. The nder works for 40 week. Profit of M1 uld the manufacturer models so as to make oblem as LPP.			
							001	
4	a	An agriculturist has and Potato. Whate for tomato/kg, Rs. average yield is 1,5 1200 kg of potato/ and to produce ea manure. Labour rea tomato and potato days of labour at a this as a LP model	s a farm with 126 a ver he raises is ful 4/- for mango/kg 00 kg of tomato/ acre. To produce ch 80 kg of potato quired for each ac each and 5 man- rate of Rs. 40/- p to maximize the a	acres. He produ Ily sold in the m g and Rs. 5/- fo acre, 1800 kg o each 100 kg of o a sum of Rs. 12 cre to raise the o days for mango er man day are agriculturist's to	ices Tomato, Mango harket. He gets Rs. 5/- r potato/kg. The f mango/acre and tomato and mango 2.50 has to be used for crop is 6 man-days for b. A total of 500 man- available. Formulate tal profit.	5	CO3	L3
	b	A company manufa processed in the sa product A and 2 mi operates for a max and B 0.5 kg of raw week. Market cons Product A costs Rs 6/- per unit and ca Determine the nun	actures two produ ame machine. It ta inutes for each un imum of 35 hours material per unit traint on product 5.5/- per unit and an be sold in the n nber of units of A	ucts A & B. Thes akes 10 minutes it of product B in a week. Proc the supply of w B is known to b sold at Rs. 10/- narket at a unit & B per week to	ses products are to process one unit of and the machine duct A requires 1 kg which is 600 kg per e 800 unit every week. Product B costs Rs. price of Rs. 8/ o maximize the profit	6	CO4	L3
		A		с I			00-	
5	а	A paper mill produ- raw material restric and 300 tons of gra- week. It requires 0. respectively with c Formulate the abo- product mix.	ces two grades of ctions, it cannot pr ade Y in a week. T 2 and 0.4 hours to orresponding pro ve as a LPP to ma	roduce more th oduce more th here are 160 pr produce a ton fits of Rs. 200/- iximize profit an	X and Y. Because of an 400 tons of grade X oduction hours in a of products X and Y and Rs. 500/- per ton. d find the optimum	5	CO5	L3
	b	Farmer furniture m per chair, \$60 per a manufacture these maximum of 300 n item requires a cer assembly time. These are given in	hakes chairs, arm- arm-chair and \$ 8 e items are fabric a neters of fabric ar tain amount of wo the following tabl	chairs and sofa 30 per sofa. The and wood. A su nd 350 units of v ood and fabric a	s, the profits are \$ 50 material used to pplier can provide a wood each week. Each as well as certain	5		L3
				Wood	Ass. Time			
		Item Chair	Fabric	Gunaita	9 hours			
		Armobair	∠III Em	o units	o nours			
		Sofa	SIII 8m	4 units 5 units	5 hours			
		Avail./Wk	300m	350 units	480 hours			
			OR	<u> </u>				
6	a	A person requires a garden. One unit or respectively. One u the liquid product a how many of each and meet the requ	10,12 and 12 units f liquid product co unit of dry product sells for Rs. 3/- ar should be purcha irements.	chemicals A,B,C ontains 5,2 and t contains 1,2 ar nd the dry prode ased, in order to	C respectively for his 1 units of A,B and C ad 4 units of A,B,C. If uct sells for Rs. 2/-, 0 minimize the cost	5	CO5	L3
	b	A company produc	ces two types of H	lats. Each hat o	f the first type requires	5	CO5	L3
		twice as much labo	our time as the se	cond type. The	company can			
		produce a total of g	500 hats a day. Th	ne market limits	daily sales of the first			

