

माँ शाकुम्भरी विश्वविद्यालय, सहारनपुर Maa Shakumbhari University, Saharanpur

B.Sc. Honours in Mathematics Under FYUP-NEP2020 PROGRAMME

> CURRICULUM & SYLLABUS For

Department of Mathematics Affiliated Colleges Maa Shakumbhari University, Saharanpur

(Effective from Session 2025-26)

Members, Board of Studies (Mathematics)

Maa Shakumbhari University, Saharanpur

S.No.	Name	Designation	College/Universit	Signature
1.	Prof. Sanjay Kumar	Convener	M.S. College, Saharanpur	fint
2.	Prof. Praveen Kumar	Member	J. V. Jain College, Saharanpur	27/2/25
3.	Prof. Naveen Sharma	Member	D.A.V. College Muzaffarnagar	Hoummy 27/02/25
4.	Prof. Mridul Gupta	Member(External)	C.C.S. University, Meerut	Onjone 1
5.	Prof. Shivraj Singh	Member(External)	C.C.S. University, Meerut	Ju Juliu

Four Year Program under FYUP-NEP2020 Syllabus Four Year **B.Sc. Honours (Mathematics)** as per NEP2020

SEMESTER	PAPER CODE	PAPER TYPE	COURSE NAME	TH/ PRC/ PR	CR	IE	EE (MinMarks)	Total	Min Marks	Lecture Hours
		C	ERTIFICATE IN MATHEMATICS	•						
Sem-I	0120301	CC	Differential Calculus & Integral Calculus	ТН	4	25	75(25)	100	33	4x15=60
Sem-1	0120380	CC	Practical	PRC	2		100	100	33	4x15=60
Sem-II	0220301	CC	Matrices and Differential Equations & Geometry	TH	6	25	75(25)	100	33	4x15=60
			DIPLOMA IN MATHEMATICS							
Sem-III	0320301	CC	Algebra & Mathematical Methods	ТН	6	25	75(25)	100	33	4x15=60
Sem-IV	0420301	CC	Differential Equation & Mechanic	ТН	6	25	75(25)	100	33	4x15=60
			DEGREE IN MATHEMATICS							
	0520301	CC	Group and Ring Theory & Lincar Algebra	ТН	5	25	75(25)	100	33	4x15=60
	m		Any one of the Following							
Sem-V	0520302	EL	Number Theory & Game Theory	ТН	5	25	40	100	33	4x15=60
	0520303	EL	Graph Theory & Discrete Mathematics	TH	5	25	75(25)	100	33	4x15=60
j	0520304	EL	Differential Geometry & Tensor Analysis	ТH	5	25	75(25)	100	33	4x15=60
	0620301	CC	Metric Space & Complex Analysis	TH	-1	25	75(25)	100	33	4x15=60
Sem-VI	0620302	CC	Numerical Analysis & Operations Research	TH	4	25	75(25)	100	33	4x15=60
	0620380	CC	Practical	PRC	2		100	100	40	4x15=60
			B.Sc. Honours in Mathematics							
Sem-VII	0720321	СС	Abstract Algebra	TH	4	25	75(25)	100	40	4x15-60



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	0720322	CC	Real Analysis	ТН	4	25	75(25)	100	40	4x+5=60
	0720323	CC	Advance Differential Equation	TH	4	25	75(25)	100	40	4x15=60
	0720324	CC	Metric Space	ТН	4	25	75(25)	100	40	4x 5=60
			Choose Any One							
	0720325	EL	Mathematical Statistics	ТН	1	25	75(25)	100	40	4x15=60
	0720326	EL	Advance Numerical Analysis	TH	4	25	75(25)	100	40	4x1560
	0820321	CC	Topology	TH	4	25	75(25)	100	40	4x15=60
	0820322	CC	Advance Complex Analysis	TH	4	25	75(25)	100	40	4x15=60
	0820323	CC	Number Theory	TH	4	25	75(25)	100	40	4x15=60
		Core	Elective G-1 Any One of the following							
	0820324	EL	1. Mechanics	TH	-1	25	75(25)	100	40	4x15-60
Sem-VIII	0820325	EL	2. Financial Mathematics	TH	4	25	75(25)	100	40	4x15-60
	0820326	EL	3. Fluid Dynamics	TH	4	25	75(25)	100	40	4x15-60
	ļ	Core	Elective G-2 Any One of the following							
	0820327	EL	1. Linear Algebra	ТН	4	25	75(25)	100	40	4x15: 60
	0820328	EL	2. Data Structure with C	TH	4	25	75(25)	100	40	4x15=60
	0820329	EL	3. Dynamical systems	TH	4	25	75(25)	100	40	4x15-60

Minor Elective Paper for Other Faculty Students

SEMESTER	PAPER TYPE	COURSE NAME	тн	CR	IE	EE (MinMarks)	Total	Min Marks	Lecture Hours
	EL	Fundamental of Computers	ТН	6	25	75(25)	100	33	90
	 EL	Vedic Mathematics	ТН	6	25	75(25)	100	33	90
	 EL	Elementary Mathematics	ТН	6	25	75(25)	100	33	90

CC-Core Compulsory, EL-Elective, CR-Credits, IE-Internal Evaluation, EE-External Evaluation, TH-Theory, PRC-Practical, PR-Project



B.Sc. Honours with Research in Mathematics

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4.	Prof. Mridul Gupta	Member(External)	C.C.S. University, Meerut	On Zin
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Four Year Program under FYUP-NEP2020 Syllabus Four Year **B.Sc. Honours with Research** (Mathematics) as per NEP2020

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			Any one of the Following							
Sem-V	0520302	EL	Number Theory & Game Theory	TH	5	25	40	100	40	4x15=60
	0520303	EL	Graph Theory & Discrete Mathematics	ТН	5	25	75(25)	100	40	4x15=60
	0520304	EL	Differential Geometry & Tensor Analysis	TH	5	25	75(25)	100	40	4x15=60
	0620301	СС	Metric Space & Complex Analysis	TH	4	25	75(25)	100	40	4x15=60
Sem-VI	0620302	CC	Numerical Analysis & Operations Research	TH	4	25	75(25)	100	40	4x15=60
	0620380	CC	Practical	PRC	2	<u></u>		100	40	4x15=60

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		B.Sc. Ho	onours with Research in Mathematics	5						
	0720321	CC	Abstract Algebra	TH	4	25	75(25)	100	40	4x15=60
	0720322	CC	Real Analysis	TH	4	25	75(25)	100	40	4x15=60
Sem-VII	0720323	CC	Advance Differential Equation	ТН	4	25	75(25)	100	40	4x15=60
	0720324	CC	Metric Space	TH	4	25	75(25)	100	40	4x15=60
	0720365	CC	Project-I	PR	4			100	40	
	0820321	CC	Topology	ТН	4	25	75(25)	100	40	4x15=60
	0820322	CC	Advance Complex Analysis	TH	4	25	75(25)	100	40	4x15=60
	0820323	CC	Number Theory	TH	4	25	75(25)	100	40	4x15=60
		Сө	re Elective -Any One of the following							
	0820324	EL	1. Mechanics	ТН	4	25	75(25)	100	40	4x15=60
Sem-VIII	0820325	EL	2. Financial Mathematics	TH	4	25	75(25)	100	40	4x15=60
	0820326	EL	3. Fluid Dynamics	TH	4	25	75(25)	100	40	4x15=60
	0820327	EL	4. Linear Algebra	TH	4	25	75(25)	100	40	4x15=60
	0820328	EL	5. Data Structure with C	ТН	4	25	75(25)	100	40	4x15=60
	0820329	EL	6. Dynamical systems	TH	4	25	75(25)	100	40	4x15=60
	0820365	CC	Project-II	PR	4			100	40	
			Minor Elective Papers for other Fac	ulty Stu	dents					
SEMESTER	PAPER CODE	PAPER TYPE	COURSE NAME	ТН	CR	IE	EE (MinMarks)	Total	Min Marks	Lecture Hours
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		EL	Vedic Mathematics	ТН	6	25	75(25)	100	33	90
		EL	Elementary Mathematics	TH	6	25	75(25)	100	33	90

CC-Core Compulsory. EL-Elective, CR-Credits, IE-Internal Evaluation, EE-External Evaluation, TH-Theory, PRC-Practical, PR-Project

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Proceeding Board of Studies(Mathematics)

Today on date 27/02/2025 Board of Studies meeting has been conducted in hybrid mode in the Academic Block Maa Shakumbhari University, Punwarka Saharanpur. Following members have attended the meeting.

- 1. Prof. Sanjay Kumar
- 2. Prof. Praveen Kumar
- 3. Prof. Naveen Sharma
- 4. Prof. M K Gupta
- 5. Prof. Shivraj Singh

All the members have discussed in detail to form the following syllabus as per FYUP-NEP2020 guidelines.

- 1. Design four year B.Sc. Honours in Mathematics program.
- 2. Design four year B.Sc. Honours with research in Mathematics program.
- 3. Design three minor elective papers for other faculty students.

Convener

Pravedi Member

(Prof. Naveen Sharma) Member

Prof. Shivraj Singh External Expert

Prof. M K Gupta External Expert

Maa Shakumbhari University, Saharanpur

Syllabus- B.Sc. (Mathematics) Honours

Programme Outcome/ Programme Specific Outcome

Programme Outcome:

PO1: It is to give foundation knowledge for the students to understand basics of mathematics including applied aspect for the same.

PO2: It is to develope enhanced quantitative skills and pursuing higher mathematics and research as well.

PO3: Students will be able to develop solution oriented approach towards various issues related to their environment.

PO4: Students will become employable in various govt. and private sectors

PO5: Scientific temper in general and mathematical temper in particular will be developed in students.

Programme Specific Outcome:

PSO1: Student should be able to possess recall basic idea about mathematics which can be displayed by them.

PSO2: Student should have adequate exposure to many aspects of mathematical sciences,

PSO3: Student is equipped with mathematical modeling ability, critical mathematical thinking, and problem solving skills etc.

PSO4: Student should be able to apply their skills and knowledge in various fields of studies including, science, engineering, commerce and management etc.



B.Sc.(Mathematics)-I Year Certificate in Mathematics

Subject: Mathematics NEP Code: B0301017 Course Otde: B103010 Course Otde: B103010 Course Otde: B1030101 Course Otde: B10301017 CO1: The programme outcome is to give foundation knowledge for the students to understand basics of mathematics including applied aspect : enhanced quastitative skills and pursuing higher mathematics and research as well. CO2: By the time students complete the course they will have wide ranging application of the subject and have the knowledge about curvature. evolutes and trace curve in polar, Cartesian as well as parametric curves. CO3: The main objective of the course is to equip the student with necessary analytic and technical skills. By applying the principles of integr solve a variety of practical problems in science and engineering. CO4: The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking level Credits: 4 Core Compulsory Max. Marks: 25+75 Min. Passing Marks: <th c<="" th=""><th></th></th>	<th></th>						
Course Code: 0120301 Course outcomes: CO1: The programme outcome is to give foundation knowledge for the students to understand basics of mathematics including applied aspect is inhanced quantitative skills and pursuing higher mathematics and research as well. CO2: By the time students complete the course they will have wide ranging application of the subject and have the knowledge of real valued assequence and series. They will also be able to know about convergence of sequence and series. Also, they have knowledge about curvature, evolutes and trace curve in polar, Cartesian as well as parametric curves. CO3: By the time students complete the course is to equip the student with necessary analytic and technical skills. By applying the principles of integr solve a variety of practical problems in science and engineering. CO4: The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking level CO4: The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking level CO4: The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking level CO4: The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking level CO4: The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking level CO4: The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking level CO4: The student is equipped with standard encorepts and the students. Core Compulsory Max. Marks: 25+75 Min. Passing Marks: Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0 Part-A Differential Calculus Intermediate to advance evely: a corregence criteric Cauchysequence, limit superior an limit inferior of a sequence, sh							
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Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0 Part-A Differential Calculus Unit Topics Introduction to Indian Ancient Mathematics and Mathematicians should be included under Continuous Internal Evaluation (CIE). Definition of a sequence, theorems on limits of sequences, bounded and monotonic sequences, Cauchy's convergence criterio I Cauchysequence, limit superior and limit inferior of a sequence, subsequence, Series of non-negative terms, convergence and divergence, Comparison tests, Cauchy's integral test, Ratio tests, Root test, Raabe's logarithmic test, de Morgan and Bertrand's tests, alternating series, Leibnitz's theorem, absolute and conditional convergence. Limit, continuity and differentiability of function of single variable, Cauchy's definition, Heine's definition, equivalence of definition of Cauchy and Heine, Uniform continuity, Borel's theorem, boundedness theorem, Bolzano's theorem, Intermediate value theorem, extreme value theorem, Darboux's intermediate value theorem for derivatives, Chain rule, indeterminate forms. Rolle's theorem, Lagrange and Cauchy Mean value theorems, mean value theorems of higher order, Taylor's theorem with various forms of remainders, Successive differentiation, Leibnitz theorem, Maclaurin's and Taylor's series, Partial differentiation, Euler's theorem on homogeneous function.							
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III various forms of remainders, Successive differentiation, Leibnitz theorem, Maclaurin's and Taylor's series, Partial differentiation, Euler's theorem on homogeneous function.							
differentiation, Euler's theorem on homogeneous function.							
	7						
IV Tangent and normals Asymptotes Curvature Envelops and evolutes Tests for concavity and convexity Points of inflexion.	3						
Multiple points, Parametric representation of curves and tracing of parametric curves, Tracing of curves in Cartesian and Polar form	7						

	Part-B. Integral Calculus						
Ur	it Topics	No. of Lectures					
v	Definite integrals as limit of the sum, Riemann integral. Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean value theorems of integral calculus, Differentiation under the sign of Integration.	9					
VI	Improper integrals, their classification and convergence, Comparison test, µ-test, Abel's test, Dirichlet's test, quotient test, Beta and Gamma functions.	7					
V	Rectification, Volumes and Surfaces of Solid of revolution, Pappus theorem, Multiple integrals, change of order of double integration, Dirichlet's theorem, Liouville's theorem for multiple integrals.						
VI	Vector Differentiation, Gradient, Divergence and Curl, Normal on a surface, Directional Derivative, Vector Integration, Theorems of Gauss, Green, Stokes (without proof) and related problems.	7					
Sugge	sted Readings (Part- A Differential Calculus):						
1, R.	G. Bartle & D.R. Sherbert, Introduction to Real Analysis, John Wiley & Sons						
2. T.	A. Apostal, Calculus Vol. I, John Wiley & Sons Inc.						
3. S.	Balachandra Rao & C. K. Shantha, Differential Calculus, New Age Publication.						
4. H.	Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.						
5. G.	B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.						
6. Su	ggestive digital platforms web links: NPTEL/SWAYAM/MOOCS						
7. Co	urse Books published in Hindi may be prescribed by the Universities.						
lugge	ted Readings (Part-B Integral Calculus):						
1. T.I	A. Apostal, Calculus Vol. II, John Wiley Publication						
2. Sh	unti Narayan & Dr. P.K. Mittal, Integral Calculus, S.Chand						
3. Er	vin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.						
4. Su	ggestive digital platforms web links: NPTEL/SWAYAM/MOOCS						
5. Cc	urse Books published in Hindi may be prescribed by the Universities.						
	ourse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), Chemistry/Biochemistry/Life es(UG),						
cono	nics(UG/PG), Commerce(UG), BBA/BCA, B.Sc.(C.S.)						
	Suggested Continuous Evaluation Methods: Max. Marks: 25						
IN	Assessment Ma Type	x. Marks					
CI	ass Tests	10					
0	aline Quizzes/ Objective Tests	5					
Pr	esentation	5					
As	signment (Introduction to Indian ancient Mathematics and Mathematicians).	5					
	prerequisites: To study this course, a student must have subject Mathematics in class 12th						

UG MATHEMATICS

B.Sc. I (SEMESTER-I) Paper-II Practical

Program	me: Certificate	Year: First	Semester: First					
Class: B	.Sc.							
			Subject: Mathematics					
	Code: 0120380 ie: B030102P		Course Title: Practical					
Course o	utcomes:							
CO1: The	e main objective of	f the course is to eq	quip the student to plot the different graph and solve the different types of equations by p	olotting the graph				
using diff	erent computer sof	tware such as Matl	hematica /MATLAB /Maple /Scilab/Maxima etc.					
CO2, Aft	er completion of t	his course student	would be able to know the convergence of sequences through plotting, verify Bolzar	o-Weierstrass				
theorem the	hrough plotting the	sequence, Cauchy	's root test by plotting n^{th} roots and Ratio test by plotting the ratio of n^{th} and $(n + 1)^{th}$ term	n.				
CO3. Stu	dent would be able	to plot Complex n	numbers and their representations, Operations like addition, substraction, Multiplication,	Division, Modulus				
and Graph	nical representation	a of polar form.						
CO4: Stu	ident would be a	ble to perform fol	llowing task of matrix as Addition, Multiplication, Inverse, Transpose, Determinant	, Rank, Eigenvector				
Eigenvalu	es, Characteristic e	equation and verific	cation of the Cayley-Hamilton theorem, Solving the systems of linear equations.					
	Credits: 2		Core Compulsory/ Elective					
	Max. Marks: 100)	Min. Passing Marks: 33					
12. C		Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4						
Unit	Topics							
			Lecture					
		4	med in Computer Lab. ng Mathematica /MATLAB /Maple /Scilab/Maxima etc.					
	1. Plotting the gr	aphs of the followi	ng functions:	1				
	(i) ax							
	(ii) [x] (greatest	integer function)						
	(iii) x^{2n} ; $n \in \mathbb{N}$							
	(iv) x^{2n-1} ; $n \in \mathbb{N}$	1						
	(v) <u>∟:n∈N</u>							
	x ²ⁿ⁻¹							
	$(v_i) \stackrel{i}{\underset{x^{2m}}{}} n \in \mathbb{N}$							
				2				
		+ bl, c <u>,± la</u> x + bl						
	x^{2n} (vii) $\sqrt{ax} + b$, lax	+ bl, $c_{\pm} \frac{\pm lax}{ax}$ + bl $c_{sin}(\frac{1}{x})$, e^{x} , e^{-x} for	or $x \neq 0$.					
	$ \begin{array}{c} x^{2n} \\ (vii) \sqrt{ax} + b, \\ ix \\ (ix) \\ \hline x \\ x \\ \end{array}, \\ sin \left(\frac{i}{x} \right), \\ \end{array} $	$c \sin(\frac{1}{x}), e^{x}, e^{-x} fc$	or $x \neq 0$. (x + b), $\cos(ax + b)$, $\sin(ax + b)$, $\cos(ax + b)$.					

Bh

ugg	gested Readings
	(9) Matrix Operations: Addition, Multiplication, Inverse, Transpose, Determinant, Rank.
	(8) Complex numbers and their representations, Operations like addition, Multiplication, Division, Modulus. Graphical representation of polar form.
	(7) Obtaining surface of revolution of curves.
	(6) Graph of circular and hyperbolic functions.
	(5) Tracing of conic in Cartesian coordinates.
	 (3) Plotting the graphs of polynomial of degree 2,3, 4 and 5, and their first and second derivatives. (4) Sketching parametric curves, e.g., Trochoid, Cycloid, Epicycloid and Hypocycloid etc.
	$x = e^x$, $x^2 + 1 = e^x$, $1 - x^2 = e^x$, $x = \log_{10}(x)$, $\cos(x) = x$, $\sin(x) = x$, $\cos(y) = \cos(x)$, $\sin(y) = \sin(x)$ etc
	(2) By plotting the graph find the solution of the equation
	Observe and discuss the effect of changes in the real constants a and b on the graphs.

