Course:         ELEMENTS OF OPERATIONS RESEARCH I         Course Code: BH.USACOR501           Image: Course Code:         Teaching Scheme         Evaluation Scheme (Theory)           Image: Course Code:         Practical (Periods per week per batch) per week)         Tutorial (Periods per week per batch)         Credits (Theory)           Image: Course Code:         Practical per batch)         The code per batch         Practical Assessment (CIA)           Image: Course Code:         Pre-requisites: nil         Course Consectives:         Image: Course Code:         Marks: 60           Pre-requisites:         Image: Course Code:         To introduce students to various deterministic optimization techniques.         Image: Course Code:         Image: Course:         Image: Cour	Course:	ELEMENTS (						
Teaching Scheme         Evaluation Scheme (Theory)           Lecture (Periods per week week)         Practical (Periods per week per batch)         Tutorial per week per week per week per batch)         Credits (Theory per week per week per batch)         End Semester Examinatio (ESE)           4         4          2+2         Marks: 40         Marks: 60           Pre-requisites: nil         Course Objectives:           2+2         Marks: 40         Marks: 60           Pre-requisites: nil         Course Objectives:               1. To introduce students to various deterministic optimization techniques.              3. Students will be able to quantify the relationship between entropy and information.              4. Students will be able to solve examples and Practical use of Mathematical Economics.              5. Students will be able to understand the basics of the finance and security market.              Detailed Syllabus: (per session plan)                1. Mathematical Economics: Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Supply.			<u>JF UPERA</u>	FIONS RESE	EARCH I	Cours	e Code: BH.USACO	OR501
Lecture (Periods per week)       Practical (Periods per week)       Tutorial (Periods per week)       Credits (Theory per week)       Continuous (Theory Pre-requisites)       End Semester Examinatie (ESE)         4       4        2+2       Marks: 40       Marks: 60         Pre-requisites: nil        2+2       Marks: 40       Marks: 60         Course Objectives:        2+2       Marks: 40       Marks: 60         1. To introduce students to various deterministic optimization techniques.            2. To introduce students to Mathematical Economics.       3.       Students will be able to quantify the relationship between entropy and information.         4. Students will be able to solve examples and Practical use of Mathematical Economics.       2.       Students will be able to understand the basics of the finance and security market.         Detailed Syllabus: (per session plan)       Interions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Supply.       15         Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. Cost of (i) demand (ii) Supply.       15         0. Normal conditions of (i) demand (ii) Supply with respect to cost. Features of perfect competition.       15         0. Nonopoly (including effects of taxation and subsidy), Duopoly.       15         0. Monopoly (including effects of taxation and subsidy), Duo		Teaching	Scheme		Ev	aluatio	n Scheme (Theory)	
4       4        2+2       Marks: 40       Marks: 60         Pre-requisites: nil         Course Objectives:         1. To introduce students to various deterministic optimization techniques.         2. To introduce students to Mathematical Economics.         3. Students will be able to quantify the relationship between entropy and information.         4. Students will be able to solve basic problems in financial mathematics.         Course Outcomes:         1. Students will be able to solve examples and Practical use of Mathematical Economics.         2. Students will be able to understand the basics of the finance and security market.         Detailed Syllabus: (per session plan)         Unit       Description         I       Mathematical Economics: Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Supply.         • Normal conditions of (i) demand (ii) Supply with respect to cost. Features of perfect competition.       • Monopoly (including effects of taxation and subsidy), Duopoly.         • Production function. Euler's theorem linear homogeneous production functions.       • The elasticity of substitution.	Lecture (Periods per wee	<ul> <li>Practical</li> <li>(Periods</li> <li>k) per week</li> <li>per batch)</li> </ul>	Tutorial (Periods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment	s t (CIA)	End Semester Exa (ESE)	mination