		1										
		& second type for type A & Rs to determine	e to 150 & 2 5. 5 for type	250 ha e B. Fo	ats. Ass ormula	suming th ate the pro	at th oble	ne profits/ m as LP m	hat are Rs. 8/- odel in order			
		the number o	f hats to b	e proo	duced	of each t	ype	so as to m	aximize the pro	ofit.		
7	a	The standard v ingredients B1 Strength consi of B1 & a minir likely to be rela as LP model.	weight of a & B2. B1 c iderations num of 2 k ated to the	a spec ost R dictat g of E e price	cial pur s. 5/- p te that 32, sinc e of the	pose bric per kg & E the brick ce the der e brick. Fc	ck is 32 cc con man prmu	5Kg and it osts Rs. 8/ tains not n d for the p Ilate the al	contains two - per kg. nore than 4 kg roduct is bove problem	6	CO5	L3
	b	Old hens can b each. The old egg costs Rs. 2 Rs. 2000/- to s of each kind o than 40 hens.	be bought hens lay 3 2/ A hen spend for l f hen shou	at Rs eggs costs hens, Ild he	5.50/- week Rs.5/ formul buy?	each but and your - per wee late the p Assume t	youi ng h ek to robl hat	ng ones co ens 5 egg fee. If a po em to dec ne cannot	ost Rs. 100/- s/week. Each erson has only ide how many house more	5	CO5	L3
					<u> </u>						00	
8	a	A retail store attractive carc of 400 shirts storage capac combined. Typ profit of Rs. 5/ per week to n of the problem	stocks tw lboard box of type A ity, howev pe A shirt '- per unit naximize t n.	o typ kes. D ver, is fetch How he to	bes of Ouring a limited hes a p v many tal pro	shirts A a a week th ximum o d to a ma orofit of R / of each fit? Form	and ne st f 30 ximi s. 2/ type ulate	 B. These ore can se ore can se o shirts c um of 600 /- per unit the store a mathe 	are packed in ell a maximum of type B. The of both types and type B a e should stock matical model	6	CO4	L3
	b	A company ma processed in t product A and operates for a and B 0.5 kg o week. Market o Product A cost 6/- per unit ar Determine the	anufacture he same n 2 minutes maximum f raw mate constraint ts Rs. 5/- p nd can be number c	es two nachii for e of 35 erial p or a on pr oer ur sold ii of unit	p produ ne. It ta ach un bours er unit oduct nit and n the n s of A 8	acts A & B akes 10 m in a weel the supp B is know sold at R harket at a & B per w	6. The inut k. Pre ly of n to s. 10 a un eek	eses produ es to proce 3 and the oduct A re which is 6 be 800 ur / Produc it price of to maximi	ucts are ess one unit of machine quires 1 kg 500 kg per hit every week. t B costs Rs. Rs. 8/ ze the profit	5	CO5	L3
9	а	Solve the follo	wing gam	e by a	applyir	ng domina	ance	e rule		5	CO5	L2
		2	4		3		8		4			
		5	6		3		7		8			
		6	7		9	1	8		7			
		4	2		8		4		3			
	b	Solve the follo	wing gam	e by a	applyir	ng domina	ance	e rule		5	CO5	L2
		1		7				2				
		6		2				7				
		5		2				6				
			••••		(DR	1.2			0		
10	а	solve the follo rule e) A1 A2	B1 B2 3 -3 -1 1	e by a 2 E 3 2 -	applyir 33 1 -3	ng a) grap b)	3 -2 -1 4 2 2	4 2 6	6	CO5	L2
	b	Solve the follo	wing gam	e by a	applyir	ng graphi	cal r	ule		5	CO5	L2
		-							-			

2. SEE Important Questions

Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant series Image: Participant ser			 			
Image: section of the section of th						
Image: section of the section of th						
Image: section of the section of th						
Image: section of the section of th						
Image: section of the section of th						
Image: section of the section of th						
Image: Section of the section of th						
Image: Section of the section of th						
Image: Section of the section of th						
Image: Section of the section of th						
Image: Section of the section of th						
Image: Section of the section of t						
Image: Section of the section of th						
Image: Section of the section of th						
Image: Section of the section of th						
Image: Section of the section of th						
Image:						
Image: Section of the section of th						
Image: Sector of the sector						
Image: Sector of the sector						
Image:						
Image:						
Image: Sector of the sector						
Image: Constraint of the second sec						