XV

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B.Sc. I (SEMESTER-II) PAPER-I Matrices and Differential Equations & Geometry

	e: Certificate	Year: First	Semester:	
lass: B.S.	e		Second	
			Subject: Mathematics	
	le: 0220301 B030201T		Course Title: Matrices and Differential Equations & Geometry	
Course out	comes:			
CO1: The s	ubjects of the co	ourse are designed in	such a way that they focus on developing mathematical skills in algebra, calculus and analysis a	and give
depth know	ledge of geometr	y, calculus, algebra a	and other theories.	
CO2: The s	tudent will be al	ble to find the rank,	eigen values of matrices and study the linear homogeneous and non-homogeneous equations. Th	e course
lifferential	equation intends	to develop problem	n solving skills for solving various types of differential equation and geometrical meaning of	differenti
equation.				
CO3: The	subjects learn ar	nd visualize the fund	damental ideas about coordinate geometry and learn to describe some of the surface by using	analytic
geometry.				
CO4: On s	uccessful compl	etion of the course	students have gained knowledge about regular geometrical figures and their properties. The	y have t
foundation f	or higher course	in Geometry.		
	Credits: 6		Core Compulsory	
N	Iax. Marks: 25-	+75	Min. Passing Marks:	
		Total No	o. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 6-0-0	
		PART	C-A. Matrices and Differential Equations	
Unit		PART	T-A. Matrices and Differential Equations Topics	No. of Lecture
	Types of Matrice	· ·	Topics	
1	Inverseof a Matri	s, Elementary operat	Topics tions on Matrices, Rank of a Matrix, Echelon form of a Matrix, Normal form of a Matrix, erations, System of linear homogeneous and non-homogeneous equations, Theorems on	
I	Inverseof a Matri consistency of a	is, Elementary operat ix by elementary ope system of linear equa	Topics tions on Matrices, Rank of a Matrix, Echelon form of a Matrix, Normal form of a Matrix, erations, System of linear homogeneous and non-homogeneous equations, Theorems on	Lecture
I 1	Inverseof a Matri consistency of a s Eigen values, Eig natrix,Complex	is, Elementary operat ix by elementary ope system of linear equa gen vectors and chara functions and separa	Topics tions on Matrices, Rank of a Matrix, Echelon form of a Matrix, Normal form of a Matrix, erations, System of linear homogeneous and non-homogeneous equations, Theorems on ations.	Lecture
I I I II I	Inverseof a Matri consistency of a Eigen values, Eig natrix,Complex and hyperbolic fu	is, Elementary operat ix by elementary ope system of linear equa gen vectors and chara functions and separa unctions.	Topics tions on Matrices, Rank of a Matrix, Echelon form of a Matrix, Normal form of a Matrix, erations, System of linear homogeneous and non-homogeneous equations, Theorems on ations. acteristic equation of a matrix, Caley-Hamilton theorem and its use in finding inverse of a tion into real and imaginary parts, Exponential and Logarithmic functions Inverse trigonometric	Lecture
I I I I I I I I I I I I I I I I I I I	Inverseof a Matri consistency of a s Bigen values, Eig matrix,Complex and hyperbolic fu Formation of diff Equationin which	es, Elementary operat ix by elementary ope system of linear equa gen vectors and chara functions and separa inctions. ferential equations, C h the variables are sep	Topics tions on Matrices, Rank of a Matrix, Echelon form of a Matrix, Normal form of a Matrix, erations, System of linear homogeneous and non-homogeneous equations, Theorems on ations. acteristic equation of a matrix, Caley-Hamilton theorem and its use in finding inverse of a	Lecture
	Inverseof a Matri consistency of a Eigen values, Eig natrix,Complex and hyperbolic fu Formation of diff Equationin which exact form, Lines	is, Elementary operat ix by elementary ope system of linear equa gen vectors and chara functions and separa inctions. ferential equations, C h the variables are sep ar equations.	Topics tions on Matrices, Rank of a Matrix, Echelon form of a Matrix, Normal form of a Matrix, erations, System of linear homogeneous and non-homogeneous equations, Theorems on ations. acteristic equation of a matrix, Caley-Hamilton theorem and its use in finding inverse of a tion into real and imaginary parts, Exponential and Logarithmic functions Inverse trigonometric Geometrical meaning of a differential equation, Equation of first order and first degree,	Lecture 12 11

PART-B. Geometry

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Uni	Topics		No. of Lectures
	V General equation of second degree, System of conics, Tracing of conics, Confocal conics in two dimentional geometry.		12
	/I Three-Dimensional Coordinates, Projection and Direction Cosine, Plane (Cartesian and vector form), Straight line in the	ree dimension.	11
	VII Sphere and Cone with related problems		11
	TII Cylinder, Definition only: Central conicoids, Paraboloids, Plane section of conicoids, Generating lines, Confocal	conicoids.	11
Su	gested Readings (PART-A Matrices and Differential Equations):		
1	. Stephen H. Friedberg, A.J Insel & L.E. Spence, Linear Algebra, Person		
2	. B. Rai, D.P. Choudhary & H. J. Freedman, A Course in Differential Equations, Narosa		
3	D.A. Murray, Introductory Course in Differential Equations, Orient Longman		
4	Suggested digital plateform:NPTEL/SWAYAM/MOOCs		
5	Course Books published in Hindi may be prescribed by the Universities.		
Su	gested Readings (Part-B Geometry):		
1.	Robert J. T Bell, Elementary Treatise on Coordinate Geometry of three dimensions, Macmillan India Ltd.		
2.	P.R. Vittal, Analytical Geometry 2d & 3D. Pearson.		
3.	S.L. Loney, The Elements of Coordinate Geometry, McMillan and Company, London.		
4.	R.J.T. Bill, Elementary Treatise on Coordinate Geometry of Three Dimensions, McMillan India Ltd., 1994.		
5.	Suggested digital plateform:NPTEL/SWAYAM/MOOCs		
6.	Course Books published in Hindi may be prescribed by the Universities.		
3CA	course can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), Economics(UG/PG), Co., (C.S.)	ommerce(UG),	BBA/
	Suggested Continuous Evaluation Methods: Max. Marks: 25		
S	Assessment Type	Ma	x. Marks
	Class Tests		10
	Online Quizzes/ Objective Tests		5
	Presentation		5
	Assignment		5
Cou	se prerequisites: To study this course, a student must have subject Mathematics in class 12th		
ug	ested equivalent online courses:		
urt	her Suggestions:		



B.Sc.(Mathematics)-II Year Diploma in Mathematics

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B.Sc.II (SEMESTER-III) PAPER-I Algebra & Mathematical Methods

	me: Diploma s: B.Sc.	Year: Second	Semester: Third	
			Subject: Mathematics	
	de: 0320301 : B030301T		Course Title: Algebra & Mathematical Methods	
theory and CO2: A sta in advance CO3: The CO4: On s	up theory is one of their properties. adent learning this d mathematics and course gives empl	s course gets a concept d Algebra. hasis to enhance students tion of the course stude	modern algebra. Objective of this course is to introduce students to basic concepts of Group, of Group, Ring, Integral Domain and their properties. This course will lead the student to ba s' knowledge of functions of two variables, Laplace Transforms, Fourier Series. ents should have knowledge about higher different mathematical methods and will help him	sic course
	Credits: 6		Core Compulsory	
	Max. Marks: 25+	-75	Min. Passing Marks:	
		Total No. of	Lectures-Tutorials-Practical (in hours per week): L-T-P: 6-0-0	
			Part-A. Algebra	
Unit			Topics	No. of Lecture
I	(CIE). Equivalence relat		natics and Mathematicians should be included under Continuous Internal Evaluation ngruence modulo n, Definition of a group with examples and simple properties, c groups.	12
11	Ũ		nutations, The alternating group, Cayley's theorem, Direct products, Coset its consequences, Fermat and Euler theorems	11
m	Normal subgroup on isomorphism.	os, Quotient groups, H	lomomorphism and isomorphism, Fundamental theorem of homomorphism, Theorems	11
IV	Rings, Subrings, quotient of an inte	-	elds, Characteristic of a ring, Ideal and quotient rings, Ring homomorphism, Field of	11

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	Part- B	
	Mathematical Methods	
Unit	Topics	No. of Lecture
v	Limit and Continuity of functions of two variables, Differentiation of function of two variables, Necessary and sufficient condition for differentiability of functions two variables, <u>Schwarz's</u> , <u>Young theorem</u> , <u>Taylor's theorem</u> (Statements only) for functions of two variables with examples, Maxima and minima for functions of two variables, Lagrange multiplier method(without proof), Jacobians.	12
VI	Existence theorems for Laplace transforms, Linearity of Laplace transform and their properties, Laplace transform of the derivatives and integrals of a function, Convolution theorem, inverse Laplace transforms, Solution of the differential equations using Laplace transforms.	11
VII	Fourier series, Fourier expansion of piecewise monotonic functions, Half and full range expansions, Fourier transforms (finite and infinite).	11
vш	Calculus of variations-Variational problems with fixed boundaries- Euler's equation for functionals containing first order derivative and one independent variable, Extremals, Functionals dependent on higher order derivatives.	11
 Suggester T.M. G.F. S Erwir Suggester Suggester Course Course 	A. Herstein, Topics in Algebra, John Wiley & Sons ggested digital plateform: NPTEL/SWAYAM/MOOCS burse Books published in Hindi may be prescribed by the Universities. ed Readings (Part- B Mathematical Methods): Apostal, Mathematical Analysis, Person Simmons, Differential Equations with Application and Historical Notes, Tata -McGrawHill a Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons. ested digital plateform: NPTEL/SWAYAM/MOOCs se Books published in Hindi may be prescribed by the Universities. se can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25	
S .	Assessment Ma Type	ax. Marks
Class	Tests	10
Onli	ne Quizzes/ Objective Tests	5
Prese	Intation	5
Assig	nment (Introduction to Indian ancient Mathematics and Mathematicians)	5
Course p	rerequisites: To study this course, a student must have subject Mathematics in class 12th	
uggester	d equivalent online courses:	
urther S	Suggestions:	_

B.Sc. II (SEMESTER-IV) PAPER-I Differential Equations & Mechanics

-	me: Diploma	Year: Second	Semester: Fourth	
Class: B	,Sc.			
			Subject: Mathematics	
	Code: 0420301 le: B030401T		Course Title: Differential Equations & Mechanics	
Course o	utcomes:			
CO1: Th	e objective of th	is course is to famili	iarize the students with various methods of solving differential equations, partial differential equation	ons of fir
order and	second order an	d to have qualitative	applications.	
C O2: A s	student doing thi	s course is able to so	olve differential equations and is able to model problems in nature using ordinary differential equat	tions. Afte
completir	ng this course, a	student will be able	to take more courses on wave equation, heat equation, diffusion equation, gas dynamics, non linea	r evolutio
equation	etc. These entire	courses are importan	nt in engineering and industrial applications for solving boundary value problem.	
CO3: Th	e object of the pa	per is to give student	ts knowledge of basic mechanics such as simple harmonic motion, motion under other laws and force	es.
CO4: Th	e student, after c	ompleting the course	e can go for higher problems in mechanic such as hydrodynamics, this will be helpful in getting emp	loyment i
industry.				
	Credits: 6	ļ	Core Compulsory / Elective	
	Max. Marks: 7	25+75	Min. Passing Marks:	
		Total	No. of Lectures-Tutorials-Practical (in hours per week); L-T-P: 6-0-0	
		Total	No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 6-0-0 Part- A	
		Total	Part-A	
		Total l		
Unit	1	Total I	Part-A	No. of
Unit			Part- A Differential Equations Topics	No. of Lecture
Unit		linear differential equ	Part- A Differential Equations Topics uations with variable coefficients: Use of a known solution to find another, normal form, method	Lecture
Unit	of undetermin	linear differential equ ed coefficient, variati	Part- A Differential Equations Topics uations with variable coefficients: Use of a known solution to find another, normal form, method ion of parameters.	
	of undetermin	linear differential equ ed coefficient, variati ea of Power series so	Part- A Differential Equations Topics uations with variable coefficients: Use of a known solution to find another, normal form, method	Lecture
I	of undetermin Elementary id their propertie	linear differential equ ed coefficient, variati ea of Power series so s	Part- A Differential Equations Topics uations with variable coefficients: Use of a known solution to find another, normal form, method ion of parameters.	Lecture
I	of undetermin Elementary id their propertie Origin of first	linear differential equ ed coefficient, variati ea of Power series so s order partial differen	Part- A Differential Equations Topics uations with variable coefficients: Use of a known solution to find another, normal form, method ion of parameters. olutions of second order ordinary differential equations(ODE); Bessels and Legender functions and	Lecture
I N	of undetermin Elementary id their propertie Origin of first Partial differen	linear differential equ ed coefficient, variati ea of Power series so s order partial differen ntial equation of first	Part- A Differential Equations Topics uations with variable coefficients: Use of a known solution to find another, normal form, method ion of parameters. olutions of second order ordinary differential equations(ODE); Bessels and Legender functions and ntial equations. Partial differential equations of the first order and degree one, Lagrange's solution,	11 12

Part- B
Mechanics

UG MATHEMATICS

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Unit	Topic s	No. of Lecture s
v	Frame of reference, work energy principle, Forces in three dimensions, Poinsot's central axis, Wrenches, Null lines and planes.	11
VI	Virtual work, Stable and Unstable equilibrium.	11
VI	Velocities and accelerations along radial and transverse directions, and along tangential and normal directions, Simple Harmonic motion, Motion under other law of forces. Elastic strings, Motion in resisting medium,	11
VII	I Constrained motion, Motion on smooth and rough plane curves. Central orbit, Kepler's laws of motion, Motion of particle in three dimensions	12
Sugges	ted Readings(Part-A Differential Equations):	
1. G.F.	Simmons, Differential Equations with Application and Historical Notes, Tata -McGrawHill	
2. B. R	ai, D.P. Choudhary & H. J. Freedman, A Course of Ordinary Differential Equations, Narosa	
3. Ian I	N. Snedden, Elements of Partial Differential Equations, Dover Publication	
4. L.E.	Elsgolts, Differential Equation and Calculus of variations, University Press of the Pacific.	
5. Sug	gested digital plateform:NPTEL/SWAYAM/MOOCs	
6. Cou	rse Books published in Hindi may be prescribed by the Universities.	
Sugges	ted Readings(Part-B Mechanics):	
l. R.	C. Hibbeler, Engineering Mechanics-Statics, Prentics Hall Publishers	
2. R	C. Hibbeler, Engineering Mechanics-Dynamics, Prentics Hall Publishers	
3. A	Nelson, Engineering Mechanics Statics and Dynamics, Tata McGraw Hill	
4. J.	L. Synge & B.A. Griffith, Principles of Mechanics, Tata McGraw Hill	
5. Si	aggested digital plateform:NPTEL/SWAYAM/MOOCs	
6. C	purse Books published in Hindi may be prescribed by the Universities.	
his cou	rse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), Economics(UG/PG), B.Sc.(C.S.)	
	Suggested Continuous Evaluation Methods: Max. Marks: 25	
	Assessment Ma Type	x. Marks
Clas	is Tests	10
On	line Quizzes/ Objective Tests	5
Pres	ientation	5
Assi	gament	5
ourse	prerequisites: To study this course, a student must have Certificate Course in Applied Mathematics	
aggest	ed equivalent online courses:	
urther	Suggestions:	

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B.Sc.(Mathematics)-III Year Degree in Mathematics

B.Sc. III (SEMESTER-V) PAPER-I Group and Ring Theory & Linear Algebra

0	ne: Degree	Year: Third	Semester: Fifth	
Class: B.S	Sc.		Subject: Mathematics	_
			Subject: Mathematics	
	ode: 0520301 :: B030501T		Course Title: Group and Ring Theory & Linear Algebra	
Course ou	tcomes:			
ndsome o CO2: Stud he relevan CO3: The	f its applications. lents will be able it fields. student will use t	to know the concepts of g	nnches of science. The objective of this course is to introduce a student to the basics of linear a group, ring and other related properties which will prepare the students to take up further appli er science, finance mathematics, industrial mathematics and bio mathematics. After completion	cations in
	Credits: 5		Core Compulsory	
	Max. Marks: 25	+75	Min. Passing Marks: 33	
		Total No. of Lectu	res-Tutorials-Practical (in hours per week): L-T-P: 5-0-0	
			PART-A	
			Group and Ring Theory	
				No. of
Unit			Topics	Lecture
Unit I	(CIE).		Topics atics and Mathematicians should be included under Continuous Internal Evaluation omorphism groups, Automorphism groups of finite and infinite cyclic groups.	
	(CIE). Automorphism,	inner automorphism, Aut	atics and Mathematicians should be included under Continuous Internal Evaluation	Lecture
I	(CIE). Automorphism, Characteristic su Polynomial ring	inner automorphism, Aut bgroups, Commutator sul s over commutative rir	atics and Mathematicians should be included under Continuous Internal Evaluation omorphism groups, Automorphism groups of finite and infinite cyclic groups.	Lecture

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	PART-B Linear Algebra	
Unit	Topics	No, of Lectures
v	Vector spaces, Subspaces, Linear independence and dependence of vectors, Basis and Dimension, direct sum and Quotient space.	10
VI	Linear transformations, The Algebra of linear transformations, rank and null space,	9
VII	Rank nullity theorem, their representation as matrices., Change of basis, Characteristic values, Cayley Hamilton Theorem.	9
VIII	Inner product spaces and norms, Cauchy-Schwarz inequality, Orthogonal vectors, Orthonormal sets and bases, Bessel's inequality for finite dimensional spaces, Gram-Schmidt orthogonalization process.	9
	se can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), BCA, B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks; 25	
S N	Assessment Type Max. N	Marks
Class	s Tests	10
2 Onli	ine Quizzes/ Objective Tests	5
Press	entation	5
Assig	gnment (Introduction to Indian ancient Mathematics and Mathematicians)	5
Course p	rerequisites: To study this course, a student must have Diploma in Mathematics	
Suggeste	d equivalent online courses:	
Further S	Suggestions:	
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B.Sc. III (SEMESTER-V) PAPER-II (i) Number Theory & Game Theory

Program Class: B	me: Degree .Sc.	Year: Third	Semester: Sixth	
			Subject: Mathematics	
Course C Code: B0	Code: 0520302 030502T		Course Title: Number Theory & Game Theory	
Course o	utcomes:			
CO1: Up elementar		pletion, students will	l have the knowledge and skills to solve problems in elementary number theory and also apply	
aumber th	eory to cryptograp	phy.		
the: CO3: A s stra	refore help improv situation is strategi itegic.	e decision making.	s. It is aimed at explaining and predicting how individuals behave in a specific strategic situ decision problem depends on the choices of more than one person. Most decision problems in r ples, case studies, and classroom experiments might be used.	
	Credits: 5		Elective	
	Max. Marks: 25	+75	Min. Passing Marks: 33	
		Total No.	. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 5-0-0	
			Part- A	11
			Number Theory	
Unit			Topics	No. of Lectures
I		clidean algorithm; prim	mes; congruences; Fermat's theorem, Euler's theorem and Wilson's theorem; Fermat's uences; solutions of congruences; Chinese remainder theorem.	10
и		dulo powers of prime on and Euler's phi Fur	; primitive roots and their existence; quadratic residues; Legendre symbol, Jacobi symbol, netion.	9
ш	Diophantine Equipolations of ax diophantine equip	+ by = c, $x^n + y^n = z$	r; properties of Pythagorean triples; sums of two and four squares; assorted examples of	9
IV	Generating Fun Summation Me	thod. Recurrence Re	nce Relations lating coefficient of generating functions, Partitions, Exponential Generating Functions, A elations: Recurrence Relation Models, Divide and conquer Relations, Solution of Linear, omogeneous Recurrence Relations, Solutions with Generating Functions.	9

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	Part-B	
Uni	Game Theory t Topic s	No. of Lectur
v	Introduction, overview, uses of game theory, some applications and examples, and formal definitions of: the normal form, payoffs, strategies, pure strategy Nash equilibrium.	10
VI	Introduction, characteristic of game theory, Two- person zero-sum game, Pure and Mixed strategies, Saddle point and its existence.	10
VI	Fundamental Theorem of Rectangular games, Concept of Dominance, Dominance and Graphical method of solving Rectangulargames.	9
VII	Relationship between rectangular game and Linear Programming Problem, Solving rectangular game by Simplex method, reduction of m x n game and solution of 2x2, 2 x s, and r x 2 cases by graphical method.	9
1. Mart 2. Vijay 3. Prajit 5. Allar 5. Sugg 7. Cour	ted Readings (Part-B Game Theory): in Osborne, An Introduction to Game Theory, Oxford University Press, 2003 v Krishna, Game Theory, Academic Press. Dutta, Strategies and Games, MIT Press, (Website 1) <u>http://www.ccc.stevens-tech.edu/-ccommis/ccs00c.html</u> i MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 ested digital plateform:NPTEL/SWAYAM/MOOCS see Books published in Hindi may be prescribed by the Universities. urse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.)	
1. Mart 2. Vijay 3. Prajit 5. Allar 5. Sugg 7. Cour	in Osborne, An Introduction to Game Theory, Oxford University Press, 2003 Krishna, Game Theory, Academic Press. Dutta, Strategies and Games, MIT Press, (Website 1) <u>http://www.ccc.stevens-tech.edu/-ccommic/ccs00c.html</u> MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 ested digital plateform:NPTEL/SWAYAM/MOOCS se Books published in Hindi may be prescribed by the Universities.	
1. Mart 2. Vijay 3. Prajit 5. Alłar 5. Sugg 7. Cour This co	in Osborne, An Introduction to Game Theory, Oxford University Press, 2003 • Krishna, Game Theory, Academic Press. Dutta, Strategies and Games, MIT Press, (Website 1) http://www.ccc.stovens-tech.cdu/-ccommic/ceROQc.html • MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 ested digital plateform:NPTEL/SWAYAM/MOOCS see Books published in Hindi may be prescribed by the Universities. urse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25	x. Marks
. Mart 2. Vijay 5. Prajit 5. Altar 5. Sugg 7. Cour This co	in Osborne, An Introduction to Game Theory, Oxford University Press, 2003 ¹ Krishna, Game Theory, Academic Press. Dutta, Strategies and Games, MIT Press, (Website 1) <u>http://www.ccc.stevens-tech.cdu/~ccomanic/ceR00c.html</u> ¹ MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 ested digital plateform:NPTEL/SWAYAM/MOOCS se Books published in Hindi may be prescribed by the Universities. urse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Ma	x. Marks
. Mart 2. Vijay 3. Prajit 5. Altar 5. Sugg 7. Cour This co	in Osborne, An Introduction to Game Theory, Oxford University Press, 2003 'Krishna, Game Theory, Academic Press. Dutta, Strategies and Games, MIT Press, (Website 1) http://www.ccc.stevens-tech.edu/-ccommis/ccst00c.html i MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 ested digital plateform:NPTEL/SWAYAM/MOOCS see Books published in Hindi may be prescribed by the Universities. urse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Ma Type	
1. Mart 2. Vijay 3. Prajit 5. Altar 5. Sugg 7. Cour This co 1. Cla 2. Or	in Osborne, An Introduction to Game Theory, Oxford University Press, 2003 Krishna, Game Theory, Academic Press. Dutta, Strategies and Games, MIT Press, (Website 1) http://www.ecc.stevens-tech.edu/-ecommil/ectR00c.html a MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 ested digital plateform:NPTEL/SWAYAM/MOOCS se Books published in Hindi may be prescribed by the Universities. urse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Type ss Tests Ma	10
I. Mart 2. Vijay 3. Prajit 5. Alłar 5. Sugg 7. Cour Fhis co Fhis co	in Osborne, An Introduction to Game Theory, Oxford University Press, 2003 V Krishna, Game Theory, Academic Press. Dutta, Strategies and Games, MIT Press, (Website 1) http://www.ccc.stevens-tech.edu/-ccommin/centrol/c.html MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 ested digital plateform:NPTEL/SWAYAM/MOOCS see Books published in Hindi may be prescribed by the Universities. urse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Type ss Tests Uline Quizzes/ Objective Tests	10 5
1. Mart 2. Vijay 3. Prajit 5. Allar 5. Sugg 7. Cour This co This co S V 1 Cla 2 Or 3 Pre 4 Ass	in Osborne, An Introduction to Game Theory, Oxford University Press, 2003 Krishna, Game Theory, Academic Press. Dutta, Strategies and Games, MIT Press, (Website 1) http://www.ecc.stevens-tech.edu/-ecomunicetaBD2.html MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 ested digital plateform:NPTEL/SWAYAM/MOOCS se Books published in Hindi may be prescribed by the Universities. urse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Ma Type ss Tests bline Quizzes/ Objective Tests sentation Ma	10 5 5
1. Mart 2. Vijay 3. Prajit 5. Altar 5. Sugg 7. Cour 7. Cour 7. Cour 7. Cour 8. V 1. Cla 8. V 1. Cla 8. V 2. Or 8. Pre 4. Ass 2. Course	in Osborne, An Introduction to Game Theory, Oxford University Press, 2003 Krishna, Game Theory, Academic Press. Dutta, Strategies and Games, MIT Press, (Website 1) http://www.ecc.stovens-tech.edu/~ccommit@em09c.html MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 ested digital plateform:NPTEL/SWAYAM/MOOCS se Books published in Hindi may be prescribed by the Universities. urse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Type ss Tests dine Quizzes/ Objective Tests sentation ignment Ma	10 5 5