Pre-requisites: nil         Course Objectives:         1. To introduce students to various deterministic optimization techniques.         2. To introduce students to Mathematical Economics.         3. Students will be able to quantify the relationship between entropy and information.         4. Students will be able to solve basic problems in financial mathematics.         Course Outcomes:         1. Students will be able to solve examples and Practical use of Mathematical Economics.         2. Students will be able to quantify the relationship between entropy and information.         3. Students will be able to quantify the relationship between entropy and information.         3. Students will be able to quantify the relationship between entropy and information.         3. Students will be able to quantify the relationship between entropy and information.         3. Students will be able to understand the basics of the finance and security market.         Detailed Syllabus: (per session plan)         Unit       Description         I       Mathematical Economics: Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Supply.         • Normal conditions of (i) demand (ii) Supply with respect to cost. Features of perfect competition.         • Monopoly (including effects of taxation and subsidy), Duopoly.         • Production function. Euler's theorem linear homogeneous production functions, Cobb-Douglas production function,	4	4		2+2	Marks:	40	Marks: 60	)
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2. To infroduce students to Mathematical Economics.         3. Students will be able to quantify the relationship between entropy and information.         4. Students will be able to solve basic problems in financial mathematics.         Course Outcomes:         1. Students will be able to solve examples and Practical use of Mathematical Economics.         2. Students will be able to quantify the relationship between entropy and information.         3. Students will be able to quantify the relationship between entropy and information.         3. Students will be able to quantify the relationship between entropy and information.         3. Students will be able to understand the basics of the finance and security market.         Detailed Syllabus: (per session plan)         Unit       Description         I       Mathematical Economics: Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Supply.         • Normal conditions of (i) demand (ii) Supply with respect to cost. Features of perfect competition.         • Monopoly (including effects of taxation and subsidy), Duopoly.         • Production function. Euler's theorem linear homogeneous production functions.         • The elasticity of substitution.		Fo introduce stud	lonts to Vari	thomatical E	nonomias		ceninques.	
3. Students will be able to quantify the relationship between entropy and information.         4. Students will be able to solve basic problems in financial mathematics.         Course Outcomes:         1. Students will be able to solve examples and Practical use of Mathematical Economics.         2. Students will be able to quantify the relationship between entropy and information.         3. Students will be able to quantify the relationship between entropy and information.         3. Students will be able to understand the basics of the finance and security market.         Detailed Syllabus: (per session plan)         Unit       Description         I       Mathematical Economics: Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Supply.         • Normal conditions of (i) demand (ii) Supply with respect to cost. Features of perfect competition.         • Monopoly (including effects of taxation and subsidy), Duopoly.         • Production function. Euler's theorem linear homogeneous production functions, Cobb-Douglas production function, CES production function.	2. 1				conomics.			
<ul> <li>4. Students will be able to solve basic problems in financial mathematics.</li> <li>Course Outcomes:         <ol> <li>Students will be able to solve examples and Practical use of Mathematical Economics.</li> <li>Students will be able to quantify the relationship between entropy and information.</li> <li>Students will be able to understand the basics of the finance and security market.</li> </ol> </li> <li>Detailed Syllabus: (per session plan)     </li> <li>Unit Description         <ol> <li>Mathematical Economics:                 <ol> <li>Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Supply.                     <ul> <li>Normal conditions of (i) demand (ii) Supply with respect to cost. Features of perfect competition.</li></ul></li></ol></li></ol></li></ul>	3. 8	Students will be a	able to quan	tify the relati	ionship betw	een ent	ropy and information	on.
Course Outcomes:         1. Students will be able to solve examples and Practical use of Mathematical Economics.         2. Students will be able to quantify the relationship between entropy and information.         3. Students will be able to understand the basics of the finance and security market.         Detailed Syllabus: (per session plan)         Unit         Description         I         Mathematical Economics:         Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Supply.         • Normal conditions of (i) demand (ii) Supply with respect to cost. Features of perfect competition.         • Monopoly (including effects of taxation and subsidy), Duopoly.         • Production function. Euler's theorem linear homogeneous production function, function, CES production function.         • The elasticity of substitution.	4. S	Students will be a	able to solve	basic proble	ms in financ	ial mat	hematics.	