G. Content to Course Outcomes

1. TLPA Parameters

Table 1: TLPA – Example Course

Mc	Course Content or Syllabus	Content	Blooms'	Final	Identified	Instructi	Assessment
du	(Split module content into 2 parts which have	Teachin	Learning	Bloo	Action	on	Methods to
e-	similar concepts)	g Hours	Levels	ms'	Verbs for	Methods	Measure
#			for	Leve	Learning	for	Learning
			Content	l		Learning	_
A	В	С	D	Ε	F	G	Н
1	Introduction: Evolution of OR, Definitions of OR, Scope of OR, Applications of OR, Phases in OR study. Characteristics and limitations of OR, models used in	5	L1,L2	L2	Understa nd	Chalk and board	Assignment
	OR, Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. SolutionstoLPP by graphical method(Two Variables).						
2	LPP: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by S implex method, Big-M Method and Two Phase Simplex Method, Degeneracy in LPP. Concept of Duality, writing Dual of	4	L1,L2,L3	L3	Apply	Chalk and board	Assignment

	given LPP. Solutions to L.P.P by Dual Simplex Method.						
3	Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution(MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem. Assignment Problem-Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems. Travelling Salesman Problem (TSP). Difference between assignment and T.S.P, Finding best route by Little's method.	3	L1,L2,L3	L3	Apply	Chalk and board	Assignment and Slip Test
4	Numerical Problems. Network analysis: Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks, determining the probability of completing a project, predicting the completion time of project; Cost analysis in networks. Crashingofnetworks- Problems. Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), Kendall & Lee's notation of Queuing, empirical queuing models – Numerical on M/ M/1 and M/M/C Queuing models.	4	L1,L2,L3	L3	Apply	Chalk and board	Assignment
5	Game Theory: Definition, Pure Strategy problems, Saddle point, Max-Min and Min- Max criteria, Principle of Dominance, Solution of games with Saddle point. Mixed Strategy problems. Solution of 2X2 games by Arithmetic method, Solution of 2Xn m and mX2 games by graphical method. Formulationof games. Sequencing: Basic assumptions, Johnson's algorithm, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing of2 jobs on 'm' machines using graphical methodS.	4	L1,L2,L3	L3	Apply	Chalk and board	Assignment and slip test

2. Concepts and Outcomes:

Table 2: Concept to Outcome – Example Course

N C e	10 Learning or Ide Iul Outcome Cc - from study of + # the Content C or Syllabus - -	lentified oncepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome Student Should be able to
	A I	J	K	L	М	N
	1 Introduction: - Evolution of Op OR, Re Definitions of -LF OR, Scope OR, Applications of OR, Phases in in OR study. Characteristic s s and limitations of OR, models	peration esearch PP	Operation Research LPP	Understand the meaning of operation research Formulation of LPP and Obtain optimal Solution using graphical method	- Understand - Operation Research - Formulate - Graphical Methods	Understand the meaning, definitions, scope, need, phases and techniques of operations research. Formulate as L.P.P and derive optimal solutions to linear programming problems by graphical method.
	2 used in OR - S Linear & E Programming Me Problem -Di Problem -Di (LPP), Sin Generalized Me LPP- - Formulation of of problems as L.P.P. Solutions to LPP by graphical method(Two Variables). LPP: Simplex method, Canonical and and Standard form of problem, slack, surplus and artificial variables, Solutions Solutions to LPP by Simplex method, Big- M Method and Two Phase Simplex Method Degeneracy in LPP,	Simplex : Big M ethod pual mplex ethod	Simplex & Big M Method Dual Simplex Method	Using Simplex and Big M method Obtain optimal solution to LPP Using Dual Simplex method Obtain optimal solution to LPP	- Solve - Simplex method -Big M method -Solve - Dual Simplex Method	Solve for optimal solutions to linear programming problems by Simplex method & Big-M method Solve for optimal solutions to linear programming problems by Dual Simplex method.