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B.Sc. III (SEMESTER-V) PAPER-II (ii) Graph Theory & Discrete Mathematics

Class: B	nme: Degree 3.Sc.	Year: Third	Semester: Sixth	
			Subject: Mathematics	
	Code: 0520303 de: B030502T		Course Title: Graph Theory & Discrete Mathematics	
Course o	outcomes:			
CO1: Uş	oon successful com	pletion, students will l	have the knowledge of various types of graphs, their terminology and applications.	
C O2: Af	fter Successful con	apletion of this course	students will be able to understand the isomorphism and homomorphism of graphs. This cours	e covers th
		•	e and other disciplines. The topics include path, circuits, adjacency matrix, tree, coloring Afte e knowledge graph coloring, color problem, vertex coloring.	er successfu
			It have the knowledge of Logic gates, Karnaugh maps and skills to proof by using truth ta be able to apply the basics of the automation theory, transition function and table.	bles. Afte
topics inc knowledg	clude logic, count: ge in	ng, relations, hasse d	screte mathematics used in computer science and other disciplines that involve formal reasoning iagram and Boolean algebra. After successful completion of this course the student will have discrete structures and Applications.	
_	Credits: 5		Elective	
	Max. Marks: 25	5+75	Min. Passing Marks: 33	
		Total No.	of Lectures-Tutorials-Practical (in hours per week): L-T-P: 5-0-0	
			Part- A Graph Theory	
Unit	nit Topics			
1	Introduction to graphs, basic properties of graphs, Simple graph, multi graph, graph terminology, representation of graphs, Bipartite, regular, planar and connected graphs, connected components in a graph, Euler graphs, Directed, Undirected, multi-graph, mixed graph.			
				No. of Lectures
u U	mixed graph. Walk and unilat	r, planar and connected		Lectures
	mixed graph. Walk and unilat and homomorph Operation of gr	r, planar and connected eral components, unice usm of graphs, Incider aph circuit, Path and	d graphs, connected components in a graph, Euler graphs, Directed, Undirected, multi-graph, ursal graph, Hamiltonian path and circuits, Graph colouring, chromatics number, isomorphism	Lecture:

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	Part- B	
	Discrete Mathematics	
Unit	Topics	No. of Lecture
v	Propositional Logic- Proposition logic, basic logic, logical connectives, truth tables, tautologics, contradiction, normal forms (conjunctive and disjunctive), modus ponens and modus tollens, validity, predicate logic, universal and existential quantification, proofby implication, converse, inverse contrapositive, contradiction, direct proof by using truth table.	10
v	Relation- Definition, types of relation, domain and range of a relation, pictorial representation of relation, properties of relation, partial ordering relation, Representation of Posets using Hasse Diagram, Chains, Maximal and Minimal Point, Glb, Lub, Lattices and its basic properties	10
v	II Boolean Algebra- Basic definitions, Sum of products and products of sums, Logic gates Switching Circuits and Karnaugh maps	9
V	II Combinatories- Inclusion- exclusion, recurrence relations (nth order recurrence relation with constant coefficients, Homogeneous recurrence relations), generating function (closed form expression, properties of G.F., solution of recurrence relations using G.F. solution of combinatorial problem using G.F.)	9
1. Dis 2. Dis Ma Ros 4. Sug 5. Cou	sted Readings (Part-B Discrete Mathematics): crete Mathematics by C. L.Liu. crete Mathematics with computer application by Trembley and nohar.3.Discrete Mathematics and Its Applications by Kenneth H. en gested digital plateform:NPTEL/SWAYAM/MOOCS trse Books published in Hindi may be prescribed by the Universities. ourse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.)	
	Suggested Continuous Evaluation Methods: Max. Marks: 25	
SN	Assessment Type Max. N	larks
1 0	lass Tests	10
2 0	Online Quizzes/ Objective Tests	5
3 P	resentation	5
4 A	ssignment	5
Cours	e prerequisites: To study this course, a student must have Diploma in Mathematics	
	sted equivalent online courses:	
Furth	er Suggestions:	

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B.Sc. III (SEMESTER-V) PAPER-II (iii) Differential Geometry & Tensor Analysis

Program Class: B	nme: Degree 3.Sc.	Year: Third	Semester: Sixth	
			Subject: Mathematics	
	Code: 0520304 de: B030502T		Course Title: Differential Geometry & Tensor Analysis	
Course o	outcomes:			
CO1: Af CO2: Th	ter Successful con	pletion of this course, s the Local theory of Cu	students should be able to determine and calculate curvature of curves in different coordinate systemes, Local theory of surfaces, Geodesics, Geodesics curvature, Geodesic polars, Curvature o	tems. If curves
on surfac	es, Gaussian curve	ature, Normal curvature	e etc.	
	er Successful comp instein space and F		tudents should have the knowledge of tensor algebra, different types of tensors, Riemannian sp	pace, Ricci
	Credits: 5		Elective	
	Max. Marks: 25	5+75	Min. Passing Marks: 33	1.1.4
		Total No.	of Lectures-Tutorials-Practical (in hours per week): L-T-P: 5-0-0	
			Part- A	
			Differential Geometry	
				No. of
Unit			Topics	Lectures
I	Local theory of curves-Space curves, Examples, Plane Curves, tangent and normal and binormal, Osculating Plane, normal plane and rectifying plane, Osculating circle, osculating sphere Helices, Serret-Frenet apparatus, contact between curve and surfaces, tangent surfaces, involutes and evolutes of curves, Bertrand curves, Intrinsic equations, fundamental existence theorem for space curves.			10
п			patches on surface curve of a surface, family of surfaces (one parameter), edge of urfaces and developable surfaces, surfaces of revolution, Helicoids.	9
III			c length, Direction coefficients, families of curves, intrinsic properties, geodesics, roperties of geodesics, geodesics curvature, Geodesic polars.	9
IV			urves on surfaces, Gaussian curvature, normal curvature, Meusneir's theorem, mean points, lines of curvature, Rodrigue's formula, Euler's theorem.	9

	Part- B			
	Tensor Analysis			
Unit Topic §				
v	Tensor algebra: Vector spaces, the dual spaces, tensor product of vector spaces, transformation formulae, contraction, special tensors-symmetric tensor, inner product, associated tensor with examples.	10		
VI	Tensor Analysis: Contravariant and covariant vectors and tensors, Mixed tensors, Symmetric and skew-symmetric tensors, Algebra tensors, Contraction and inner product, Quotient theorem, Reciprocal tensors, Christoffel's symbols, Law of transformation of Christoffel's symbols, Covariant differentiation, non- commutativity of Covariant derivative.			
VII	Gradient of scalars, Divergence of a contravariant vector, covariant vector and conservative vectors, Laplacian of an invariant, curl of acovariant vector, irrotational vector, with examples.	f 9		
VIЦ	Riemannian space, Riemannian curvatures and their properties, geodesics, geodesic curvature, geometrical interpretation of curvaturetensor, Ricci tensor, scalar curvature, Einstein space and Einstein tensor.	9		
Suggeste	d Readings (Part-A Differential Geometry):			
 B. Ar Te Sug 10. Co Suggestee Ter David R. Sugg 	 Lang, Fundamentals of Differential Geometry, Springer, 1999. Spain, Tensor Calculus: A Concise Course, Dover Publications, 2003. Introduction to Differential Geometry (with the use of tensor Calculus), L. P. Eisenhart, Princeton University Press, 1940. nsor Analysis, Theory and Applications to Geometry and Mechanics of Continua, 2nd Edition, I. S. Sokolnikoff, John Wiley and Sons., gested digital plateform:NPTEL/SWAYAM/MOOCs urse Books published in Hindi may be prescribed by the Universities. d Readings (Part-B Tensor Analysis): usors- Mathematics of Differential Geometry by Z. Ahsan, PHI,2015 vid C. Kay, Tensor Analysis, Schaum's Outline Series, McGraw Hill 1988. S, Mishra, A Course in Tensors with Applications to Reimannian Geometry, Pothishala Pvt. Ltd, Allahabad. gested digital plateform:NPTEL/SWAYAM/MOOCS rse Books published in Hindi may be prescribed by the Universities. 	1964.		
This cour	se can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.)			
	Suggested Continuous Evaluation Methods: Max. Marks: 25			
Sn	Assessment Type Max	Marks		
Class	Tests	10		
2 Onli	ne Quizzes/ Objective Tests	5		
B Prese	intation	5		
	nmant	-		
4 Assig		5		
	rerequisites: To study this course, a student must have Diploma in Mathematics	5		

UG MATHEMATICS

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B.Sc. III (SEMESTER-VI) PAPER-I METRIC SPACES & COMPLEX ANALYSIS

Programme: D Class: B.Sc.	Degree Year: Thi	ird	Semester: Sixth	
			Subject: Mathematics	
Course Code: NEP Code: B0.			Course Title: METRIC SPACES & COMPLEX ANALYSIS	
Course outcom	nes:			
CO1: The cours	se is aimed at exposing the	students t	o foundations of analysis which will be useful in understanding various physical phenom	ena and gives
he student the f	foundation in mathematics.			
CO2: After con	npletion of this course the s	student wil	have rigorous and deeper understanding of fundamental concepts in Mathematics. This	will be helpful
o the student in	understanding pure mathe	matics and	d in research.	
CO3: Students	will be able to know the c	oncepts of	metric space, basic concepts and developments of complex analysis which will prepare t	he students to
ake up further a	applications in the relevant	fields		
	Credits: 4		Core Compulsory	
Max	. Marks: 25+75		Min. Passing Marks: 33	
Unit			Part- A. Metric Spaces	New
Unit			Topics	No. of Lectures
Bas	ic Concepts			
I Met	ric spaces: Definition and o	examples,	diameters in Metric Space, Bounded and Unbounded Metric Space.	8
Тор	ology of Metric Spaces			
	n and closed ball, Neighbo Subspaces, Dense set.	rhood, Op	en set, Interior of a set, limit point of a set, derived set, closed set, closure of a	8
TTT	npleteness in Metric Spac		ences, Complete metric space with Examples, Cantor intersection Theorem	
	actives in mente spaces, ca			7
Cor	ntinuity & Uniform Conti		Metric Spaces	7

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	Part- B	
	Complex Analysis	-
Unit	Topics	No. of Lecture
•	Functions of complex variable, Mappings; Mappings by the exponential function, Limits, Theorems on limits, Limits involving the point at infinity, Continuity, Derivatives, Differentiation formulae,	8
v	Cauchy-Riemann equations, Sufficient conditions for differentiability; Analytic functions and their examples, Harmonic Function, method of construction of a regular function(Milne-Thomson's Method.	8
v	II Conformal Mapping, necc. & suff. Condition; inverse point, bilinear transformation, critical point, cross ratio, fixed point.	7
V	III Exponential functions, Logarithmic functions, branches and derivative of logarithmic function, Trigonometric functions, Derivative of functions. Definite integral of functions, contours, contour integrals and its examples, upper bound for moduli of contour integrals	7
6. Co	ggested digital plateform:NPTEL/SWAYAM/MOOCS. arse Books published in Hindi may be prescribed by the Universities. ested Readings (Part-B Complex Analysis):	
6. Con Sugge 1. Fun 2. Con 3. Sug 4. Con	urse Books published in Hindi may be prescribed by the Universities.	
6. Con Sugge 1. Fun 2. Con 3. Sug 4. Con This c	arse Books published in Hindi may be prescribed by the Universities. ested Readings (Part-B Complex Analysis): ction of Complex Variable by Shanti Narain. mplex variable and applications by Brown & Churchill. rgested digital plateform:NPTEL/SWAYAM/MOOCS. arse Books published in Hindi may be prescribed by the Universities. ourse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Max	c. Marks
6. Con Sugge 1. Fun 2. Con 3. Sug 4. Con This c	arse Books published in Hindi may be prescribed by the Universities. ested Readings (Part-B Complex Analysis): ction of Complex Variable by Shanti Narain. mplex variable and applications by Brown & Churchill. rgested digital plateform:NPTEL/SWAYAM/MOOCS. mrse Books published in Hindi may be prescribed by the Universities. ourse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Type Max	
6. Con Sugge 1. Fun 2. Con 3. Sug 4. Con This c N 1 C	arse Books published in Hindi may be prescribed by the Universities. ested Readings (Part-B Complex Analysis): ction of Complex Variable by Shanti Narain. mplex variable and applications by Brown & Churchill. rgested digital plateform:NPTEL/SWAYAM/MOOCS. mrse Books published in Hindi may be prescribed by the Universities. ourse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Type lass Tests	10
6. Con Sugge 1. Fun 2. Con 3. Sug 4. Con This c S N 1 C 2 C	arse Books published in Hindi may be prescribed by the Universities. ested Readings (Part-B Complex Analysis): ction of Complex Variable by Shanti Narain. mplex variable and applications by Brown & Churchill. rgested digital plateform:NPTEL/SWAYAM/MOOCS. arse Books published in Hindi may be prescribed by the Universities. ourse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Type lass Tests Duline Quizzes/Objective Tests	10 5
6. Con Sugg 1. Fun 2. Con 3. Sug 4. Con This c S N 1 C 2 (3 P	arse Books published in Hindi may be prescribed by the Universities. ested Readings (Part-B Complex Analysis): ction of Complex Variable by Shanti Narain. mplex variable and applications by Brown & Churchill. rgested digital plateform:NPTEL/SWAYAM/MOOCS. mase Books published in Hindi may be prescribed by the Universities. ourse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Type lass Tests Dnline Quizzes/Objective Tests resentation	10
6. Con Sugg 1. Fun 2. Con 3. Sug 4. Con This c S N 1 C 2 (3 P 4 4 A	arse Books published in Hindi may be prescribed by the Universities. ested Readings (Part-B Complex Analysis): ction of Complex Variable by Shanti Narain. mplex variable and applications by Brown & Churchill. ggested digital plateform:NPTEL/SWAYAM/MOOCS. mase Books published in Hindi may be prescribed by the Universities. ourse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Type lass Tests Duline Quizzes/ Objective Tests resentation ssignment	10 5 5
6. Course Sugge 1. Fun 2. Coi 3. Sug 4. Course S N 1 Course Course	arse Books published in Hindi may be prescribed by the Universities. ested Readings (Part-B Complex Analysis): ction of Complex Variable by Shanti Narain. mplex variable and applications by Brown & Churchill. rgested digital plateform:NPTEL/SWAYAM/MOOCS. mase Books published in Hindi may be prescribed by the Universities. ourse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Type lass Tests Dnline Quizzes/Objective Tests resentation	10 5 5

UG MATHEMATICS

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-	nme: Degree	Year: Third	Semester: Sixth		
Class: B	l.Sc.				
	the second of		Subject: Mathematics		
	Code: 0620302 de: B030602T		Course Title: Numerical Analysis & Operations Research		
Course o	utcomes:				
CO1: Th	e aim of this cours	se is to teach the stude	ent the application of various numerical technique for variety of problems occurring in daily life. A	t the end	
ofthe cou	irse the student will	ll be able to understar	nd the basic concept of Numerical Analysis and to solve algebraic and differential equation.		
CO2: Th	ie main outcome	will be that students	will be able to handle problems and finding approximated solution. Later he can opt for advance	ce course	
in Numer	rical Analysis in hi	igher Mathematics.			
CO3: Th	e student will be a	ble to solve various p	problems based on convex sets and linear programming. After successful completion of this paper	will	
	e students to appl on of operations	ly the basic concepts	s of transportation problems and its related problems to apply in further concepts and	I	
	Credits: 4		Core Compulsory		
Max. Marks: 25+75			Min. Passing Marks: 33		
Max. Ma	urks: 25+75		Min. Passing Marks: 33		
Max. Ma	urks: 25+75	Total No	Min. Passing Marks: 33 . of Lectures-Tutorials-Practical (in bours per week): L-T-P: 4-0-0		
Max. Ma	urks: 25+75	Total No			
Max. Ma	urks: 25+75	Total No	o. of Lectures-Tutorials-Practical (in bours per week): L-T-P: 4-0-0		
Max. Ma Unit	urks: 25+75	Total No	o. of Lectures-Tutorials-Practical (in bours per week): L-T-P: 4-0-0 PART-A	No. o	
			o. of Lectures-Tutorials-Practical (in bours per week): L-T-P: 4-0-0 PART-A Numerical Analysis Topics	No. o Lectur	
	 ¡Errors in compu	itations, floating poin	e. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0 PART-A Numerical Analysis Topics		
Unit	Errors in compu- relative errors, o	itations, floating poin	e. of Lectures-Tutorials-Practical (in bours per week): L-T-P: 4-0-0 PART-A Numerical Analysis Topics at representation of numbers, significant digits, rounding and chopping errors, absolute and s using differentials, truncation errors. Solution of algebraic and transcendental equations;	Lectur	
Unit	Errors in compu relative errors, o bisection, Secar	utations, floating poin computation of errors nt, Regular Falsi, New	e. of Lectures-Tutorials-Practical (in bours per week): L-T-P: 4-0-0 PART-A Numerical Analysis Topics at representation of numbers, significant digits, rounding and chopping errors, absolute and s using differentials, truncation errors. Solution of algebraic and transcendental equations; vton Raphson's method, Newton's method for multiple roots.	Lectur	
Unit	Errors in compu relative errors, o bisection, Secar	itations, floating poin computation of errors nt, Regular Falsi, New e differences, Interpo	e. of Lectures-Tutorials-Practical (in bours per week): L-T-P: 4-0-0 PART-A Numerical Analysis Topics at representation of numbers, significant digits, rounding and chopping errors, absolute and s using differentials, truncation errors. Solution of algebraic and transcendental equations;	Lectur 8	
Unit I	Errors in compu- relative errors, of bisection, Secar Caculus of finit formula using d	ntations, floating poin computation of errors nt, Regular Falsi, New e differences, Interpo ifferences.	e. of Lectures-Tutorials-Practical (in bours per week): L-T-P: 4-0-0 PART-A Numerical Analysis Topics at representation of numbers, significant digits, rounding and chopping errors, absolute and s using differentials, truncation errors. Solution of algebraic and transcendental equations; vton Raphson's method, Newton's method for multiple roots.	Lectur 8	
Unit I II	Errors in compu relative errors, o bisection, Secar Caculus of finit formula using d Numerical diffe	utations, floating poin computation of errors nt, Regular Falsi, New e differences, Interpo ifferences. rentiation using New	e. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0 PART-A Numerical Analysis Topics It representation of numbers, significant digits, rounding and chopping errors, absolute and susing differentials, truncation errors. Solution of algebraic and transcendental equations; vton Raphson's method, Newton's method for multiple roots.	Lectur 8 8	
Unit I II	Errors in compu relative errors, o bisection, Secar Caculus of finit formula using d Numerical diffe formula. Numer	itations, floating poin computation of errors nt, Regular Falsi, New e differences, Interpo ifferences. rentiation using New rical Integration: Trap	e. of Lectures-Tutorials-Practical (in bours per week): L-T-P: 4-0-0 PART-A Numerical Analysis Topics at representation of numbers, significant digits, rounding and chopping errors, absolute and e using differentials, truncation errors. Solution of algebraic and transcendental equations; vton Raphson's method, Newton's method for multiple roots. dation, Lagrange and Hermite interpolation, Newton's Divided difference formula, Interpolation ton's forwarded and backward formula, differentiation by central and divided difference	Lectur 8 8	

B.Sc. III (SEMESTER-VI) PAPER-II Numerical Analysis & Operation Research

C

Unit	Topics	No. of Lecture					
v	Introduction, Linear programming problems, statement and formation of general linear programming problems, graphical method, slack and surplus variables, standard and matrix forms of linear programming problem, basic feasible solution.						
V	Convex sets, fundamental theorem of linear programming, basic solution, Simplex method, introduction to artificial variables, two phase method Big-M method and their comparison.	8					
V	I Resolution of degeneracy, duality in linear programming problems, primal dual relationships, revised simplex method, sensitivity analysis.	7					
VI	II Transportation problems, assignment problems.	7					
Sugg	ested Readings(Part-A Numerical Analysis):						
l. Nur	nerical Methods for Engineering and scientific computation by M. K. Jain, S.R.K. Iyengar & R.K. Jain.						
2, Intr	eductory methods of Numerical Analysis by S. S. Sastry						
3. Sug	gested digital plateform: NPTEL/SWAYAM/MOOCs						
4. Cou	rse Books published in Hindi may be prescribed by the Universities.						
Sugge	ted Readings(Part-B Operation Research):						
t.Taha	, Hamdy H, "Opearations Research- An Introduction ", Pearson Education.						
2.Kan	i Swarup, P. K. Gupta, Man Mohan Operations research, Sultan Chand & Sons						
3.Hilli	er Frederick S and Lieberman Gerald J., "Operations Research", McGraw Hill Publication.						
4.Win	ton Wayne L., "Operations Research: Applications and Algorithms", Cengage Learning, 4th Edition.						
5.Hira	D.S. and Gupta Prem Kumar, "Problems in Operations Research: Principles and Solutions", S Chand & Co Ltd.						
6. Kala	vathy S., "Operations Research", S Chand.						
7. Sug	ested digital plateform:NPTEL/SWAYAM/MOOCs.						
8. Cou	se Books published in Hindi may be prescribed by the Universities.						
This co	urse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), Economics(UG/PG), B.Sc.(C.S.)						
	Suggested Continuous Evaluation Methods: Max. Marks: 25						
S N	Assessment Type Max	. Marks					
	ass Tests	10					
2 0	aline Quizzes/ Objective Tests	5					
B P'r	esentation	5					
As	sigament	5					
Cours	prerequisites: To study this course, a student must have Certificate Course in Applied Mathematics						
Sugges	ted equivalent online courses:						
Furthe	r Suggestions:						

UG MATHEMATICS

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B.Sc. III (SEMESTER-VI) PAPER-III Practical

~	nme: Degree	Year: Third	Semester: Sixth		
Class: B	3.Sc.				
			Subject: Mathematics		
Course Code: 0620380 NEP Code: B030603P			Course Title: Practical		
ordinary	differential equation (up to third	a objective of the cons, Interpolation, Na	urse is to equip the student to solve the transcendental and algebraic equations, system of line unerical Integration, Method of finding Eigenvalue by Power method (up to 4×4), Fitting	ear equations a Polynomia	
	Credits: 2		Core Compulsory		
Max. Ma	arks: 100		Min. Passing Marks: 33		
··		Total No	. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4		
Unit			Topics	No. of Lecture	
Suggeste	Scilabetc 1. Solution of tra i) Bise ii) Ner iii)Secant m iv)Regula F 2. Solution of sy i) LU ii) Gauss-Ja ii)Gauss-Ja iv)Gauss-Se 3. Numerical Int (i) Tra (ii) Sim (iii) Sim	anscendental and algo ection method wton Raphson metho- ethod. alsi method. rstem of linear equati decomposition meth lossian elimination method cobi method idel method	d (Simple root, multiple roots, complex roots). ons od ethod		

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B.Sc.(MATHEMATICS) Honours Or Graduate in Mathematics Honours

L.