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3. Students will be able to understand the basics of the finance and security market.         3. Students will be able to understand the basics of the finance and security market.         Detailed Syllabus: (per session plan)         Unit       Description         I       Mathematical Economics: Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Supply.         •       Normal conditions of (i) demand (ii) Supply with respect to cost. Features of perfect competition.         •       Monopoly (including effects of taxation and subsidy), Duopoly.         •       Production function. Euler's theorem linear homogeneous production functions, Cobb-Douglas production function, CES production function.	2 8	tudents will be a	ble to quant	- tify the relation	onshin hetwa	een enti	rony and informatic	n
Jetailed Syllabus: (per session plan)       Period         I       Mathematical Economics: Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Supply.       15         •       Normal conditions of (i) demand (ii) Supply with respect to cost. Features of perfect competition.       •       Monopoly (including effects of taxation and subsidy), Duopoly.       •         •       Production function. Euler's theorem linear homogeneous production functions, Cobb-Douglas production function, CES production function.       •       The elasticity of substitution.		tudents will be a	ble to under	stand the he	giog of the fir		nd socurity mankat	/110
Detailed Syllabus: (per session plan)       Period         Unit       Description       Period         I <u>Mathematical Economics:</u> Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Supply.       15         • Normal conditions of (i) demand (ii) Supply with respect to cost. Features of perfect competition.       • Monopoly (including effects of taxation and subsidy), Duopoly.         • Production function. Euler's theorem linear homogeneous production functions, Cobb-Douglas production function, CES production function.       • The elasticity of substitution.	5. 5	tudents will be a		stanu the Da	sics of the m	lance a	nu security market.	
Unit       Description       Period         I       Mathematical Economics: Behaviour of Demand and Supply, Demand functions. Cost and Revenue functions. The elasticity of a function, Elasticity of (i) Demand (ii) Supply.       15         •       Normal conditions of (i) demand (ii) Supply with respect to cost. Features of perfect competition.       •         •       Monopoly (including effects of taxation and subsidy), Duopoly.       •         •       Production function. Euler's theorem linear homogeneous production functions, Cobb-Douglas production function, CES production function.         •       The elasticity of substitution.	Detailed	l Syllabus: (per s	ession plan)	)				
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<ul> <li>Normal conditions of (i) demand (ii) Supply with respect to cost. Features of perfect competition.</li> <li>Monopoly (including effects of taxation and subsidy), Duopoly.</li> <li>Production function. Euler's theorem linear homogeneous production functions, Cobb-Douglas production function, CES production function.</li> <li>The elasticity of substitution.</li> </ul>		Behaviour of I	Demand and and lasticity of a	function Fla	emand funct sticity of (i) I	ions. C Demand	Cost and Revenue	
<ul> <li>Monopoly (including effects of taxation and subsidy), Duopoly.</li> <li>Production function. Euler's theorem linear homogeneous production functions, Cobb-Douglas production function, CES production function.</li> <li>The elasticity of substitution.</li> </ul>		Normal cor	nditions of (i	) demand (ii)	Supply with 1	respect	to cost. Features of	
<ul> <li>Production function. Euler's theorem linear homogeneous production functions, Cobb-Douglas production function, CES production function.</li> <li>The elasticity of substitution.</li> </ul>		Monopoly (	including ef	fects of tavati	on and subsid	ly) Du	opoly	
functions, Cobb-Douglas production function, CES production function. • The elasticity of substitution.		Product	ion function	Fuler's the	orem linear	homog	epeous production	
		functions, Cobb • The elastici	-Douglas pro	oduction funct	tion, CES pro	duction	function.	
Input-Output Analysis a) The Inter-Industry Accounting System, b) Assumptions, c) Closed Model d)		Input-Output Ar a) The Inter-Ir	nalysis ndustry Acco	ounting Syster	n, b) Assumn	otions. c	) Closed Model. d)	
Dynamic Model.		Dynamic M	lodel.		, -,p	·, •	,	
	II	<b>INFORMATIC</b>	<u>ON THEOR</u>	Y				15
II <u>INFORMATION THEORY</u> 15		Introduction. F	undamental	Theorem of	f Informatio	n Theo	ory. Measures of	
II         INFORMATION THEORY         15           Introduction. Fundamental Theorem of Information Theory. Measures of         15		Information. Pro	operties of E	ntropy Function	on. Communi	ication S	System.	
II         INFORMATION THEORY         15           Introduction. Fundamental Theorem of Information Theory. Measures of         Information. Properties of Entropy Function. Communication System.         15           Memory loss channel. Binary Symmetric channel metric, ioint merginal         15         15		and conditional	Entropies.	y symmetric (	Linamiei, chân	mer mat	iix, joint, marginal	