_							
		Concept of					
		Duality					
		writing Dual					
		af air an LDD					
		or given LPP.					
		Solutions to					
		L.P.P by Dual					
		Simplex					
		Method.					
F	З	Transportatio	-Methods	Transportatio	Have the ability to	-Formulate	Formulate as
	5	n Problem	in	n	obtain optimum	-Transportation	Transportation
		Formulation	Tranchart	Accianmont	colution to	Formulato	problem and derive
		Formulation	Transport	-Assignment		-Formulate	
		OT	ation	-traveling	transportation	-Assignment and	optimum solutions
		transportatio	-	salesman	problem	traveling sales man	for transportation
		n problem,	-	problem	Have the ability to		problem
		types, initial	-		obtain optimum		
		basic feasible	Hungarian		solution to		Formulate as
		solution using	Method		Assignment and		Assignment
		North_\V/oct	nethod		Travoling salosman		problems and
		Comer rule,			problems		denve optimum
		vogets					solutions for
		Approximatio					Assignment and
		n method.					traveling salesman
		Optimality in					problems.
		Transportatio					
		n problem by					
		Modified					
		Distribution(M					
		ODI) mothod					
		ODI) methoa.					
		Unbalanced					
		I.P.					
		Maximization					
		T.P.					
		Degeneracy					
		in					
		transportatio					
		n problems					
		n problems,					
		n problem.					
		Assignment					
		Problem-					
		Formulation,					
		Solutions to					
		assignment					
		problems by					
		Hungarian					
		method.					
		Special cases					
		in assignment					
		problems					
		problems,					
		unpalanced,					
		Maximization					
		assignment					
		problems.					
		Travelling					
		Salesman					
		Problem					
		(TSP)					
		Difference					
		botwoon					
		Dermeen					
		assignment					

	and T.S.P,					
	Finding best					
	route by					
	Little's					
	method.					
	Numerical					
	Problems.					
4	Network	-	Network	Have ability to draw	-Construct	Construct network
	analysis:	-Network	diagram	the network	- PERT	diagrams and
	Introduction,	diagram	Queuing	diagram and	-Solve	determine critical
	Construction	-	model	determine the	-Queuing model	path, floats for
	of networks,	-queuing		critical path.		deterministic and
	Fulkerson's	model		Have ability solve		PERT networks
	rule for			problem on		including crashing
	numbering			queuing models.		of Networks
	the nodes,					
	AON and					Solve waiting line
	AOA					problems for M/M/
	diagrams;					1 and M/M/K
	Critical path					queuing models.
	method to					
	find the					
	expected					
	completion					
	time of a					
	project,					
	determinatio					
	n of floats in					
	networks,					
	PERI					
	networks,					
	the					
	une probobility of					
	probability of					
	completing a					
	project, prodicting the					
	completion					
	time					
	project: Cost					
	analysis in					
	networks					
	Crashing of					
	networks-					
	Problems.					
	Queuina					
	Theory:					
	Queuing					
	systems and					
	their					
	characteristic					
	s, Pure-birth					
	and Pure-					
	death models					
	(only					
	equations),					
	Kendall &					
	Lee's					
	notation of					
	Queuing,					
	empirical					

	queuing					
	models –					
	Numerical on					
	M/M/1 and					
	M/M/C					
	Queuing					
-	models.		Duma anal	1.1	Calua	Calua muchiana an
5	Game Theory	- Duro and	Pure and mixed		-Solve Dure and Mixed	solve problems on
	Dofinition	mixed	stratogy	mixed strategy	ctratogy	game theory for
	Pure Strategy	strategy	Johnson's	nrohlems	-Determine	strategy under
	problems	Johnson's	algorithm	Have ability to	- Johnson's	competitive
	Saddle point.	algorithm		solve problems on	algorithm	environment.
	Max-Min and			sequencing for		
	Min-Max			minimum		Determine minimum
	criteria,			processing time		processing times for
	Principle of					sequencing of n
	Dominance,					jobs-2 machines, n
	Solution of					jobs-3 machines, n
	games with					jobs-m machines
	Saddle point.					and 2 Jobs-n
	Stratogy					Indenines using
	problems					Johnson's algorithm.
	Solution of					
	2X2 games					
	by Arithmetic					
	method,					
	Solution of					
	2Xn m and					
	mX2 games					
	by graphical					
	method. Formulation					
	of games					
	Sequencina [.]					
	Basic					
	assumptions,					
	Johnson's					
	algorithm,					
	sequencing					
	'n jobs on					
	single					
	using priority					
	rules					
	sequencina					
	using					
	Johnson's					
	rule-'n' jobs					
	on 2					
	machines, 'n'					
	jobs on 3					
	inachines, 'n'					
	jobs ori m					
	Sequencina					
	of 2 jobs on					
	'm' machines					
	using					
	graphical					

method.