	COURSE-I : Abstract Algebra	
Programme/Class: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Seventh
Course Code: 0720321	Course Title: Abstract Algebra	Theory
structures, and comparing stru Course Outcomes (CO's): CO1.Ability to solve non-triv CO2. Determining the connec CO3. Ability to apply abstract CO4. Describing relationship CO5. Understanding the depe prosent and future. For examp	g ability for defining algebraic structures, constructing substructures, analyzing a given structure, developing r etures. ial problems based on various concepts in the course, tion and transit amid formerty studied mathematics (discrete mathematics) and advanced mathematics (advance t algebra to solve problems in other branches of mathematics and also in other disciplines. between Abstract Algebra and other courses in mathematics, ndoncy of results based on earlier results, and thereby developing a correct approach towards life realizing the le, in ring theory, the ring of polynomials over a field is a gift of the division algorithm. s for pursuing research in Cryptor paphy	ed abstráct inathematics).
Credits: 4	Core Compulsory	Max Marks (Int. + Ext.): 25+75 Total = 100 Minimum Marks: 40
Teach	ing Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0 (Four Hours in a week) or 60 Lecture Hours in a	Semester
Unit	Course Topic	No. of Lectures Hours
1	Definitions of a group, Subgroups, Cyclic group, Permutation group, Even and odd permutation; statement of Cayley's theorem, Lagrange's theorem; definitions of Normal subgroup, Quotient group, Ring, Subrings, Integral domain and field, Ideal and quotient ring, automorphism, inner automorphism, Polynomial ring over commutative ring, definition of division algorithm, principal ideal domain, Reducibility tests, Irreducibility tests, Eisenstein criterion. Unique factorization domains, Euclidean domain	15
11	Cauchy's theorem for finite abelian group, Cauchy's theorem for an arbitrary finite group, Fundamental theorem on homomorphism of groups. Second and third law of isomorphism of groups, Maximal subgroup, Composition series, Jordon Holder's theorem, Subnormal and normal series, Solvable groups, Characteristic property of solvable groups	15
171	Direct products, External Direct products, Internal Direct products, Sylow p-subgroups, Sylow's first theorem, Double cosets, Sylow's second and third theorem, Applications of Sylow's theorem.	15
īv	The fundamental theorem on finite abelian groups, Invariants of finite abelian groups, Isomorphic abelian groups of order, non-isomorphic abelian groups of order, Decomposable groups. Imbedding of rings, Field of quotients of an integral domain, Maximal Ideal, Field extensions, Finite field extensions, Simple field extensions, Algebraic and transcendental extensions, Minimal polynomial, Remainder theorem, Factor theorem.	15
eaching Learning Process: (Tass discussions/ demonstrations, Power point presentations, using e-content, Class activities/ assignments, etc	c
 Joseph A. Gallian: Con Khanna, <u>Vijay K & B</u> Herstein, J.N.: Topics i Bhattacharya, P.B., Na 	ichard M. Fonte: Abstract Algebra, Wiley, 3 rd Edition, 2011 itemporary Abstract Algebra 9th Edition, 2019. <u>hambri, S.K.</u> A Course in Abstract Algebra, S Chand and Company Ltd; Fifth edition (2022) n Algebra, Wiley, 2 rd Edition, 2006. igpaul, S.K. Basic Abstract Algebra (2nd Edition) Cambridge University Press, Indian Edition, 1997. son Education 3rd Edition, 1992 ourse in Abstract Algebra.	
Suggested Continuous Eval		
Suggested equivalent online	courses: on the channels such as Swayani Prabha, Mooes and NPTEL. E-contents from different online libraries, e	

	COURSE-II : Real Analysis	
Programme/Class: B.Sc.	Year: B.Sc. Mathematics Honouts	Semester: Soventh
Course Code: 0720322	Course Title: Real Analysis	Theory

This course puts forward some basic concepts of real-valued functions and its applications. The purpose of this course is to provide a foundation for understanding the This course juts forward some basic concepts of real-valued functions and its applications. The purpose of this course is to provide a foundation for understanding the different branches of mathematics. Course outcomes: CO1. To provide a topological study of real-valued functions. CO2. To study the concepts of convergence and uniform convergence of series and sequence of real-valued functions and their applications. CO3. To provide the methods for finding the maxima and minima values of multivariate real-valued functions with their applications. CO4. To study the concept of integrability of real-valued functions over the closed and bounded interval and their applications. CO5. This course gives a wide study of different concepts of functions of serval variables, such as limit and continuity, differentiability, partial differentiability and integrability. CO5. This course gives a foundation to study other important courses such as functional analysis, complex analysis and differentia equations. This course plays a central role to get the employment for the students because it is available with a great importance in the syllabi of different competitive exams

Credits: 4 Core Compulsory (Max Marks (Int. + Ext.): 25+75 Total = 100 Minimum Marks: 40
Tes	ching Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Four Hours in a week) or 60 Lecture Hours in a	Semester
Unit	Course Topic	No. of Lectures Hours
I	Definition and existence of Riemann-Stieltjes integral. Properties of the integral, integration and differentiation, The fundamental theorem of calculus, and Integration of vector-valued functions.	15
п	Sequences and series of functions. Pointwise and uniform convergence, Cauchy criterion for uniform convergence, Uniform convergence and continuity, Uniform convergence and Riemann-Stieltjes integration, Uniform convergence and differentiation, Weierstrass Approximation Theorem.	.15
III	Power series, Algebra of power series, Uniqueness theorem for power series. Abel's and Tauber's theorems.	15
ΓV	Functions of several variables, Linear transformation, Derivatives in an open subset of R ^a , Chain rule, Partial derivatives, Interchange of the order of differentiation.	15
Teaching I	earning Process: Class discussions/ demonstrations, Power point presentations, using e-content, Class activities/	assignments, die
 Brown, W., Cl Royden, H. L. Rudin, W.: Pri 	: Mathematical Analysis, Narosa Publishing, New Delhi, 1985 urchill, R. V., Fourier Series and Boundary Value Problems, 8 th 3rd Edition, 2015, McGraw Hill Edutation, New I Real Analysis, (4th Edition), Macmillan Publishing Co. Inc. New York, 1993. nciples of Mathematical Analysis, (3rd edition) McGraw-Hill, Kogaku Sha, 1903, International student edition. Analysis, An Introduction, Addison-Wesley Publishing, Co. Inc., 1968.	Dethi
Suggested Continuous E Continuous internal	valuation Methods: valuation through internal tests, quizzes and Presentation.	
suggested equivalent on	line courses: ses on the channels such as Swayam Prabha, Moocs and NPTEL, E-contents from different online libraries, c-	

s

COURSE-III : Advanced Differential Equation				
Programme/Class; B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Seventh		
Course Code: 0720323	Course Title: Advanced Differential Equation	Theory		

1. To explore the basic ideas of Differential Equations combined with some real-life problems

2. Differential equations are very important in the mathematical modeling of physical systems.

3. Many fundamental laws of physics and chemistry can be formulated as differential equations.

4. In biology and economics, differential equations are used to model the behavior of complex systems.

5. Ordinary Differential Equations are used to calculate the movement or flow of electricity, motion of an object to and fro like a pendulum, to explain thermodynamics concepts.

Course outcomes:

CO1. The use of the differential equation theory is to solve various types of Mathematical modeling problems.

CO2. The use of the differential equation theory is to solve many problems presented in different sciences such as Biology, Chemical sciences and Physics.

CO3. The use of this theory is to solve many real-life based problems such as population problem, control problems and networking security problems etc.

CO4. This theory can solve many engineering problems such as the exact trajectory path of a rocket or a missile.

CO5. Students will be able to formulate and solve differential equations arising from changes in physical world.

Credits: 4	Core Compulsory	Max Marks (Int. + Ext.): 25+75 Total = 100 Minimum Marks: 40	
Ter	ching Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0 (Four Hours in a week) or 60 Lecture Hours in a	Scmester	
Unit	Course Topic	No. of Lectures Hours	
I	Ordinary Differential Equations (ODEs), General theory of homogenous and non-homogeneous linear ODEs, System of first order ODEs, The method of variation of parameters, Wronskian, Sturm- liouville boundary value problem, Picard's method of successive approximation, Picard's Theorem.	15	
n	Ordinary points, Singularities, Regular and Irregular singular points, Series solutions about ordinary points, Probenius series solution Green function.	15	
IV ·	Origin of first order Partial Differential Equations (PDEs), Lagrange method for solving first order PDEs, Integral surfaces passing through a given curve, Surface orthogonal to a given system of		
v	General solution of higher order PDEs with constant coefficient, Diffusion, Wave and Laplace equations by the method of separation of variables, Reduction of second order partial differential equation into its canonical form, Non-linear partial differential equations of second order.	15	
Teaching L	earning Process: Class discussions/ demonstrations, Power point are sentations, using e-content, Class activities	/ assignments, etc	
 Rai, 8., Chaudhary Simmons, G.F.: Dil Sneddon, Ian: Elen Wirkus Stephen A 	A. & Levinson, Norman: Theory of Ordinary Differential equations, Tata McGraw-Hill Publication. 7. D.P. and Freedman, H.I.: A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi Terential Equations with Applications and Historical Notes, Second Edition, Tata Mcgraw-Hill Publishing Compi rents of Partial Differential Equation, McGraw-Hill Book Company. & Swift, Randall J.: A Course in Ordinary Differential Equations 1st Edition, CRC Press, Taylor & Francis tial Equations, 3 st Edition, Wiley. (1980)	any Ltd. New Delhi (2017).	

Continuous internal evaluation through internal tests, quizzes and Presentation,

Suggested equivalent online courses:

There are online courses on the channels such as Swayam Prabha, Mooes and NPTEL. E-contents from different online libraries, e-PG Pathshaala etc

Further Suggestions

	COURSE-IV : Metric Space	
Programme/Class: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Soventh
Course Code: 0720324	Course Title: Metric Space	Theory

The beauty of the subject is to gain proficiency in dealing with abstract concepts, with emphasis on clear explanations of such concepts to others; to introduce the theory of metric and topological spaces; to show how the theory and concepts grow naturally from idea of distance; to be able to give examples which show that metric spaces are more general than Euclidean spaces; to be able to work with continuous functions, and to recognize whether spaces are connected, compact or complete. Metric spaces are vital prerequisites for many mathematics courses including Analysis, Topology, Measure Theory, Complex Analysis etc. Course outcomes:

CO1: To show how the theory and concepts grow naturally from idea of distance

CO2: Differentiate between functions that define a metric on a set and those that do not.

CQ3: Use the Banach fixed point theorem to demonstrate the existence and uniqueness of solutions to differential equations

CO4: Apply the theory in the course to solve a variety of problems at an appropriate level of difficulty

CO5: Metric spaces are vital prerequisites for many mathematics courses including Analysis, Topology, Measure Theory, Complex Analysis etc.

CO6: Understand sequentially compact spaces, Countable compactness, BWP and compactness and explain the relation between the three types of compactness in metric spaces.

Credits: 4	Core Compulsory	Max Marks (Int. + Ext.): 25+75 Total = 100 Minimum Marks: 40
Teacl	ing Hours = Lecture-Tutorial-Practical (L-T-P) : 40 (Four Hours in a week) or 60 Lecture Hours in	a Semesier
Unit	Course Topic	No. of Lectures Hours
J	Metric Space: Metric on a set, preudo-metrics and metrics Distance between two sets. Equivalent metrics. Limit points and closure: closed sets, Derived set of a set. Adherent points and closure of a set, Donse subsets, Interior of a set and its properties, Subspaces, Product spaces, Structure of Open balls in a product space. Closures and interiors in a product space, Finite product of metric spaces.	15
11	Convergent sequences. Cauchy sequences. Characterization of adherent points and limit points in terms of convergent sequences. Convergence in products, Convergence in Euclidean spaces Cluster points of a sequence, Subsequences. Cluster points and convergent subsequences. Algebra of convergent real sequences, Spaces of sequences.	15
uı	Continuity at a point. Continuity over a space. Continuity of composite, graph and projection maps. Algebra of real valued continuous functions in a metric space. Homeomorphisms, Isometries, Relation between isometries and Homeomorphism. Uniform continuity. Complete metric spaces. Completeness and Continuous mappings. Completeness and subspaces. Cantor's Intersection Theorem. Contraction Mapping Principle. Connectedness: Connected metric spaces. Connected sets. Characterization of connected subsets of the real line. Properties of Connectedness	15
īV	Compact spaces and Compact subsets. Compact subsets of the real line. Sequential compactness and its characterization. Countable compactness, Bolzano-Woierstrass property. Sequential characterization of BWP. Equivalence of BWP and sequential compactness. Covering characterization of the BWP. Bolzano-Weierstrass Property and Total boundedness. Bolzano-Weierstrass Property and compactness. Lebesgue covering lemma. Compactness and completeness, Compactness and uniform continuity. Boundedness of continuous real-valued functions on compact metric spaces	15
Teaching Lea	rning Process: Class discussions/ demonstrations, Power point presentations, using e-content, Class activitie	es/ assignments, etc
 Dieudonne, J. Kasriel, R. H. Kumaresan S 	Metric Spaces, Cambridge tracts, 2010. Foundation of Modern Analysis, Academic Press, New York, 1960. Metric Spaces, Dover Publications, New York, 2009. Topology of Metric Spaces, 2 nd Edition, Narosa (2011). Evaluation Methods: Continuous internal evaluation through Internal tests, quizzes and Presentation.	
Suggested equivalent o ibraries, c-PG Pathshaale	uline courses: There are online courses on the channels such as Swayam Prabha, Mooes and NPTEL. E- etc	contents from different online,

	Core-Elective Course -V : Mathematical Statistics	
Programme/Class: B.Sc.	Programme/Class: B.Sc. Year: B.Sc. Mathematics Honours Course Code: 0720325 Course Title: Mathematical Statistics	
Course Code: 0720325		
statistical methods, Upon succe Course outcomes: CO1: Explore the basic ideas al CO2: Explain the different type CO3: Tackle big data and draw	"this course is to extend and master students' knowledge of probability and statistical methods and to provide theoretical background ssful completion of this course, students will be able to study, correctly apply and interpret different statistical methods. Sout measures of central tendency, dispersion and their applications in other statistical problems. Is of discrete and continuous distributions and their utilization. 'inferences form it by applying appropriate statistical techniques. tatistical techniques in various experimental and industrial requirements	for studying advanced
Credits: 4	Core Elective	Max Marks (Int. + Ext.): 25+75 Total 100 Minimum Marks: 40
	Teaching Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Five Hours in a week) or 60 Lecture Hours in a Semester	
Unit	Course Topic	No. of Lectures Hours
1	Probability: Set theoretic approach, Sample spaces, Events; Dependent and Independent events, The concept of Probability, Statistical or empirical definition, Conditional probability, Bay's theorem, Probability mass and density functions, Chebyshev's inequality.	15
11	Random variables, Distribution functions, Joint probability distribution function, Conditional distribution function, Probability density function, Expectation, Covariance, Variance of variables, standard discrete and continuous univariate distributions, standard errors, marginal and conditional distributions.	15
[1]	Basics concept of Moment generating function, Probability generating function and Universal generating function, Discrete distributions: Geometric, Bernoulli, Binomial, Poisson and uniform distributions. Continuous distributions: Normal, Exponential, Gumma, Chi-square, student's t and F, and Beta distributions.	15
IV	Curve Fitting, Correlation and regression: Curve fitting. The Method of Least Squares, fitting of a straight Line and second- degree Parabola, Correlation coefficients, Simple and multiple linear Regression, lines of regression, regression coefficient, Scatter diagram, test for slop and correlation	15
Teachi	ng Learning Process: Class discussions/ demonstrations, Power point presentations, using e-content, Class activities/ assignments, e	IC
 Kennedy and Gentl Mayer, P.L.: Introdu Mood, A.M. and Gr Hogg, R.V., Craig, 4 Suggested Continuous Evaluation 	h, A.K. Md. Ehsanes: An Introduction to Probability and Statistics, Second Edition Wiley-Inderscience. (2008) e: Statistics Computing, Published by CRC Press. (2021) ctory Probability and Statistical Applications, IBH. 2 ^{ed} Edition (1970) aybill, F.: Introduction to the Theory of Statistics, McGraw Hill Education, 3 ^{ed} edition (2017). L. and McKean, Joseph W.: Introduction to Mathematical Statistics, Pearson Education, 8 th Edition New Delhi (2019) atton Methods: Continuous internal evaluation through internal tests, guizzes and Presentation. aurses: There are online courses on the channels such as Swayam Problem, Moocs and NPTEL. E-contents from different online	libering o DC Participada
ele electronication de la contration de la contraticitation de la	ourses: mere are online courses on the channels such as Swayam ringha, moues and the rel. E-contents from different online	notanes, e-rei rausnaata

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		Core-Elective Course – II: Advance Numerical Analysis	
Program	me/Class: B.Sc.	Year: B.S.c. Mathematics Honours	Semester; Seventh
Course Code: 0720326 Course Title: Advance Numerical Analysis		Theory	
scelic problemssuch course outcomes: 01. Apply their know uations, a system of 1 02. Find the solution 03. Demonstrate und 04: Identify the chall	as finding roots of equations, qua ledge of computer programming near equations, interpolation and of linear and nonlinear equations restanding of common numerical anging problems in continuous m	ques for finding approximate numerical solutions to mathematical problems for which exact or analy ation of the difficulties involved in finding reliable solutions and will gain practical knowledge of how to an drature and numerical solution of differential equations. to develop and implement their own computer codes of numerical methods for solving different types of extrapolation, initial and boundary value problems of ordinary differential equations, etc. and solution of differential equations. methods and how they are used to obtain approximate. athematics (which are difficult to deal with analytically) and find theirappropriate solutions accurately and quations in numerical analysis	f complex problems viz. nonlie
Oblidentity use of spi	ine interpolation and difference e		14 . 14 L
Credits: 4		Core Elective	Max Marks (Int. + Ext.): 25+75 Total = 1 Minimum Marks: 40
			(Int. + Ext.): 25+75 Total =
		Core Elective	(Int. + Ext.): 25+75 Total = 1
Crediis: 4	Teaching Hours = 1 Modified Newton-Raphson	Core Elective .ecture-Tutorial-Practical (L-T-P) : 4-0-0 (Five Hours in a week) or 60 Lecture Hours in a Semester	(Int. + Ext.): 25+75 Total = 1 Minimum Marks: 40
Crediis: 4 Unit	Teaching Hours = I Modified Newton-Raphsor polynomial equations. Mat	Core Elective 	(Int. + Ext.): 25+75 Total = 1 Minimum Marks: 40 No. of Lectures Total 60 15
Crediis; 4 Unit I	Teaching Hours = 1 Modified Newton-Raphsor polynomial equations. Mat Algebraic Eigen values an Approximation. Least squ approximation. Approxim Chebyshev polynomials, M	Core Elective 	(Int. + Ext.): 25+75 Total = 1 Minimum Marks: 40 No. of Lectures Total 60 15

Suggested Readings: 1. Froberg, C.E.: Introduction to Numerical Analysis, Addison-Wesley Pub. Co., 2016. 2. Gupta, Radhey S.: Elements of Numerical Analysis, Macmillan India Ltd. New Delhi, 2015. 3. Jain, M.K., Iyengar, S.R.K and Jain, R.K.: Numerical Methods for Scientific and Engineering Computations, New Age International (P) Ltd. New Delhi, 2014. 4. Sastry, S.S.: Introductory Methods of Numerical Analysis, UBS Publishers, 2012.

Suggested Continuous Evaluation Methods:

Continuous internal evaluation through internal tests, quizzes and Presentation.

Course prerequisites: To study this course, a student must have had the subject Mathematics in UG degree.

Suggested equivalent online courses: There are online courses on the channels such as Swayam Prabha, Mooes, and NPTEL. E-contents from different online libraires.