	H(X, Y)=H(X/Y) + H(Y) = H(Y/X) + H(X)					
	$H(X) \ge H(X/Y)$ Channel capacity. Efficiency and Redundancy.	Encoding, Shannon	– Fano			
	Encoding Procedure.	,,,				
III	<u>MATHEMATICS OF FINANCE –I</u> Simple and compound interest, Present value, Annuities with all variations/types. Application Payback Method, (2) Net present value Method (NP Method. (4) Average Rate of Return	Annuities, Present v to investment decis V), (3) Internal Rate c	value of ions (1) of Return	15		
IV	MATHEMATICS OF FINANCE-II			15		
	Securities Market:	1 1 1 1	. 1			
	Concept of stock market, share, face value, market preferential share, bonus and right shares. Initial Pu share (EPS), price earnings ratio (PE). Index, nifty, b	value, dividend, equi ublic offer (IPO), Ear peta value. Simple pro	ty share, ming per blems.			
Mutual Funds (M.F.): Introduction, Types of M.F., Net Asset Value (NAV), entry, exit loads. Classification of M.Fs. Option plans given by M.Fs. Evaluation of M.Fs. Advantages and Disadvantages of M.Fs. Simple problems on calculation of Net income after considering entry load, dividend, change in NAV and exit load. Introduction to :Investment Plans (i) Averaging of price under the systematic Investment Plan (SIP), (ii) Systematic Withdrawal Plan (SWP), (iii) Systematic Transfer Plan (STP)						
	Total			60		
Re	ference Books:					
1.	Damodar Gujrathi, Sangeetha S: Basic Econometrics,	Fourth edition, McGra	aw-Hill Co	mpanies.		
2.	Greene William: Econometric Analysis, First edition,	McMillan Publishing	Company.	1		
3	Ingels Franklin M · Information and Coding Theory ·	Intext Educational Pu	blishers			
4.	Shankaran Sunder : Indian mutual funds hands book. A	A guide for industry p	rofessional	s and		
5	Mathematics for Finance: An Introduction to Financia	l Engineering (Spring	er Undergr	aduate		
5.	Mathematics Series), by Marek Capiński, Tomasz Zas	tawniak.	er e naergi	uuuuto		
6.	Introduction To Information Theory, by C. E. Shannor	1.				
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PRA	CTICALS	JISTRIBUTION OF	TUPICS	FUK		
	SEMESTER-V COURSE CODE USACO	<u>R5P1</u>				
Sr.N	Topic of the Practical	No. of pract.				
1	Mathematical Economics - I	1				
2	Mathematical Economics - II	1				
3	Information Theory	1				
4	Mathematics of Finance -I	1				
5	Investment Analysis	1				