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FortherSuggestions:

	COMPULSORY COURSE- I : Topology		
Programme/Class: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Eight	
Course Code: 0820321	Course Title: Topology	Theory	
topological spaces; to sh spaces; to be able to wor including Analysis, Topol Course outcomes: CO1: To show how the theo CO2: Differentiate between CO3: Use the Banach fixed CO4: Apply the theory in th CO5: Metric spaces are vita	et is to gain proficiency in dealing with abstract concepts, with emphasis on clear explanations of such concepts to others; to introdu whow the theory and concepts grow naturally from idea of distance, to be able to give examples which show that metric spaces are is with continuous functions, and to recognize whether spaces are connected, compact or complete. Metric spaces are vital prerequisites for ogy. Measure Theory, Complex Analysis etc. ry and concepts grow naturally from idea of distance functions that define a metric on a set and those that do not, point theorem to demonstrate the existence and uniqueness of solutions to differential equations e course to solve a variety of problems at an appropriate level of difficulty I prerequisites for many mathematics courses including Analysis, Topology. Measure Theory, Complex Analysis etc.	more general than Euclidean r many mathematics courses	
Credits: 4	Core Compulsory	Max Marks (Int. + Ext.): 25+75 Total = 10 Minimum Marks: 40	
	Teaching Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Five Hours in a week) or 60 Lecture Hours in a Semester		
Unit	Course Topic	No. of Lectures Hours	
I	Definition and examples of topological space, Cloud sets, Closure, Dense subset, Neighborhoods, interior, exterior, boundary and accumulation points, Derived sets. Bases and sub bases. Subspaces, product spaces and relative topology.		
II Continuous functions, homeomorphisms, the pasting lemma, Connected and disconnected sets, connectedness on the real line, components, locally connected spaces.			
ш	Countability axioms - First and second countable spaces, Lindelof's theorems, Separable spaces, second countability and separability. Separation axioms - T0, T1, T2, T3, T3½, T4, their characterizations and basic properties. Urysohn's lemma and Teitze extension theorem, Statement of Urysohn's metrization theorem.	15	
IV Compactness - Continuous functions and compact sets, basic properties of compactness, compactness and finite intersection property, sequentially and countably compact sets, local compactness and one point compactification. Statements of Tychonoff's Product theorem and Stone-cech compactification theorem.		15	
1	eaching Learning Process: Class discussions/ demonstrations, Power point presentations, using e-content, Class activities/ assignments, e	elc	
 Dieudonne ,J.; F Munkres. James Kumaresan S. T 	Introduction to Topology and Modern Analysis, Tata McGraw Hill, India,2016 oundation of Modern Analysis, Academic Press, New York, 1960. .: Topology, 2 ^{ad} Edition, Pearson Education, 2021. opology of Motric Spaces, 2 ^{ad} Edition, Narosa (2011).		
Suggested Continuous Ev	valuation Methods: Continuous internal evaluation through internal tests, quizzes and Presentation.		
Suggested equivalent only	ne courses: There are online courses on the channels such as Swayam Prabha, Moocs and NPTEL. E-contents from different online l	ibraries, e-PG Pathshaala etc	

Course Code: 0820322	Year: B.Sc. Mathematics Honours	Semester: Eight
Course Code: 0820322	rogramme/Class: B.Sc. Year: B.Sc. Mathematics Honours	
	Course Title: Advanced Complex Analysis	Theory
how how complex analysis can b course outcomes; OI. Know the fundamental con OZ. Prove the Cauchy-Riemann O3. Extend their knowledge to p	equations and apply them to complex functions in order to determine whether a given continuous function is complex differentiable.	'a complex variable, and to
Credits: 4	Core Compulsory	Max Marks (Int. + Ext.): 25+75 Total = 100 Minimum Marks: 40
	Teaching Hours = Lecture-Tutorial-Practical (L-T-P): 4-0-0 (Five Hours in a week) or 60 Lecture Hours in a Semester	
Unit	Course Topic	No. of Lectures Hours
I Complex integration, Regular Arc, Contour, Cauchy-Goursal theorem, Simply connected domains, Multiply connected domains, Cauchy's integral formula, An extension of the Cauchy's integral formula, Significance of Cauchy's integral formula, Morera's Theorem, Cauchy's inequality, Liouville's theorem and its applications, The fundamental theorem of Algebra, Maximum modulus principle.		15
u	Properties and classifications of bilinear transformations, Bilinear transformation as conformal mappings, Riemann- Mapping Theorem, Examples of conformal mappings, Meromorphic functions, Entire functions, Taylor's theorem and its applications, Laurent's Theorem and its applications.	15
111	Singularities, Categorization of Singularities using Laurent's series, Isolated singularities, Residues, Cauchy's residue theorem, Evaluation of integrals, Many valued functions, branch points, branch cuts and branches of many valued functions, and with special reference to arg z, log z and z*, The argument principle, Rouche's theorem. Analytic continuation, Uniqueness of direct analytic continuation, Uniqueness of analytic continuation along a curve, Power series method of analytic continuation.	15
IV	Canonical products, Jensen's formula, Poisson-Jensen formula, Hadamard's three oircles theorem, Order of an entire function, Exponent of convergence, Borci's theorem, Hadamard's factorization Theorem.	15
Teac	ching Learning Process: Class discussions/ demonstrations, Power point presentations, using e-content, Class activities/ assignments, etc	· · · · · · · · · · · · · · · · · · ·
 Brown, J., Churchill, R.' Conway, J. B.; Functions 	Analysis, McGraw Hill Education; 3rd Edition, 2017. V.: Complex Variable and Applications, McGraw-Hill Education; 9th Edition, 2013. 5 of One Complex Variable, Springer-Verlag, International student Edition, 2 nd Edition, 1996. ion to Complex Analysis, Oxford University Press, 2008.	
uggested Continuous Evalua	tion Methods: Continuous internal evaluation through internal tests, quizzes and Presentation.	
ingrested courselent online or	ourses: There are online courses on the channels such as Swayam Prabha, Mooes and NPTEL. E-contents from different online librari	ice o PG Pathehaala ata

Compulsory	Course-	III :	Number	Theory	
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Programme/Class: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Eight
Course Code: 0820323	Course Title: Number Theory	Theory

The aim of the course is to acquaint students with almost all basic concepts of number theory and to demonstrate applications of number theory. It will help students to grasp rigorous and tricky proofs of many important results that have been used by them from quiet long time. The students will learn the use of Chinese remainder theorem, Fermat's Theorem, Wilson's theorem, Lagrange theorem, Quadratic reciprocity, etc. It will supply methods to solve linear Diophantine equations, linear congruences, system of linear congruences, quadratic congruences, etc. Students will be able to detect the primality of a large integer. It will show how various number theoretic concepts and theorems are applicable in cryptography. Course outcomes:

COL. Identify the challenging problems in modern mathematics and find their appropriate solutions. COL. Formulate and prove conjectures about numeric patterns, and produce rigorous arguments centered on the material of number theory, most notably in the use of Mathematical Induction and/or the Well Ordering Principal in the proof of theorems.

CO3. Apply the knowledge of Number theory and Cryptography to attain a good mathematical maturity and enables to build mathematical thinking and skill.

CO4. Design, analyse and implement the concepts of Diophantine equations for solving different types of problems, for example, sum of two and four squares

Credits: 4	Core Elective	Max Marks (Int. + Ext.): 25+75 Total = 100 Minimum Marks: 40		
	Teaching Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Five Hours in a week) or 60 Lecture Hours in a Semeste	r		
Unit	Unit Topics N			
I	The division algorithm, Definition and theory of the GCD, Euclid's Lemma, Definition and theory of the LCM, the extended Euclidean algorithm, Distribution of primes, the fundamental theorem of arithmetic, The Sieve of Eratosthenes, The Goldbach conjecture, Consequences of Dirichlet theorem, Statement of Prime Number theorem, Solutions of word problems using the theory of linear Diophantine equation, Solution of simultaneous system of linear congruences.	15		
н	Number Theoretic Functions: The number (), sum (), and product of the divisors, Multiplicative function, Mobius function, Morten's Lemma, The Mobius inversion formula and its applications, The greatest integer function, Legendre formula and its application.	15		
ш	The order of an integer modulo n and order of higher powers of the integer modulo n, Primitive roots for primes, Finding all primitive roots of a prime, Composite numbers having primitive roots, The theory of indices, Properties of index, Solutions of non-linear congruences, Euler's criterion, Solutions of quadratic congruences with prime moduli	15		
IV	Pseudoprimes and absolute pseudoprimes, Perfect numbers, even perfect numbers, The Fibonacci sequence and its properties, Continued fractions: representation of rational number as a finite simple continued fraction, Solution of linear Diophantine equation by means of simple continued fractions	15		
Suggested Readings: 1. Burton, David M.: E 2. Dudley U.: Elements	cess: Class discussions/ demonstrations. Power point presentations, Class activities/ assignments, etc. lementary Number Theory (7th Edition), McGraw Hill Education, 2017. ry Number Theory (2nd edition) Dover Publications, 2008. Number Theory, Dover Publications, 1994.			
Suggested Continuous Continuous internal eval				
Suggested equivalent o	nline courses: There are online courses on the channels such as Swayam Prabha, Moocs, and NPTEL. E-contents from different online hi	braires.		
FurtherSuggestions				

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Programme/C	lass: B.Sc.	3.Sc. Year: B.Sc. Mathematics Honours Semester		Eight	
Course Code	: 0820324	Course Title: Mechanics	Theor	ry	
majors. The core Course outcome COI. To distingu CO2. To frame U CO3. To undersu CO4. To differen CO5. To determ CO5. To identify CO7. To apply fi CO8. To use adv:	oldest branch of the Physic is the new formulation of s s: ish between inertia frame of the mathematical constraints and the mechanics of a syst flate between Newtonian, I ine the Lagrangian and Ha the conserved quantities, i indamental conservation pr anced theoretical technique	ts discipline and is as well important in the discipline of Mathematics. It is mechanics and the substantial range of new techniques in the applications. of reference and non-inertial frame of reference. Is on the bases of physical restrictions imposed on a system, which simplific em of particles falling under classical mechanics. Lagrangian, Hamiltonian and Routhian approach of solving a mechanical imiltonian of mechanical systems and use these functions to obtain the f any, associated with the mechanical system. inciples to analyze mechanical systems. Is to solve mechanical problems like use of canonical transformations, var- ge's Brackets to solve mechanical problems.	es the process of solution of a physical problem. problem. solutious of even compleated mechanical systems		
Credits: 4		Core Elective	Max Ma (Int. + Ext.): 25+ Minimum M	75 Total = 100	
	Teachin	g Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Five Hours in a	week) or 60 Lecture Hours in a Semester		
Unit		Course Topic		No. of Lectures Hours	
1	Constraints and const systems, Degree of momentum), General Definition of the Lag	system of particles, Conservation laws for the system of particles, gu- rained motion, classification of constraints: Holonomic versus non-holo Freedom, generalized velocity, generalized acceleration, generalized ized force. Lagrangian Mechanics: Physics in configuration space with ge- rangian, Euler-Lagrange equations of motion, Derivation of Euler-Lagran (e, Simple applications of the Lagrangian formulation to systems with hol	nomic systems, Scieronomic versus rheonomic potential, generalized momentum (Conjugate eneralized coordinates as independent variable, ge equations from differential principle i.e., by	15	
п	Hamiltonian (through coordinates as well, H Hamilton's principle I Hamilton's principle,	es: physics in phase space with generalized coordinates and momenta tree Legendre's transformation) and its relation to the energy, Hamilton's c lamilton's principle, Derivation of Hamilton's equations by integral princ by differential principle i. e. by D' Alembert's principle, Derivation of La Simple applications of Hamilton's equations of motion. Cyclic (ignorable n of Routhian. Routh's equations of motion and energy function Princ	anonical equations in cylindrical and spherical iple i.e. by Hamilton's principle, Derivation of agrange's equations from integral principle i.e. e) coordinates and conservation laws. Routhian	15	
ш	dependent variables (i	nd its Application to Mechanics: Euler's equation for functions of one dep j) higher order derivatives, Applications of calculus of variation: Short revolution, Brachistochrone problem, Isoperimetric problem, Geodesic, La	ost distance between two points on a plane,	15	
IV	Hamilton Jacobi theor simple applications.	y: Hamilton Jacobi equation, Jacobi theorem, Method of separation of var	iables in Hamilton Jacobi equation and its	15	
	Teaching Learn	ing Process: Class discussions/ demonstrations, Power point presentation	s, using e-content, Class activities/ assignments, e	tc	
2. Goldsi	ein, H.: Classical Mechani	Silverman ,R.A.: Calculus of Variations, Prentice Hall,2000 ics (3rd Edition), Pearson New International Edition, 2014, ISBN 13: 978 sical Mechanics, Tata McGraw Hill, New Delhi, 1991, ISBN-10: 007460			
	inuous Evaluation Metho	ods: Continuous internal evaluation through internal tests, quizzes and	Presentation.		
suggested Cont					

Programme/Cl	ogramme/Class: B.Sc. Year: B.Sc. Mathematics Honours Semester: Eight		t	
Course Code:	0820325	Course Title: Financial Mathematics	Theory	
roblem-solving sl Course outcomes CO1: Demonstrate CO2: Demonstrate CO3: Employ me CO4: Apply logic CO5: Use approp	cills with a particular e c understanding of basi c understanding of con	problem solving.	ess. This also highlights the inter-relationshi	ps of the mathematics an
Credits: 4 Core Elective Max Marks (Int. + Ext.): 25+75 Total Minimum Marks: 40				
	Tea	ching Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Five Hours in a week) of	75 Lecture Hours in a Semester	
Unit		Course Topic	No. of Lectur	
1		initions and Terminology, Basic option theory: single and multi-period binomial pr toles formula for potion pricing as a limit of CCR model.	cing models, Cox-Ross-Rubinstein (CCR)	15
п	Brownian ad Ge	Brownian ad Geometric Brownian Motion, Theory of Martingales, Stochastic Calculus, Stochastic differential Equations.		15
т	Ito"s formula to s and Black Schole	solve SDE"s, FeymannKae theorem, Application of stochastic calculus in option pricing s formula.	Black Scholes partial differential equations	15
IV	Mean Variance portfolio theory: Markowitz model for Portfolio optimization and Capital Asset Pricing Model (CAPM). Interest rates and interest rate derivatives:		15	
	Teaching L	earning Process: Class discussions/ demonstrations, Power point presentations, using o	-content, Class activities/ assignments, etc	
1. Roman	J.C., Stochastic Proce	ess and Financial Markots, Alphs Science International, 2003. e Mathematics of Finance, Springer, 1st Edition, 2000 athematical Finance, Cambridge University press,3rd Edition, 2011.		
Suggested Conti	nuous Evaluation M	ethods: Continuous internal evaluation through internal tests, quizzes and Presentation	n	
	Jand an Han antimate	There are online courses on the channels such as Swayam Prabha, Moocs and NPT	E contente from different enline librado	e-PG Pathebaala etc

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Program	ne/Class: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Eigl	ht
Course (Code: 0820326	Course Title: FLUID DYNAMICS	Theory	
lisciplines of en- formulate physics COL To know, COL To know, COL To know, COL To coaver COL To coaver COL To frame COL To frame COL To unders COL To unders COL To unders COL To unders COL To nake of COLL To defini	ngineering. The main objective i feal problems encountered in di understand and apply the basic co- be the physical properties of a flui uphysical laws of conservation of and discribe the flow through pac- ter the motion of ideal and real flui tand stress-strain relationship in N Bernoulli equations in their domai mand the singularities of the flow r bimensional analysis and use it to iow behavior with non-dimension the similitude concept and set up	d. 'mass, momentum, moment of momentum and energy into mathematical equations and apply them to ential function and stream function. ds with different techniques including complex variable technique. levetonian fluids. a of validity for fluid flow rate measurement. ield. derive the dimensionless numbers. al parameters the relation between a model and a prototype. we equations, such as tim Navie-Slokes equations to evaluate velocity, pressure drop in simple geome	at rest and in motion to develop the ability	y to demonstrate and
	Credits: 4	Core Compulsery	Max Marks (Iat. + Ext.): 25+75 Tot: Minim Marks: 4	
	Teaching Hours =	Lecture-Tutorial-Practical (L-T-P): 4-0-0 (Four Hours in a week) of	or 60 Lecture Hours in a Seme	ster
Unit		Topics		No. of Lectures Total 6
1	descriptions of fluid motion in a velocity field), Rotation	ntroduction: fluid characteristics, continuum concept and basic properties of fluids, Newtonian law of viscosity, Kinematics of fluids: Eulerian vs. Lagrangie tescriptions of fluid motion, Equivalence of Lagrangian and Eulerian methods, General motion of a fluid element: Translation (Acceleration of a fluid partic n a velocity field), Rotation (angular deformation) and Deformation (volumetric or extensional strain/ shear strain), Flow lines: Stream lines, Path lines, Strea ness, Boundary conditions and boundary surface.		
п	system, Symmotry of stres Conservation laws by the Equivalence of the mass co	theory of stress in a real fluid: Normal stress, Shearing stress, Transformation of stress components from one coordinate system to another coordinate Symmetry of stress tensor, Plane stresses, Principal directions and Principal values of stress tensor, Constitutive equation for Newtonian fluid valion laws by the Control Volume approach: Mass conservation equation in rectangular cartesian, cylindrical and spherical coordinate system acc of the mass conservation equations derived by Lagrangian method and Eulerian method. Equation of conservation of momentum (NavierStoke n and Euler Equation), Equation of conservation of moment of momentum, Equation of conservation of energy, Simple and direct applications o action enautions.		15
D 1	Vorticity and circulation, Elementary properties of vortex motion. Stream function for two-dimensional incompressible Flow, Stream function and potenti flow theory, Theorems about rotational and irrotational flows of inviseid and incompressible flows – Stokes' theorem, Kelvin's minimum energy theorem Gauss theorem, Kelvin's circulation theorem, Uniqueness of irrotational flows. Bemoulli's equation for incompressible and inviscid flows: Integration a Euler's equation along a streamline for steady and unsteady flows, Applications of Bernoulli's equation for irrotational flows. Flow through an orifice, Motic of a jet through atmosphere. Pitot tube, Venturi meter.		m, Kelvin's minimum energy theorem, sible and inviscid flows: Integration of	
īv	Two-dimensional irrotational incompressible flows (Complex variable technique and its applications): Blasius theorem, Milne's circle theorem, Flow fis singularities: Sources, Sinks and Doublets in two dimensions, Images of a source' sink/ doublet with respect to a line and with respect to a circle, Sim applications of source, sink and doublet. Dimensional analysis, Buckingham Pi theorem, Dimensionless numbers (Reynold number, Pressure coefficient, Min number, Froude number, Prandt number) and their properties Basic introduction to Newtonian and non-Newtonian theologies		ne and with respect to a circle, Simple told number, Pressure coefficient, Mach	15
feaching Learn	Ing Process: Class discussions/ d	emonstrations, Power polnt presentations, Class activities/ assignments, etc.		·····
. Charlton, F.: . Raisingbania, . Rathy, R.K.: . Yuan, S.W.: F	K. An Introduction of Fluid Mechn Text Book of Fluid Dynamics, CB M.D.: Fluid Dynamics: with Cor An Introduction of Fluid Dynamic oundations of Fluid Mechanics, P	anies, Oxford University Books, NewDelin, 2000. 35 Publishers, Delbi, 2004. aplete Hydrodynamics and Boundary Layer Theory, S. Chand Publishing, 2014, ISBN 13: 97881219 s, Oxford and IBH Publishing Co.New Delhi, 1903. restitice Hall of India Frivate Limited.New-Delhi, 1988, ISBN 10: 0133298132/ ISBN-13: 978-01332 ontfouous internal evaluation through Internal tests quizzes and Presentation.		
		tudent must have had the subject Mathematics in UG Level.		

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Programme/Class: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Eight
Course Code: 0820327	Course Title: Linear Algebra	Theory
igenvectors, the minimal poly- inear algebra finds applicatio divanced contents of the above course outcomes: CO1: Understand the notion of CO2: Understand the concept of CO3: Find the eigenvectors and	is is to develop theoretical as well as working knowledge of the central ideas of linear algebra like linear transformations, invertibility & somial, diagonalization, canonical forms, rational & Jordan forms, bilinear forms and their classification. Is in coding theory, cryptography, graph theory and linear programming. Thus, after completing this course, students shall bear a good mentioned courses. A vector space and linear transformation and to determine basis and dimension of a vector space. I linear transformation and to find the range space and null space of the linear transformation Eigen-value of a square matrix and to know diagonalization of the matrix asis using the Gram-Schmidt process.	
Credits: 4	Core Elective	Max Marks (Int. + Ext.): 25+75 Total = 10 Minimum Marks: 40
	Teaching Hours = Lecture-Tutorial-Practical (L-T-P): 4-0-0 (Five Hours in a week) or 60 Lecture Hours in a Semester	
Unit	Course Topic	No. of Lectures Hours
1	Linear transformations, Isomorphism, Range and null space, The matrix representation of linear transformations, Linear functional, Double dual,	15
II	Invertibility and Isomorphisms, The change of coordinate matrix, The transpose of a linear transformations, Polynomial ideals, Prime factorization of polynomials, Inner product spaces, Bessel's inequality, Normal and unitary operators.	15
m	Elementary canonical forms: Annihilating polynomials, The minimal polynomial, Invariant subspaces, Simultaneous triangulation, Simultaneous diagonalization, Direct-sum decomposition, Invariant direct sums, The primary decomposition theorem.	15
1V	Orthogonal and unitary reduction of quadratic and Hermitian form, Positive definite quadratic forms, simultaneous reduction. Bilinear forms, Matrix of a bilinear form, Classification of bilinear forms: Symmetric bilinear forms, Skew-symmetric bilinear forms	15
eaching Learning Process: C	lass discussions/ demonstrations, Power point presentations, using e-content, Class activities/ assignments, etc	
 Hoffman, K., Kunze R. Friedberg, S.H., Insel, Strang, G. Lincar Algeb 	Lay and Judi J.MC Donald; Linear Algebra and Its Applications, 6 th Edition Pearson Education 2021. Linear Algebra (2 nd Edition), Pearson, 2017. A.J., Spence, L.E.: Linear Algebra Pearson Education India.2015. a and its Applications (4 th Edition), Congage Learning, 2007. inear Algebra (2 nd Edition), Narosa Publishing House, 2013. ration Methods: Continuous internal evaluation through internal tests, guizzes and Presentation.	

Programme/Class: B.Sc	Year: B.Sc. Mathematics Honours	Semester: Eight
Course Code: 0820328	Course Title: Data Structure with C	Theory "
 Programming langua Studying programmin Choose the most app A programming langua Programming langua Course outcomes: CO1. Understanding a functi CO2. Ability to define and m CO4. Students will be able to CO4. Students will be able to 	c of programming languages is to provide instructions to a computer. ages differ from most other forms of human expression in that they require a greater degree of precision and completeness. Ing languages will help the students be better at their job, make more money, and be a happier, more fulfilled and more informed citizen, beer worprate language for a given task. guage lets the students to express computational tasks in certain ways. ges often produce more efficient code through optimization for specific system architecture. itonal hierarchical code organization. manage data structures based on problem subject domain. extual information, characters and strings. o develop logics which will help them to create programs, applications in C. asic programming constructs they can easily switch over to any other Language in future.	ause they will learn to:
Credits: 4	Core Elective	Max Marks (Int. + Est.): 25+75 Total = 10 Minimum Marks: 40
	Teaching Hours = Lecture-Tutorial-Practical (L-T-P): 4-0-0 (Five Hours in a week) or 60 Lecture Hours in a Semester	
Unit	Course Topic	No. of Lectures Hours
1	Introduction to the C Language: Writing a Simple C Program: Learning the format of a C program, declaring variables, designing program flow and control, defining and using functions, data types, using standard terminal I/O functions.	15
n	Conditional Program Execution: Applying if and switch statements, nesting if and else, restrictions on switch values, use of break and default with switch. Program Loops and Iteration: Uses of while, do and for loops, multiple loop variables, assignment operators, using break and continue. Modular Programming, Arrays and Structures Passing arguments by value, scope rules and global variables, separate compilation, and linkage, building your own modules. Array notation and representation, manipulating array elements, using multidimensional arrays, arrays of unknown or varying size.	15
m	Structures: Purpose and usage of structures, declaring structures, assigning of structures. Unions: Components in overlapping memory, declaring and using unions. h vs. private c files, hiding private variables and functions	15
	Functions and Pointers to Objects: Simple C-functions, passing anguments to functions, returning values from functions, reference arguments, overloaded functions, recursion, inline functions, default arguments, scope and storage class, returning by	15
IV	reference, Constant function arguments, runtime memory management. Pointer and address arithmetic, pointer operations and declarations, using pointers as function arguments, Dynamic memory allocation	

3.Kanetkar, Yashwant "Pointers in C"
 4.Schleld, Herbert, Complete Reference in C." TMH
 1. Yashwant Kanetkar," Let us C", BPB
 Suggested Continuous Evaluation Methods: Continuous internal evaluation through internal tests, quizzes and Presentation.
 Suggested equivalent online courses: There are online courses on the channels such as Swayam Prabha, Mooce and NPTEL. E-contents from different online libraries, e-PG Pathshaala etc

Further Suggestions:



Programme/Cl	ass: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Eight
Course Code:	0820329	Course Title: Dynamical Systems	Theory
differential equations, different analytic tool CO1. To introduce st forms, phase portraits CO2. To provide a br	, usually nonlinear a s. Course outcomes: audents to the basic , and bifurcations. ief introduction to the	lescribe the time evolution of systems which arise from mathematics, physics, biology, chemistry and other areas. As maind therefore not usually able to explicitly solved. The aim of the course is to see how to make a qualitative analysis mathematical skills for the qualitative solving of low dimensional systems of ordinary differential equations in continue way ordinary differential equation can be used to model, explain and interpret real world problems. e theory and concepts that under pin the field of dynamical systems.	of a dynamical system using ma
Credits	Credits: 4 Core Elective		Max Marks (Int. + Ext.): 25+75 Total = 10 Minimum Marks: 40
	Teach	ng Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Four Hours in a week) or 60 Lecture Hours in a Semester	
Unit	Unit Course Topic		No. of Lectures Hours
I	The orbit of a	map, fixed point, equilibrium point, periodic point, circular map, configuration space and phase space.	15
ц		reation. Stability of a fixed point, equilibrium point. Concept of limit cycle and torus. Hyperbolicity Quadratic map. universal constant.	15
ш	Turning point Hamiltonian	, trans critical, pitch work. Hopf bifurcation. Period doubling phenomena. Nonlinear OscillatorsConservative system. ystem. Various Type of oscillators in nonlinear system. Solutions of nonlinear differential equations.	15
IV	Phenomena o	flosing stability. Quasiperiodic motion. Topological study of nonlinear differential equations. Poincare map.	15
Feaching Learning P	rocess: Class discus	sions/ demonstrations, Power point presentations, using e-content, Class activities/ assignments, etc	
 Arrowosmith. Robert L.Day 	ynamical Systems, C D.K., Introduction t aney. An Introductio	ambridge University Press, 1993. o Dynamical Systems, Cambridge University Press, 1990. n to Chaotic Dynamical Systems, Addison-Wesley Publishing Co. 1989.	
		hods: Continuous internal evaluation through internal tests, quizzes and Presentation, se, a student must have had the subject Mathematics in UG degree.	
		There are online courses on the channels such as Swayam Prabha, Moocs and NPTEL, E-contents from different online I	ihuninan

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Maa Shakumbhari University, Saharanpur

Syllabus- B.Sc. (Mathematics) Honours with Research



B.Sc.(Mathematics)-I Year Certificate in Mathematics

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UG MATHEMATICS

B.Sc. I (SEMESTER-I) PAPER-I Differential Calculus & Integral Calculus

Programme: Class: B.Sc.	Certificate	Year: First	Semester: First		
			Subject: Mathematics		
NEP Code: B Course Code:			Course Title: Differential Calculus & Integral Calculus		
Course outcon	mes:				
			on knowledge for the students to understand basics of mathematics including applied aspect for nathematics and research as well.	developin	
CO2: By the t	ime students c	omplete the course th	ey will have wide ranging application of the subject and have the knowledge of real valued fun	ctions suc	
			now about convergence of sequence and series. Also, they have knowledge about curvature, en		
			as parametric curves.		
CO3: The mai	n objective of	the course is to equip	b the student with necessary analytic and technical skills. By applying the principles of integral l	ne learns le	
solve a variety	of practical pr	oblems in science and	d engineering.		
CO4: The stud	dent is equippo	ed with standard conc	septs and tools at an intermediate to advance level that will serve him well towards taking mo	re advanc	
course in math	ematics.				
	Credits: 4		Core Compulsory		
Ma	x. Marks: 25+	-75	Min. Passing Marks:		
		Total No.	of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0		
			Part- A Differential Calculus		
11.5				No. of	
Unit			Topics	Lectures	
In	troduction to	Indian Ancient Mathe	ematics and Mathematicians should be included under Continuous Internal Evaluation		
(CI	E). Definition	of a sequence, theore	ms on limits of sequences, bounded and monotonic sequences, Cauchy's convergence criterion,		
I Car	uchysequence,	limit superior and li	mit inferior of a sequence, subsequence, Series of non-negative terms, convergence and	9	
div	divergence, Comparison tests, Cauchy's integral test, Ratio tests, Root test, Raabe's logarithmic test, de Morgan and Bertrand's				
test	s, alternating	series, Leibnitz's theor	rem, absolute and conditional convergence.		
Lin	nit, continuity	and differentiability of	of function of single variable, Cauchy's definition, Heine's definition, equivalence of		
II def	inition of Cau	chy and Heine, Unifo	orm continuity, Borel's theorem, boundedness theorem, Bolzano's theorem, Intermediate	7	
val	ue theorem,				
ext	reme value the	orem, Darboux's inter	mediate value theorem for derivatives, Chain rule, indeterminate forms.		
Rol	le's theorem,	Lagrange and Cauchy	y Mean value theorems, mean value theorems of higher order, Taylor's theorem with		
III var	ious forms of	remainders, Successi	ve differentiation, Leibnitz theorem, Maclaurin's and Taylor's series, Partial	7	
		uler's theorem on hou			
			vature, Envelops and evolutes, Tests for concavity and convexity, Points of inflexion, ion of curves and tracing of parametric curves, Tracing of curves in Canesian and Polar forms.	7	

UG MATHEMATICS

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Uni	Topics	No. of Lecture:		
v	Definite integrals as limit of the sum, Riemann integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean value theorems of integral calculus, Differentiation under the sign of Integration.	9		
VI	Improper integrals, their classification and convergence, Comparison test, µ-test, Abel's test, Dirichlet's test, quotient test, Beta and Gamma functions.	7		
VI	Rectification, Volumes and Surfaces of Solid of revolution, Pappus theorem, Multiple integrals, change of order of double integration, Dirichlet's theorem, Liouville's theorem for multiple integrals.	7		
VII	Vector Differentiation, Gradient, Divergence and Curl, Normal on a surface, Directional Derivative, Vector Integration, Theorems of Gauss, Green, Stokes (without proof) and related problems.			
Sugges	ted Readings (Part- A Differential Calculus):			
I. R.(Bartle & D.R. Sherbert, Introduction to Real Analysis, John Wiley & Sons			
2. T.N	I. Apostal, Calculus Vol. I, John Wiley & Sons Inc.			
3. S. I	Balachandra Rao & C. K. Shantha, Differential Calculus, New Age Publication.			
4. H.	Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.			
5. G.I	3. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.			
6. Su	gestive digital platforms web links: NPTEL/SWAYAM/MOOCS			
7. Co	rse Books published in Hindi may be prescribed by the Universities.			
Sugges	ed Readings (Part-B Integral Calculus):			
1. T.N	I. Apostal, Calculus Vol. II, John Wiley Publication			
2. Sha	nti Narayan & Dr. P.K. Mittał, Integral Calculus, S.Chand			
3. Erv	in Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.			
4. Sug	gestive digital platforms web links: NPTEL/SWAYAM/MOOCS			
5. Co	rse Books published in Hindi may be prescribed by the Universities.			
Science	surse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), Chemistry/Biochemistry/Life s(UG), mics(UG/PG), Commerce(UG), BBA/BCA, B.Sc.(C.S.)			
	Suggested Continuous Evaluation Methods: Max. Marks: 25			
SN	Assessment Type	x. Marks		
Ch	ss Tests	10		
2 01	line Quizzes/ Objective Tests	5		
Pre	sentation	5		
As	ignment (Introduction to Indian ancient Mathematics and Mathematicians).	5		

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UG MATHEMATICS

B.Sc. I (SEMESTER-I) Paper-II Practical

Programme: Certificate	Year: First	Semester:	
Class: B.Sc.		First	
		Subject: Mathematics	
Course Code: 0120380 NEP Code: B030102P		Course Title: Practical	
Course outcomes:			
CO1: The main objective	of the course is to equi	ip the student to plot the different graph and solve the different types of equations by p	plotting the graph
using different computer so	oftware such as Mathe	matica /MATLAB /Maple /Scilab/Maxima etc.	
		vould be able to know the convergence of sequences through plotting, verify Bolzar	
heorem through plotting th	he sequence, Cauchy's	root test by plotting n^{th} roots and Ratio test by plotting the ratio of n^{th} and $(n + 1)^{th}$ ten	n.
CO3. Student would be ab	le to plot Complex nu	mbers and their representations, Operations like addition, substraction, Multiplication,	Division, Modulus
and Graphical representation	•		
	-	owing task of matrix as Addition, Multiplication, Inverse, Transpose, Determinant	, Rank, Eigenvector
Eigenvalues, Characteristic	equation and verification	tion of the Cayley-Hamilton theorem, Solving the systems of linear equations.	
Credits:		Core Compulsory / Elective	
Max. Marks: 100 Min. Passing Marks: 33			
	Total No	o. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4	
Unit		Topics	No. of Lecture
		ed in Computer Lab. Mathematica /MATLAB /Maple /Scilab/Maxima etc.	
i. Plotting the	graphs of the following	g functions:	
(i) ax			
(ii) [x] (greates	t integer function)		
$(iii) \underline{x^{2n}}; n \in \mathbb{N}$	ĩ		
	N		
$(iv) \underline{x^{2n-1}}$; n \in			
(v) <u>∟;n∈</u> N			
$(v) \underbrace{\underset{x^{2n-1}}{i : n \in \mathbb{N}}}_{x^{2n}} (vi) \xrightarrow{1}; n \in \mathbb{N}$			
$(v) \frac{1}{x^{2n-1}}; n \in N$ $(vi) \frac{1}{x^{2n}}; n \in N$ $(vi) \sqrt{\frac{1}{x^{2n}}}; n \in N$	I	x ≠ 0.	

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UG MATHEMATICS

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	Observe and discuss the effect of changes in the real constants a and b on the graphs.	
	(2) By plotting the graph find the solution of the equation	
	$x = e^x$, $x^2 + 1 = e^x$, $1 - x^2 = e^x$, $x = \log_{10}(x)$, $\cos(x) = x$, $\sin(x) = x$, $\cos(y) = \cos(x)$, $\sin(y) = \sin(x)$ ele	
	 (3) Plotting the graphs of polynomial of degree 2,3, 4 and 5, and their first and second derivatives. (4) Sketching parametric curves, e.g., Trochoid, Cycloid, Epicycloid and Hypocycloid etc. 	1
	(5) Tracing of conic in Cartesian coordinates.	i
	(6) Graph of circular and hyperbolic functions.	
	(7) Obtaining surface of revolution of curves.	
	(8) Complex numbers and their representations, Operations like addition, Multiplication, Division, Modulus. Graphical	1
	representation of polar form.	
	(9) Matrix Operations: Addition, Multiplication, Inverse, Transpose, Determinant, Rank.	
Suggest	ted Readings	

UG MATHEMATICS

B.Sc. I (SEMESTER-II) PAPER-I Matrices and Differential Equations & Geometry

Programm Class: B.S	ie: Certificate	Year: First	Semester: Second		
			Subject: Mathematics		
	de: 0220301 : B0302017		Course Title: Matrices and Differential Equations & Geometry		
Course ou	tcomes:				
COI: The	subjects of the co	urse are designed in s	such a way that they focus on developing mathematical skills in algebra, calculus and analysis	and give i	
depth know	viedge of geometry	y, calculus, algebra ar	nd other theories.		
CO?: The	student will be ab	ole to find the rank, ei	igen values of matrices and study the linear homogeneous and non-homogeneous equations. Th	e course i	
differential	equation intends	to develop problem	solving skills for solving various types of differential equation and geometrical meaning of	differentia	
equation.					
CO3: The	subjects learn an	d visualize the funda	amental ideas about coordinate geometry and learn to describe some of the surface by using	g analytica	
geometry.					
CO1: On	successful comple	etion of the course-	students have gained knowledge about regular geometrical figures and their properties. The	y have th	
	for higher course				
	Credits: 6		Core Compulsory		
1	Max. Marks: 25+	75	Min. Passing Marks:		
		Total No.	of Lectures-Tutorials-Practical (in hours per week): L-T-P: 6-0-0		
		PART-	A. Matrices and Differential Equations		
Unit			Торіся	No. of Lectures	
	Types of Matrices	Elementary operation	ons on Matrices, Rank of a Matrix, Echelon form of a Matrix, Normal form of a Matrix,		
ĭ	Inverseof a Matrix by elementary operations, System of linear homogeneous and non-homogeneous equations, Theorems on				
1	consistency of a system of linear equations.				
	Eigen values, Eigen vectors and characteristic equation of a matrix, Caley-Hamilton theorem and its use in finding inverse of a				
II					
	and hyperbolic fu		on morear and imaginary parts, Exponential and Cogarithinne reactions inverse digonometric	11	
			consetrical meaning of a differential equation, Equation of first order and first degree,		
1		• •			
	III Equation in which the varial			11	

First order higher degree equations solvable for x, y, p, Clairaut's equation and singular solutions, orthogonal trajectories,

Linear differential equation of order greater than one with constant coefficients, Cauchy- Euler form.

PART-B. Geometry

UG MATHEMATICS

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exact form, Linear equations.

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Unit	Topics	No. o
v	General equation of second degree, System of conics, Tracing of conics, Confocal conics in two dimentional geometry.	12
VI	Three-Dimensional Coordinates, Projection and Direction Cosine, Plane (Cartesian and vector form), Straight line in three dimension.	11
VII	Sphere and Cone with related problems	11
VII	Cylinder, Definition only: Central conicoids, Paraboloids, Plane section of conicoids, Generating lines, Confocal conicoids.	n
Suggest	ed Readings (PART-A Matrices and Differential Equations):	
1. Ste	phen H. Friedberg, A.J Insel & L.E. Spence, Linear Algebra, Person	
2. B.	Rai, D.P. Choudhary & H. J. Freedman, A Course in Differential Equations, Narosa	
3. D.,	A. Murray, Introductory Course in Differential Equations, Orient Longman	
4. Տպ	ggested digital plateform:NPTEL/SWAYAM/MOOCs	
5. Co	urse Books published in Hindi may be prescribed by the Universities.	
Suggest	ed Readings (Part-B Geometry):	
1. Robe	rt J.T Bell, Elementary Treatise on Coordinate Geometry of three dimensions, Macmillan India Ltd.	
2. P.R. V	/ittal, Analytical Geometry 2d & 3D, Pearson.	
3. S.L. I	oney, The Elements of Coordinate Geometry, McMillan and Company, London.	
4. R.J.T	Bill, Elementary Treatise on Coordinate Geometry of Three Dimensions, McMillan India Ltd., 1994.	
5. Sugg	ested digital plateform:NPTEL/SWAYAM/MOOCs	
6. Cours	e Books published in Hindi may be prescribed by the Universities.	
bis cour CA, Sc.(C.S	se can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), Economics(UG/PG), Commerce(UG),	BBA/
	Suggested Continuous Evaluation Methods: Max. Marks: 25	
		x. Mark
1	Туре	

N	Туре	
1	Class Tests	10
2	Online Quizzes/ Objective Tesis	5
3	Presentation	5
4	Assignment	5
Co	surse prerequisites: To study this course, a student must have subject Mathematics in class 12th	
Su	ggested equivalent online courses:	
Fu	rther Suggestions:	



B.Sc.(Mathematics)-II Year Diploma in Mathematics

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B.Sc.II (SEMESTER-III) PAPER-I Algebra & Mathematical Methods

	mme: Diploma ass: B.Sc.	Year: Second Semester: Third	
		Subject: Mathematics	
	Code: 0320301 Ie: B030301T	Course Title: Algebra & Mathematical Methods	
CO1: Gr theory an CO2: A s in advance CO3: Th CO4: Or	d their properties. student learning this ed mathematics and e course gives empl	basis to enhance students' knowledge of functions of two variables, Laplace Transforms, Fourie tion of the course students should have knowledge about higher different mathematical metho	lead the student to basic course
	Credits: 6	Core Compulsory	
	Max. Marks: 25-	-75 Min. Passing Marks:	
		Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 6-0-0	
		Part- A. Algebra	
Unit		Topics	No. o Lectur
ľ	(CIE). Equivalence rela	Indian ancient Mathematics and Mathematicians should be included under Continuous Inter- tions and partitions, Congruence modulo n, Definition of a group with examples and simple rators of a group, Cyclic groups.	
	Permutation grou	ups, Even and odd permutations, The alternating group, Cayley's theorem, Direct products,	Coset
		agrange's theorem and its consequences, Fermat and Euler theorems	11
II	decomposition, L	aspringers theorem and has equipoquences, remain and galor theorems	
II III		ps, Quotient groups, Homomorphism and isomorphism, Fundamental theorem of homomorphism	orphism, Theorems 11
	Normal subgrou on isomorphism.	ps, Quotient groups, Homomorphism and isomorphism, Fundamental theorem of homomorphism	

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		Part- B	
		Mathematical Methods	
	Unit	Topics	No. of Lecture
	v	Limit and Continuity of functions of two variables, Differentiation of function of two variables, Necessary and sufficient condition for differentiability of functions two variables, <u>Schwarz's</u> , <u>Young theorem</u> , <u>Taylor's theorem</u> (Statements only) for functions of two variables with examples, Maxima and minima for functions of two variables, Lagrange multiplier method(without proof), Jacobians.	12
	vı	Existence theorems for Laplace transforms, Linearity of Laplace transform and their properties, Laplace transform of the derivatives and integrals of a function, Convolution theorem, inverse Laplace transforms, Solution of the differential equations using Laplace transforms.	11
	VII	Fourier series, Fourier expansion of piecewise monotonic functions, Half and full range expansions, Fourier transforms (finite and infinite).	11
	VIII	Calculus of variations-Variational problems with fixed boundaries- Euler's equation for functionals containing first order derivative and one independent variable, Extremals, Functionals dependent on higher order derivatives.	11
S	uggeste	d Readings(Part-A Algebra):	
	1. J.B.	Fraleigh, A first course in Abstract Algebra, Addison-weley	
	2. I. N	. Herstein, Topics in Algebra, John Wiley & Sons	
	3. Sug	gested digital plateform: NPTEL/SWAYAM/MOOCS	
	4. Co	urse Books published in Hindi may be prescribed by the Universities.	
S	uggeste	d Readings (Part- B Mathematical Methods):	
1	. T.M. A	Apostal, Mathematical Analysis, Person	
2	. G.F. S	immons, Differential Equations with Application and Historical Notes, Tata -McGrawHill	
3	. Erwin	Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.	
4	I. Sugge	sted digital plateform: NPTEL/SWAYAM/MOOCs	
5	. Cours	e Books published in Hindi may be prescribed by the Universities.	
Гh	is cours	e can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.)	
		Suggested Continuous Evaluation Methods: Max. Marks: 25	
S		Assessment Ma Type	ax. Marks
1	Class	Tests	10
2	Onlir	ne Quizzes/ Objective Tests	5
3	Prese	ntation	5
4	Assig	nment (Introduction to Indian ancient Mathematics and Mathematicians)	5
Co	urse pr	erequisites: To study this course, a student must have subject Mathematics in class 12th	
Su	ggested	equivalent online courses:	

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B.Sc. II (SEMESTER-IV) PAPER-I Differential Equations & Mechanics

Programme: Diploma Class: B.Sc.	Year: Second	Semester: Fourth	
		Subject: Mathematics	
Course Code: 0420301 NEP Code: B030401T		Course Title: Differential Equations & Mechanics	
Course outcomes:			

CO1: The objective of this course is to familiarize the students with various methods of solving differential equations, partial differential equations of first order and second order and to have qualitative applications.