6	Securities	1	
7	Mutual Fund	1	

Details of Conduct of Practical Examination (Evaluation Scheme): At the end of the semester, examinations of 3 hours duration and 80 marks shall be held for each course. 20 marks for laboratory work and journal (80+20 =100)

**Details of Continuous Internal Assessment (CIA)** 

For continuous internal assessment, it is proposed to hold one class test (for 20 marks) and one assignment /project/survey conduction & data presentation using

data visualization techniques, learnt in a course to be given (for 20 marks) on topics which they may explore on their own (under due guidance by teacher).

Any other information: Batch size of practical batch/Tutorial batch as prescribed by University of Mumbai.

Progr	amme: B.S	c.			Semester: VI			
Course	e: <u>ELEME</u>	ENTS O	F OPERAT	IONS RESE	ARCH II	Cour	se Code: BH.U	JSACOR601
Teaching Scheme					Evaluation Scheme (Theory)			
Lecture (Periods per week)Practical (Periods per week per batch)		Tutorial (Periods per week per batch)	Credits (Theory +Practical )	Continuous Internal Assessment (CIA)		End Semester Examination (ESE)		
4		4		2+2	Marks:	40	Mar	ks: 60
Pre-re	equisites: ni	il			1		1	
2. 3. Cours 1. 2. 3. 4. Detail	Students v scientific c se Outcome Students v Students v To acquain Student v manipulat	$\frac{1}{1} = \frac{1}{1} + \frac{1}$	able to solve ble to solve ble to solve ble to solve tudents with rn Python entific comp	on program ne Python pro alisation. problems ba problems ba Python pro programmin puting and vis	ming languag ogramming la sed on Qualit sed on Accep gramming lan ng language sualisation.	ge and anguag ty cont tance s nguage that	Python IDEs. ge for data ma rol. Sampling. e and Python I includes libra	nipulation, DEs. aries for data
Unit	Descripti	on						Periods
1	1 <u>Control Charts:</u> Principles of control. Process quality control of attributes and variables. Xbar, R, p, c, np charts, their uses. p-chart with variable sample size. Problems involving setting up standards for future use.					15		
2	Acceptance Sampling: Lot Acceptance Sampling Plans by Attribu (without curtailment). OC function and OC cur AOQ, Consumer's risk, Producer's risk. Dou curtailment). OC function and OC curves. Intro			ributes: Sing curves. AQL Double Samp Introduction to	le San , LTPE oling P o Six s	ppling Plans , ASN, ATI, lan (without igma limits	15	

3	Basics Of Python:	15
	Introduction to Python programming language and its various IDEs. Use of	
	Python Jupyter IDEs.	
	Python concepts: Expressions, values, types, variables, programs &	
	algorithms.	
	Data structures:	
	List, set, dictionary (mapping), tuple, graph (from a third-party library)	
	List slicing (sublist), list comprehension (shorthand for a loop)	
	Mutable and immutable data structures	
	Distinction between identity and (abstract) value	
	(About data or How to import & export data in python)	
	Testing and debugging:	
	Test design, coverage, & adequacy	
	Debugging strategies: divide & conquer, the scientific method	
4	Statistical Analysis and Visualization in Python	15
	Descriptive Statistics: Summary statistics, Correlation and simple	
	regression.	
	Statistical hypothesis testing: Normality Check, parametric and non -	
	parametric tests. One-way and Two-way ANOVA.	
	Visualization (graphing/plotting results): Diagrammatic and Graphical	
	representation of data using different libraries in Python (Matplotlib and Seeborn)	
	Total	60
	1000	00
Re	eference Books:	
1.	E.L. Grant. (2nd edition) McGraw Hill, 1988.: Statistical Quality Control	
1. 2.	<ul><li>E.L. Grant. (2nd edition) McGraw Hill, 1988.: Statistical Quality Control</li><li>Duncan. (3rd edition) D. Taraporewala sons &amp; company.: Quality Control and Ir</li></ul>	ndustrial
1. 2.	E.L. Grant. (2nd edition) McGraw Hill, 1988.: Statistical Quality Control Duncan. (3rd edition) D. Taraporewala sons & company.: Quality Control and Ir Statistics	ndustrial
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3	Single Sampling Plan	1	1
4	Double Sampling Plan	1	1
5	Basics Of Python - I	1	1
6	Descriptive Statistics with Python	1	1
7	Data Visualization in Python	1	

Details of Conduct of Practical Examination (Evaluation Scheme): At the end of the semester, examinations of 3 hours duration and 80 marks shall be held for each course. 20 marks for laboratory work and journal (80+20 =100). Practical Examination based on Python to be conducted in Computer Laboratory.

**Details of Continuous Internal Assessment (CIA)** 

For continuous internal assessment, it is proposed to hold one class test (for 20 marks) and one assignment /project/survey conduction & data presentation using data visualization techniques, learnt in a course to be given (for 20 marks) on topics which they may explore on their own (under due guidance by teacher).

Any other information: Batch size of practical batch/Tutorial batch as prescribed by University of Mumbai.