CO2: A student doing this course is able to solve differential equations and is able to model problems in nature using ordinary differential equations. After completing this course, a student will be able to take more courses on wave equation, heat equation, diffusion equation, gas dynamics, non linear evolution equation etc. These entire courses are important in engineering and industrial applications for solving boundary value problem.

CO3: The object of the paper is to give students knowledge of basic mechanics such as simple harmonic motion, motion under other laws and forces.

CO4: The student, after completing the course can go for higher problems in mechanic such as hydrodynamics, this will be helpful in getting employment in industry.

Credits: 6	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks:
Total No. of Lect	ures-Tutorials-Practical (in hours per week): L-T-P: 6-0-0

Part- A

Differential Equations

Unit	Topics	No. of Lectures
I	Second order linear differential equations with variable coefficients: Use of a known solution to find another, normal form, method of undetermined coefficient, variation of parameters.	11
п	Elementary idea of Power series solutions of second order ordinary differential equations(ODE); Bessels and Legender functions and their properties	12
III	Origin of first order partial differential equations. Partial differential equations of the first order and degree one, Lagrange's solution, Partial differential equation of first order and degree greater than one. Charpit's method of solution,	IJ
IV	Origin of second order PDE, Solution of partial differential equations of the second and higher order with constant coefficients, Classification of linear partial differential equations of second order, Solution of second order partial differential equations with variable coefficients, Monge's method of solution.	11

Part- B	
Mechanics	Kri

	Unit ·	Topic s	No. of Lecture S
	v	Frame of reference, work energy principle, Forces in three dimensions, Poinsot's central axis, Wrenches, Null lines and planes.	
	VI	I Virtual work, Stable and Unstable equilibrium.	
	VII	Velocities and accelerations along radial and transverse directions, and along tangential and normal directions. Simple Harmonic motion, Motion under other law of forces. Elastic strings, Motion in resisting medium,	11
	VIII	Constrained motion, Motion on smooth and rough plane curves. Central orbit, Kepler's laws of motion, Motion of particle in three dimensions	12
Sı	ggeste	d Readings(Part-A Differential Equations):	
1	. G.F. Si	immons, Differential Equations with Application and Historical Notes, Tata -McGrawHill	
2	. B. Rai	, D.P. Choudhary & H. J. Freedman, A Course of Ordinary Differential Equations, Narosa	
3	. Ian N.	Snedden, Elements of Partial Differential Equations, Dover Publication	
4	. L.E. E	lsgolts, Differential Equation and Calculus of variations, University Press of the Pacific.	
5	. Sugges	sted digital plateform:NPTEL/SWAYAM/MOOCs	
6	. Course	Books published in Hindi may be prescribed by the Universities.	
Su	iggested	l Readings(Part-B Mechanics):	
	1. R.C.	Hibbeler, Engineering Mechanics-Statics, Prentics Hall Publishers	
	2. R.C.	Hibbeler, Engineering Mechanics-Dynamics, Prentics Hall Publishers	
	3. A.N	lelson, Engineering Mechanics Statics and Dynamics, Tata McGraw Hill	
	4. J.L.	Synge & B.A. Griffith, Principles of Mechanics, Tata McGraw Hill	
	5. Sugg	gested digital plateform:NPTEL/SWAYAM/MOOCs	
	6. Cour	rse Books published in Hindi may be prescribed by the Universities.	
bi	s course	e can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), Economics(UG/PG), B.Sc.(C.S.)	
		Suggested Continuous Evaluation Methods: Max. Marks: 25	
1		Assessment Ma Type	x. Marks
	Class '	Tests	10
	Onlin	e Quizzes/ Objective Tests	5
	Presen	itation	5
1	Assign	ment	5
01	urse pr	erequisites: To study this course, a student must have Certificate Course in Applied Mathematics	
ug	gested	equivalent online courses:	
ur	ther Su	iggestions:	

B.Sc.(Mathematics)-III Year Degree in Mathematics

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B.Sc. III (SEMESTER-V) PAPER-I Group and Ring Theory & Linear Algebra

Programm Class: B.S	ne: Degree Sc.	Year: Third	Semester: Fifth	
			Subject: Mathematics	
	ode: 0520301 e: B030501T		Course Title: Group and Ring Theory & Linear Algebra	
andsome o CO2: Stud the relevan CO3: The	er algebra is a bas f its applications. lents will be able at fields. student will use t	to know the concepts of	ranches of science. The objective of this course is to introduce a student to the basics of linear a group, ring and other related properties which will prepare the students to take up further appli ter science, finance mathematics, industrial mathematics and bio mathematics. After completion e.	cations in
	Credits: 5		Core Compulsory	
	Max. Marks: 25+75 Min. Passing Marks: 33			
		Total No. of Lect	ures-Tutorials-Practical (in hours per week): L-T-P: 5-0-0	
			PART-A	
			Group and Ring Theory	
Unit			Topics	No. of Lectures
I	(CIE).		natics and Mathematicians should be included under Continuous Internal Evaluation atomorphism groups, Automorphism groups of finite and infinite cyclic groups.	. 10
II	Characteristic su	bgroups, Commutator su	abgroup and its properties; Applications of factor groups to automorphism groups.	10
III			ings, Division algorithm and consequences, Principal ideal domains, Factorization of oility tests, Eisenstein criterion.	9
	Divisibility in in	tegral domains, Irreducil	oles, Primes, Unique factorization domains, Euclidean domains.	9

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	PART-B	
	Linear Algebra	
Unit	Topics	No. of Lecture:
v	Vector spaces, Subspaces, Linear independence and dependence of vectors, Basis and Dimension, direct sum and Quotient space.	10
VI	Linear transformations, The Algebra of linear transformations, rank and null space.	9
VI	Rank nullity theorem, their representation as matrices., Change of basis, Characteristic values, Cayley Hamilton Theorem.	9
VI	Inner product spaces and norms, Cauchy-Schwarz inequality, Orthogonal vectors, Orthonormal sets and bases, Bessel's inequality for finite dimensional spaces, Gram-Schmidt orthogonalization process.	9
	se Books published in Hindi may be prescribed by the Universities. urse can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), BCA, B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25	
S	Assessment Type Max. N	larks
Class Tests		10
2 0	line Quizzes/ Objective Tests	5
Pr	isentation	5
As	ignment (Introduction to Indian ancient Mathematics and Mathematicians)	
-		5
Course	prerequisites: To study this course, a student must have Diploma in Mathematics	5
	prerequisites: To study this course, a student must have Diploma in Mathematics ted equivalent online courses:	5

UG MATHEMATICS

B.Sc. III (SEMESTER-V) PAPER-II (i) Number Theory & Game Theory

Program	nme: Degree	Year: Third	Semester: Sixth		
Class: B	B.Sc.				
			Subject: Mathematics		
Course (Code: B	Code: 0520302 030502T		Course Title: Number Theory & Game Theory		
Course o	outcomes:				
CO1: Up elementa		ompletion, students wi	Il have the knowledge and skills to solve problems in elementary number theory and also apply		
number t	heory to cryptogr	raphy.			
ma the CO3: A stra	aking process of erefore help impro situation is strate ategic.	interdependent subject ove decision making. gic if the outcome of a	iame Theory. Game Theory is a mathematical framework which makes possible the analysis of the test. It is aimed at explaining and predicting how individuals behave in a specific strategic situate a decision problem depends on the choices of more than one person. Most decision problems in respect, case studies, and classroom experiments might be used.	lation, and	
	Credits: 5		Elective		
	Max. Marks: 2	25+75	Min. Passing Marks: 33		
~		Total N	p. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 5-0-0		
			Part- A		
			Number Theory		
Unit			Topics	No. of Lectures	
T	Theory of Numbers Divisibility; Euclidean algorithm; primes; congruences; Fermat's theorem, Euler's theorem and Wilson's theorem; Fermat's quotients and their elementary consequences; solutions of congruences; Chinese remainder theorem.			10	
п	Congruences Congruence modulo powers of prime; primitive roots and their existence; quadratic residues; Legendre symbol, Jacobi symbol, Mobious Function and Euler's phi Function.			9	
LII	Diophantine Equations				
	Solutions of $ax + by = c$, $x^n + y^n = z^n$; properties of Pythagorean triples; sums of two and four squares; assorted examples of				
	diophantine equations.				
IV	Generating Functions and Recurrence Relations Generating Function Models, Calculating coefficient of generating functions, Partitions, Exponential Generating Functions, A Summation Method. Recurrence Relations: Recurrence Relation Models, Divide and conquer Relations, Solution of Linear, Recurrence Relations, Solution of Inhomogeneous Recurrence Relations, Solutions with Generating Functions.			9	

UG MATHEMATICS

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	Game Theory			
Unit	Topic s	No. of Lectur		
v	Introduction, overview, uses of game theory, some applications and examples, and formal definitions of: the normal form, payoffs, strategies, pure strategy Nash equilibrium.			
VI	Introduction, characteristic of game theory, Two- person zero-sum game, Pure and Mixed strategies, Saddle point and its existence.	10		
vп	Fundamental Theorem of Rectangular games, Concept of Dominance, Dominance and Graphical method of solving Rectangulargames.			
VIII	Relationship between rectangular game and Linear Programming Problem, Solving rectangular game by Simplex method, reduction of $n x n$ game and solution of $2x2$, $2 x s$, and $r x 2$ cases by graphical method.			
1 Vilor	Osborne, An Introduction to Game Theory, Oxford University Press, 2003			
3.Prajit D 5. Allan N 6. Sugges	Crishna, Game Theory, Academic Press. Outra, Strategies and Games, MIT Press, (Website 1) <u>http://www.ecc.stevens-tech.edu/-ccomanie/ce800c.html</u> MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 sted digital plateform:NPTEL/SWAYAM/MOOCS Books published in Hindi may be prescribed by the Universities.			
3. Prajit D 5. Allan N 6. Sugges 7. Course	Krishna, Game Theory, Academic Press. Dutta, Strategies and Games, MIT Press, (Website 1) <u>http://www.ecc.stevens-tech.edu/~ccomanic/ce800c.html</u> MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 sted digital plateform:NPTEL/SWAYAM/MOOCS			
3. Prajit D 5. Allan N 6. Sugges 7. Course	Krishna, Game Theory, Academic Press. Autta, Strategies and Games, MIT Press, (Website 1) <u>http://www.ecc.stevens-tech.edu/-ccomanic/ce800c.html</u> MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 sted digital plateform:NPTEL/SWAYAM/MOOCS Books published in Hindi may be prescribed by the Universities.			
3. Prajit D 5. Allan N 6. Sugges 7. Course	Crishna, Game Theory, Academic Press. Autta, Strategies and Games, MIT Press, (Website 1) <u>http://www.ecc.stevens-tech.edu/-ccomanie/ce800c.html</u> MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 sted digital plateform:NPTEL/SWAYAM/MOOCS Books published in Hindi may be prescribed by the Universities. se can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25	x. Marks		
3. Prajit D 5. Allan N 6. Sugges 7. Course This cour	Krishna, Game Theory, Academic Press. Dutta, Strategies and Games, MIT Press, (Website 1) http://www.ecc.stevens-tech.edu/-ccomanie/ce800c.html MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 Sted digital plateform:NPTEL/SWAYAM/MOOCS Books published in Hindi may be prescribed by the Universities. se can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment	x. Marks 10		
3. Prajit D 5. Allan N 6. Sugges 7. Course This cour S N t Class	Krishna, Game Theory, Academic Press. Putta, Strategies and Games, MIT Press, (Website 1) http://www.ecc.stevens-tech.edu/-ccomanie/ce800c.html MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 Sted digital plateform:NPTEL/SWAYAM/MOOCS Books published in Hindi may be prescribed by the Universities. See can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Ma Type			
3. Prajit D 5. Allan N 6. Sugges 7. Course This cour S N 1. Class 2. Onli	Strishna, Game Theory, Academic Press. Dutta, Strategies and Games, MIT Press, (Website 1) http://www.ecc.atevens-tech.edw/-ecomanite/ce800c.html MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 sted digital plateform:NPTEL/SWAYAM/MOOCS Books published in Hindi may be prescribed by the Universities. se can be opted as an elective by the students of following subjects: Engg, and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Type s Tests	10		
3. Prajit D 5. Allan N 6. Sugges 7. Course This cour S N t Class 2 Onli 3 Prese	Krishna, Game Theory, Academic Press. Putta, Strategies and Games, MIT Press, (Website 1) http://www.ecc.stevens-tech.edu/-ccomanie/ce800c.html MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 Sted digital plateform:NPTEL/SWAYAM/MOOCS Books published in Hindi may be prescribed by the Universities. sec can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Ma Type Type	10 5		
3. Prajit D 5. Allan N 6. Sugges 7. Course This cour S N 1 Class 2 Onli 3 Prese 4 Assig	Krishna, Game Theory, Academic Press. Putta, Strategies and Games, MIT Press, (Website 1) http://www.ecc.stevens-tech.edu/-ccomanie/ce800c.html MacKenzie, Game Theory for Wireless Engineers, Synthesis lectures on Communications, 2006 Sted digital plateform:NPTEL/SWAYAM/MOOCS Books published in Hindi may be prescribed by the Universities. se can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.) Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Ma Type s s Tests in e Quizzes/ Objective Tests	10 5 5		

UG MATHEMATICS

Programme: Degree Year: Third Semester: Sixth Class: B.Sc. Subject: Mathematics Course Code: 0520303 Course Title: Graph Theory & Discrete Mathematics NEP Code: B030502T Course outcomes: CO1: Upon successful completion, students will have the knowledge of various types of graphs, their terminology and applications. CO2: After Successful completion of this course students will be able to understand the isomorphism and homomorphism of graphs. This course covers the basic concepts of graphs used in computer science and other disciplines. The topics include path, circuits, adjacency matrix, tree, coloring.. After successful completion of this course the student will have the knowledge graph coloring, color problem, vertex coloring. CO3: After successful completion, students will have the knowledge of Logic gates, Kamaugh maps and skills to proof by using truth tables. After Successful completion of this course students will be able to apply the basics of the automation theory, transition function and table. CO4: This course covers the basic concepts of discrete mathematics used in computer science and other disciplines that involve formal reasoning. The topics include logic, counting, relations, hasse diagram and Boolean algebra. After successful completion of this course the student will have the knowledge in Mathematical reasoning, combinatorial analysis, discrete structures and Applications. Credits: 5 Elective Max. Marks: 25+75 Min. Passing Marks: 33 Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 5-0-0 Part-A **Graph Theory** No. of Unit Topics Lectures 10 1 Introduction to graphs, basic properties of graphs, Simple graph, multi graph, graph terminology, representation of graphs, Bipartite, regular, planar and connected graphs, connected components in a graph, Euler graphs, Directed, Undirected, multi-graph, mixed graph.

Walk and unilateral components, unicursal graph, Hamiltonian path and circuits, Graph colouring, chromatics number, isomorphism

Operation of graph circuit, Path and circuits, Eulerian circuits, Hamiltonian path and cycles, Adjacency matrix, Weighted

Tree, Binary and Spanning trees, Coloring, Color problems, Vertex coloring and important properties.

and homomorphism of graphs, Incidence relation and degree of the graph.

graph, Travelling salesman problem, Shortest path, Dijkstra's algorithm.

B.Sc. III (SEMESTER-V) PAPER-II (ii) Graph Theory & Discrete Mathematics

UG MATHEMATICS

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III

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	Part- B		
Un	Unit Topics	.5	No. of Lecture
	 Propositional Logie- Proposition logic, basic logic, logical connectives, true (conjunctive and disjunctive), modus ponens and modus tollens, validity, pred proofby implication, converse, inverse contrapositive, contradiction, direct proof 	cate logic, universal and existential quantification,	10
	Relation - Definition, types of relation, domain and range of a relation, pictori partial ordering relation, Representation of Posets using Hasse Diagram, Chains, its basic properties		10
	VII Boolean Algebra- Basic definitions, Sum of products and products of sums, Logi	gates Switching Circuits and Kamaugh maps	9
	VIII Combinatories- Inclusion- exclusion, recurrence relations (nth order recurrence recurrence relations), generating function (c recurrence relations using G.F. solution of combinatorial problem using G.F.)		9
Sug	Suggested Readings (Part-A Graph Theory):		
N R 4. S	 Discrete Mathematics with computer application by Trembley and Manohar. 3.Discrete Mathematics and Its Applications by Kenneth H. Rosen Suggested digital plateform:NPTEL/SWAYAM/MOOCS Course Books published in Hindi may be prescribed by the Universities. 		
	This course can be opted as an elective by the students of following subjects: Engg. and Tech.	(UG) B Se (C S)	
	Suggested Continuous Evaluation Methods: Ma		
S	S Assessment Type	Max. M	arks
1	1 Class Tests		10
2	2 Online Quizzesi Objective Tests		5
3	3 Presentation		5
4	4 Assignment		5
Cor	Course prerequisites: To study this course, a student must have Diploma in Mathematics		
·—	Suggested equivalent online courses:		-
Sug	Beorea educidante oparacat		

UG MATHEMATICS

B.Sc. III (SEMESTER-V) PAPER-II (iii) Differential Geometry & Tensor Analysis

Program Class: E	nme: Degree 3.Sc.	Year: Third	Semester: Sixth	
			Subject: Mathematics	
	Code: 0520304 de: B030502T		Course Title: Differential Geometry & Tensor Analysis	
Course	outcomes:			
			students should be able to determine and calculate curvature of curves in different coordinate syst arves, Local theory of surfaces, Geodesics, Geodesics curvature, Geodesic polars, Curvature o	
on surfac	ces, Gaussian curva	ature, Normal curvature	e etc.	
	er Successful comp instein space and E		tudents should have the knowledge of tensor algebra, different types of tensors, Riemannian sp	bace, Ricci
	Credits: 5		Elective	
	Max. Marks: 25	5+75	Min. Passing Marks: 33	
		Total No.	of Lectures-Tutorials-Practical (in hours per week): L-T-P: 5-0-0	
			Part- A	
			Differential Geometry	
				No. of
Unit			Topics	
I	rectifying plane	, Osculating circle, os	Examples, Plane Curves, tangent and normal and binormal, Osculating Plane, normal plane and culating sphere Helices, Serret-Frenet apparatus, contact between curve and surfaces, tangent ves, Bertrand curves, Intrinsic equations, fundamental existence theorem for space curves.	10
п			patches on surface curve of a surface, family of surfaces (one parameter), edge of urfaces and developable surfaces, surfaces of revolution, Helicoids.	9
Metric-first fundamental form and are length. Direction coefficients, families of curves, intrinsic properties, geodesics, canonicalgeodesic equations, normal properties of geodesics, geodesics curvature, Geodesic polars.			9	
IV			urves on surfaces, Gaussian curvature, normal curvature, Meusneir's theorem, mean points, lines of curvature, Rodrigue's formula, Euler's theorem.	9

		Part-B			
		Tensor Analysis	_		
	Unit Topic s				
	v	Tensor algebra: Vector spaces, the dual spaces, tensor product of vector spaces, transformation formulae, contraction, special tensors-symmetric tensor, inner product, associated tensor with examples.	10		
	VI	Tensor Analysis: Contravariant and covariant vectors and tensors, Mixed tensors, Symmetric and skew-symmetric tensors, Algebra of tensors, Contraction and inner product, Quotient theorem, Reciprocal tensors, Christoffel's symbols, Law of transformation of Christoffel's symbols, Covariant differentiation, non- commutativity of Covariant derivative.	10		
	VII	Gradient of scalars, Divergence of a contravariant vector, covariant vector and conservative vectors, Laplacian of an invariant, curl of acovariant vector, irrotational vector, with examples.	9		
	VIII	Riemannian space, Riemannian eurvatures and their properties, geodesics, geodesic curvature, geometrical interpretation of curvaturetensor, Ricci tensor, scalar curvature, Einstein space and Einstein tensor.	9		
Su	7. An 8. Ten 9. Sugg 10. Cou ggested 1. Tens 2. Dav 3. R. S 4. Sugg 5. Cour	 Spain, Tensor Calculus: A Concise Course, Dover Publications, 2003. Introduction to Differential Geometry (with the use of tensor Calculus), L. P. Eisenhart, Princeton University Press, 1940. sor Analysis, Theory and Applications to Geometry and Mechanics of Continua, 2nd Edition, I. S. Sokolnikoff, John Wiley and Sons., 19 ested digital plateform:NPTEL/SWAYAM/MOOCs use Books published in Hindi may be prescribed by the Universities. Readings (Part-B Tensor Analysis): ors- Mathematics of Differential Geometry by Z. Ahsan, PHI,2015 id C. Kay, Tensor Analysis, Schaum's Outline Series, McGraw Hill 1988. Mishra, A Course in Tensors with Applications to Reimannian Geometry, Pothishala Pvt. Ltd, Allahabad. ested digital plateform:NPTEL/SWAYAM/MOOCS 	964.		
Thi	s course	e can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.)			
Sn		Suggested Continuous Evaluation Methods: Max. Marks: 25 Assessment Type Max. M	Aarks		
	Class		10		
		e Quizzes/ Objective Tests	5		
	Preser		5		
	Assign	ment	5		
-	rse pro	requisites: To study this course, a student must have Diploma in Mathematics			
_01	rested	equivalent online courses:			
-	Besteu				

UG MATHEMATICS

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B.Sc. III (SEMESTER-VI) PAPER-I METRIC SPACES & COMPLEX ANALYSIS

Program Class: B	me: Degree	Year: Third	Semester: Sixth	
C1433. 1			Subject: Mathematics	
	Code: 0620301 le: B030601T		Course Title: METRIC SPACES & COMPLEX ANALYSIS	
Course o	utcomes:			
CO1: Th	e course is aimed a	at exposing the students	to foundations of analysis which will be useful in understanding various physical phenome	na and gives
the studer	nt the foundation i	n mathematics.		
CO2: Afi	ter completion of t	his course the student w	ill have rigorous and deeper understanding of fundamental concepts in Mathematics. This v	vill be helpful
to the stu	dent in understand	ing pure mathematics ar	nd in research,	
CO3: St	udents will be able	to know the concepts o	f metric space, basic concepts and developments of complex analysis which will prepare th	e students to
take un fu	uther applications	in the relevant fields.		
and up it	Credits: 4	in the relevant neitas	Core Compulsory	
	Max. Marks: 25	+75	Min. Passing Marks: 33	
		Total No. of Y	ectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0	
Unit			Part- A. Metric Spaces	No. of Lectures
	Basic Concepts			
I	Metric spaces: I	Definition and examples	, diameters in Metric Space. Bounded and Unbounded Metric Space.	8
	Topology of Me	tric Spaces		
u	Open and closed set.Subspaces, D	÷ .	pen set, Interior of a set, limit point of a set, derived set, closed set, closure of a	8
	Completeness i	n Metric Spaces		
III	Sequences in metric spaces, Cauchy sequences, Complete metric space with Examples, Cantor intersection Theorem		uences, Complete metric space with Examples, Cantor intersection Theorem	7
	Continuity & U	Iniform Continuity in	Metric Spaces	
757	Continuous map	pings, Sequential criteri	on and other characterizations of continuity, Uniform continuity, Homeomorphism,	
IV	Contraction mapping, Banach fixed point theorem		7	

UG MATHEMATICS

	Part- B	
	Complex Analysis	
Unit Topics		No. of Lecture
v	Functions of complex variable, Mappings; Mappings by the exponential function, Limits, Theorems on limits, Limits involving the point at infinity, Continuity, Derivatives, Differentiation formulae,	8
VI	Cauchy-Riemann equations, Sufficient conditions for differentiability; Analytic functions and their examples, Harmonic Function, method of construction of a regular function(Milne-Thomson's Method	8
VII	Conformal Mapping, necc. & suff. Condition; inverse point, bilinear transformation, critical point, cross ratio, fixed point.	7
VIII	Exponential functions, Logarithmic functions, branches and derivative of logarithmic function, Trigonometric functions, Derivative of functions. Definite integral of functions, contour integrals and its examples, upper bound for moduli of contour integrals	7
I. Functio 2. Compl 3. Sugges 4. Course	d Readings (Part-B Complex Analysis): n of Complex Variable by Shanti Narain. ex variable and applications by Brown & Churchill. ted digital plateform:NPTEL/SWAYAM/MOOCS. Books published in Hindi may be prescribed by the Universities. se can be opted as an elective by the students of following subjects: Engg. and Tech. (UG), B.Sc.(C.S.)	
	Suggested Continuous Evaluation Methods: Max. Marks: 25	
S V	Assessment Ma Type	x. Marks
Class	Tests	10
Onli	ne Quizzes/ Objective Tests	5
Prese	entation	5
Assig	nment	5
Course p	rerequisites: To study this course, a student must have Diploma in Mathematics	
	d equivalent online courses:	
Further S	Suggestions:	

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B.Sc. III (SEMESTER-VI) PAPER-II Numerical Analysis & Operation Research

Class: B.	me: Degree .Sc.	Year: Third	Semester: Sixth	
			Subject: Mathematics	
	ode: 0620302 e: B030602T		Course Title: Numerical Analysis & Operations Research	
Course of	utcomes:			
CO1: The	e aim of this cours	e is to teach the student	the application of various numerical technique for variety of problems occurring in daily life. A	t the end
ofthe cour	rse the student will	l be able to understand t	the basic concept of Numerical Analysis and to solve algebraic and differential equation.	
CO2: The	e main outcome w	vill be that students wil	Il be able to bandle problems and finding approximated solution. Later he can opt for advance	e course
in Numeri	ical Analysis in hi	gher Mathematics.		
CO3: The	e student will be al	ble to solve various pro	blems based on convex sets and linear programming. After successful completion of this paper	will
enable the	students to apply	y the basic concepts of	f transportation problems and its related problems to apply in further concepts and	
applicatio	n of operations			
research.				
	Credits: 4		Core Compulsory	
Max. Man	rks: 25+75	PI	Min. Passing Marks: 33	•••
		Total No. of	f Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0	
			PART-A	
			Numerical Analysis	
Unit			Numerical Analysis Topics	No, of
Unit				No, of Lectures
Unit	Errors in compu	tations, floating point re		1943
Unit		•	Topics	1975
	relative errors, c	omputation of errors us	Topics epresentation of numbers, significant digits, rounding and chopping errors, absolute and	Lecture
	relative errors, c bisection, Secan	omputation of errors us t, Regular Falsi, Newton	Topics epresentation of numbers, significant digits, rounding and chopping errors, absolute and ing differentials, truncation errors. Solution of algebraic and transcendental equations; n Raphson's method, Newton's method for multiple roots.	Lecture
	relative errors, c bisection, Secan	omputation of errors us t, Regular Falsi, Newton e differences, Interpolati	Topics epresentation of numbers, significant digits, rounding and chopping errors, absolute and ing differentials, truncation errors. Solution of algebraic and transcendental equations;	Lecture: 8
I	relative errors, c bisection, Secan Caculus of finite formula using di	omputation of errors us t, Regular Falsi, Newton differences, Interpolati fferences.	Topics epresentation of numbers, significant digits, rounding and chopping errors, absolute and ing differentials, truncation errors. Solution of algebraic and transcendental equations; n Raphson's method, Newton's method for multiple roots.	Lecture: 8
I	relative errors, c bisection, Secan Caculus of finite formula using di Numerical differ	omputation of errors us t, Regular Falsi, Newton differences, Interpolati fferences. entiation using Newton	Topics epresentation of numbers, significant digits, rounding and chopping errors, absolute and ing differentials, truncation errors. Solution of algebraic and transcendental equations; n Raphson's method, Newton's method for multiple roots. ion, Lagrange and Hermite interpolation, Newton's Divided difference formula, Interpolation	Lecture: 8 8
I	relative errors, c bisection, Secan Caculus of finite formula using di Numerical differ formula. Numeri	omputation of errors us t, Regular Falsi, Newton e differences, Interpolati fferences. rentiation using Newton ical Integration: Trapezo	Topics epresentation of numbers, significant digits, rounding and chopping errors, absolute and ing differentials, truncation errors. Solution of algebraic and transcendental equations; in Raphson's method, Newton's method for multiple roots. ion, Lagrange and Hermite interpolation, Newton's Divided difference formula, Interpolation 's forwarded and backward formula, differentiation by central and divided difference	Lecture 8 8

	PART-B. Operatio	ons Research	
Unit	Jnit Topics		No. of Lecture
v	V Introduction, Linear programming problems, statement and formation of general linear programming problems, graphical method, slack and surplus variables, standard and matrix forms of linear programming problem, basic feasible solution.		
VI	Convex sets, fundamental theorem of linear programming, basic solution two phase method Big-M method and their comparison.	n, Simplex method, introduction to artificial variables,	8
VII	Resolution of degeneracy, duality in linear programming problems, prinsensitivity analysis.	nal dual relationships, revised simplex method,	7
VIII	Transportation problems, assignment problems.		7
Suggeste	ted Readings(Part-A Numerical Analysis):		-
1. Numer	rical Methods for Engineering and scientific computation by M. K. Jain, S.R.I	K. Iyengar & R.K. Jain.	
2. Introdu	uctory methods of Numerical Analysis by S. S. Sastry		
3. Sugges	sted digital plateform:NPTEL/SWAYAM/MOOCs		
4. Course	e Books published in Hindi may be prescribed by the Universities.		
Suggeste	ed Readings(Part-B Operation Research):		
I.Taha, H	Hamdy H, "Opearations Research- An Introduction ", Pearson Education.		
2.Kanti S	Swarup , P. K. Gupta, Man Mohan Operations research, Sultan Chand & So	ns	
3.Hillier	Frederick S and Lieberman Gerald J., "Operations Research", McGraw Hill J	Publication.	
4.Winston	on Wayne L., "Operations Research: Applications and Algorithms", Cengage J	earning, 4 th Edition.	
5.Hira D.	S. and Gupta Prem Kumar, "Problems in Operations Research: Principles and	d Solutions", S Chand & Co Ltd.	
5. Kalava	athy S., "Operations Research", S Chand.		
7. Sugges	sted digital plateform:NPTEL/SWAYAM/MOOCs.		
. Course	Books published in Hindi may be prescribed by the Universities.		
This cours	rse can be opted as an elective by the students of following subjects: Engg. an	d Tech. (UG), Economics(UG/PG), B.Sc.(C.S.)	
	Suggested Continuous Evaluation Ma	thods: Max. Marks: 25	
S .	Assessment Type	Max.	Marks
Class	s Tests .		10
Onli	ine Quizzes/ Objective Tests		5
Prese	entation		5
Assig	gnment		5
Course p	prerequisites: To study this course, a student must have Certificate Course	in Applied Mathematics	
Suggestee	d equivalent online courses:		
urther S	Suggestions:		

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UG MATHEMATICS

B.Sc. III (SEMESTER-VI) PAPER-III Practical

5	ime: Degree	Year: Third	Semester: Sixth	
Class: B	.Sc.			
			Subject: Mathematics	
Course Code: 0620380 Course Title: Practical NEP Code: B030603P		Course Title: Practical		
ordinary	utcomes:The main differential equation (up to third	n objective of the cou ons, Interpolation, Nur	rse is to equip the student to solve the transcendental and algebraic equations, system of line merical Integration, Method of finding Eigenvalue by Power method (up to 4×4), Fitting	ar equations a Polynomia
	Credits: 2		Core Compulsory	
Max. Ma	rks: 100		Min. Passing Marks: 33	
		Total No.	of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4	
Unit			Topics	No. of
				Lecture
Suggester	i) Bise ii) Nev iii)Secant m iv)Regula Fi 2. Solution of sy i) LU ii) Gat iii)Gauss-Ja iv)Gauss-Se 3. Numerical Int (i) Trap (ii) Sim (iii) Sim	ethod. alsi method. stem of linear equatio decomposition metho issian elimination met cobi method idel method	(Simple root, multiple roots, complex roots). ns d hod	

UG MATHEMATICS

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B.Sc.(MATHEMATICS) Honours with Research Or Graduate in Mathematics Honours with Research

UG MATHEMATICS

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	COURSE-I : Abstract Algebra	
Programme/Class: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Seventh
Course Code: 0720321	Course Title: Abstract Algebra	Theory

Course Objectives: Acquiring ability for defining algebraic structures, constructing substructures, analyzing a given structure, developing new structures based on given structures, and comparing structures.

Course Outcomes (CO's):

CO1. Ability to solve non-trivial problems based on various concepts in the course.

CO2. Determining the connection and transit amid formerly studied mathematics (discrete mathematics) and advanced mathematics (advanced abstract mathematics).

CO3. Ability to apply abstract algebra to solve problems in other branches of mathematics and also in other disciplines.

CO4. Describing relationship between Abstract Algebra and other courses in mathematics.

COS. Understanding the dependency of results based on earlier results, and thereby developing a correct approach towards life realizing the deep connection among past, present and future. For example, in ring theory, the ring of polynomials over a field is a gift of the division algorithm.

CO6. Possessing pre-requisites for pursuing research in Cryptography

Credits: 4	Core Compulsory	Max Marks (Int. + Ext.): 25+75 Total = 100 Minimum Marks: 40
Ter	aching Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0 (Four Hours in a week) or 60 Lecture Hours in a	Semester
Unit	Course Topic	No. of Lectures Hours
I	Definitions of a group, Subgroups, Cyclic group, Permutation group, Even and odd permutation; statement of Cayley's theorem, Lagrange's theorem; definitions of Normal subgroup, Quotient group, Ring, Subrings, Integral domain and field, Ideal and quotient ring, subomorphism, inner automorphism, Polynomial ring over commutative ring, definition of division algorithm, principal ideal domain, Reducibility tests, Irreducibility tests, Eisenstein criterion. Unique factorization domains, Euclidean domain	15
ш	Cauchy's theorem for finite abglian group, Cauchy's theorem for an arbitrary finite group, Fundamental theorem on homomorphism of groups, Second and third law of isomorphism of groups, Maximal subgroup, Composition series, Jordon Holder's theorem, Subnormal and normal series, Solvable groups, Characteristic property of solvable groups	15
ш	Direct products, External Direct products, Internal Direct products, Sylow p-subgroups, Sylow's first theorem, Double cosets, Sylow's second and third theorem, Applications of Sylow's theorem.	15
١V	The fundamental theorem on finite abelian groups, Invariants of finite abelian groups, Isomorphic abelian groups of order, non-isomorphic abelian groups of order, Decomposable groups. Imbedding of rings, Field of quotients of an integral domain, Maximal Ideal, Field extensions, Finite field extensions, Simple field extensions, Algebraic and transcendental extensions, Minimal polynomial, Remainder theorem, Factor theorem.	15

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ľ	Suggested Readings:	
ļ.	1. David S. Dummit & Richard M. Foote: Abstract Algebra, Wiley, 3rd Edition, 2011	
L	2. Joseph A. Gallian: Contemporary Abstract Algebra 9th Edition, 2019.	
t	3. Khanna, Vijav K & Bhambri, S K A Course in Abstract Algebra, S Chand and Company Ltd; Fifth edition (2022)	
ł	4. Hersteln, I.N.: Topics in Algebra, Wiley, 2 ²⁴ Edicion, 2006.	
Į.	5 Bhattacharya, P.B., Nagpaul, S.K. Basic Abstract Algebra (2nd Edition) Cambridge University Press, Indian Edition, 1997.	
	6. Lang, S.: Algebra, Pearson Education 3rd Edition, 1992	
!	7. J. B. Fraleigh : A first course in Abstract Algebra.	
Γ	Suggested Captinuous Evaluation Methods:	
	Continuous internal evaluation through internal tests, quizzes and Presentation.	
I	Suggested equivalent online courses;	
L	There are online courses on the channels such as Swayam Prabha, Mooes and NPTEL. E-contents from different online libraries, e-PG Pathshaala etc	
Í	further Suggestions.	-



Programme/Class; B.Sc.		and the set of the set	
Programme/Class; B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Seventh	
Course Code: 0720322	Course Title: Real Analysis	Theory	
different branches of mathematic Course outcomes: CO1. To provide a topological st CO3. To study the concepts of ce CO3. To provide the methods fot CO4. To study the concept of int CO5. This course gives a wide st CO6. This course gives a foundati	•	reas, such as quantum physics. I differentiability and integrabili	
Credits: 4	Core Computsory	Max Merks (Int. + Ext.): 25+75 Total = 10 Minimum Marks: 40	
Teaching	Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Four Hours in a week) or 60 Lecture Hours in a	Semester	
Unit	Course Topic	No. of Lectures Hours	
r	Definition and existence of Riemann-Stieltjes integral. Properties of the integral, integration and differentiation. The fundamental theorem of calculus, and Integration of vector-valued functions.	15	
п	Sequences and series of functions. Pointwise and uniform convergence, Cauchy criterion for uniform convergence, Uniform convergence and continuity, Uniform convergence and Riemann-Stielijes integration, Uniform convergence and differentiation, Weierstrass Approximation Theorem.	15	
m	Power series, Algebra of power series, Uniqueness theorem for power series. Abel's and Tauber's theorems.	15	
IV	Functions of several variables, Linear transformation, Derivatives in an open subset of R ⁰ . Chain rule, Partial derivatives, Interchange of the order of differentiation.	15	
Teaching Learn	Ing Process: Class discussions/ demonstrations, Power point presentations, using e-content, Class activities/	assignments, elc	
 Brown. W., Church Royden, H. L.: Real Rudin, W.: Principle 	nematical Analysis, Narosa Publishing, New Delhi, 1985 III ,R.V., Pourier Senes and Boundary Value Problems, 8th 3rd Edition, 2015, McGraw Hill Education, New Analysis, (4th Edition), Macmillan Publishing Co. Inc. New York, 1993. s of Mathematical Analysis, (3rd edition) McGraw-Hill, Kogaku Sha, 1903, International student edition. sis, An Introduction, Addison-Wesley Publishing, Co. Inc., 1968.	Delhí	
Suggested Continuous Evalua Continuous internal evalua	tion Methods: tion through internal tests, quizzes and Presentation.		
Suggested equivalent online c There are online courses o	ourses: n the chancels such as Swayam Prabha, Moocs and NPTEL. E-contents from different online libraries, e	PG Pathshaala etc	

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	COURSE-III : Advanced Differential Equation	
Programme/Class: B.Sc.	Year: B.Sc. Mathematics Honours	Scmester: Seventh
Course Code: 0720323	Course Title: Advanced Differential Equation	Theory

Course Objectives:

1. To explore the basic ideas of Differential Equations combined with some real-life problems

2. Differential equations are very important in the mathematical modeling of physical systems.

3. Many fundamental laws of physics and chemistry can be formulated as differential equations.

4. In biology and economics, differential equations are used to model the behavior of complex systems

5. Ordinary Differential Equations are used to calculate the movement or flow of electricity, motion of an object to and fro like a pendulum, to explain thermodynamics concepts.

Course outcomes:

CO1. The use of the differential equation theory is to solve various types of Mathematical modeling problems.

CO2. The use of the differential equation theory is to solve many problems presented in different sciences such as Biology, Chemical sciences and Physics.

CO3. The use of this theory is to solve many real-life based problems such as population problem, control problems and networking security problems etc.

CO4. This theory can solve many engineering problems such as the exact trajectory path of a rocket or a missile.

CO5. Students will be able to formulate and solve differential equations arising from changes in physical world.

Credits: 4	Core Compulsory	Max Marks (Int. + Ext.): 25+75 Total = 100 Minimum Marks: 40
Te	aching Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0 (Four Hours in a week) or 60 Lecture Hours in a	Semester
Unit	Course Topie	No. of Lectures Hours
I	Ordinary Differential Equations (ODEs), General theory of homogenous and non-homogeneous linear ODEs, System of first order ODEs, The method of variation of parameters, Wronskian, Sturm- liouville boundary value problem, Picard's method of successive approximation, Picard's Theorem.	15
п	Ordinary points, Singularities, Regular and Irregular singular points, Series solutions about ordinary points, Frobenius series solution Green function.	15
īv	Origin of first order Partial Differential Equations (PDEs), Lagrange method for solving first order PDEs, Integral surfaces passing through a given curve, Surface orthogonal to a given system of surface, Not-linear PDEs of the first order, Charpit's method for first order PDEs, Jacobi Mathod, Cauchy problem for first order PDEs, Origin of second order partial differential equation and their classification, linear PDEs with constant and variable coefficients.	15
v	General solution of higher order PDEs with constant coefficient, Diffusion, Wave and Laplace equations by the method of separation of variables, Reduction of second order partial differential equation into its canonical form, Non-linear partial differential equations of second order.	15
Teaching I	earning Process: Class discussions/ demonstrations, Power point presentations, using e-content, Class activities	assignments, etc

2. Rai, B., Chaudhary, D.P. and Freedman, H.I.: A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi 2013.

3. Simmons, G.F.: Differential Equations with Applications and Historical Notes, Second Edition, Tata Mcgraw-Hill Publishing Company Ltd. New Delhi (2017).

Simmons, Gr.: Differential Equations with Applications and Historical Notes, Second Edition, Tala Megraw-Hill Publishing Company Ed. New J. Seddon, Ian: Elements of Partial Differential Equation, McGraw-Hill Book Company.

 Wirkus Stephen A, & Swift, Randall J.: A Course in Ordinary Differential Equations 1st Edition, CRC Press, Taylor & Francis Group, 2015.
 Ross, S. L.: Differential Equations, 3rd Edition, Wiley. (1980)

Suggested Continuous Evaluation Methods:

Continuous internal evaluation through internal tests, quizzes and Presentation.

Suggested equivalent online courses;

There are online courses on the channels such as Swayam Prabha, Moocs and NPTEL. E-contents from different online libraries, e-PG Pathshaala etc Further Suggestions:

- 1	COURSE-IV : Metric Space	
Programme/Class; B.Se.	Year: B.Sc. Mathematics Honours	Semester: Seventh
Course Code: 0720324	Course Title: Metric Space	Theory

Course Objectives:

The beauty of the subject is to gain proficiency in dealing with abstract concepts, with emphasis on clear explanations of such concepts to others; to introduce the theory of metric and topological spaces; to show how the theory and concepts grow naturally from idea of distance; to be able to give examples which show that metric spaces are more general than Euclidean spaces; to be able to work with continuous functions, and to recognize whether spaces are connected, compact or complete. Metric spaces are vital prerequisites for many mathematics courses including Analysis, Topology, Measure Theory, Complex Analysis etc. Course outcomes:

CO1: To show how the theory and concepts grow naturally from idea of distance

CO2: Differentiate between functions that define a metric on a set and those that do not.

CO3: Use the Banach fixed point theorem to demonstrate the existence and uniqueness of solutions to differential equations

CO4: Apply the theory in the course to solve a variety of problems at an appropriate level of difficulty

CO5: Metric spaces are vital prerequisites for many mathematics courses including Analysis, Topology, Measure Theory, Complex Analysis etc. CO6: Understand sequentially compact spaces, Countable compactness, BWP and compactness and explain the relation between the three types of compactness in metric spaces.

Credits: 4	Core Compulsory	Max Marks (Int. + Ext.): 25+75 Total = 100 Minimum Marks: 40
Teach	ing Hours = Lecture-Tutorial-Practical (L-T-P): 4-0 (Four Hours in a week) or 60 Lecture Hours in	a Semester
Unit	Course Topic	No. of Lectures Hours
1	Metric Space: Metric on a set, pseudo-metrics and metrics Distance between two sets. Equivalent metrics. Limit points and closure: closed sets, Derived set of a set, Adherent points and closure of a set, Dense subsets, Interior of a set and its properties, Subspaces, Product spaces, Structure of Open halls in a product space. Closures and interiors in a product space, Finite product of metric spaces.	15
п	Convergent sequences. Cauchy sequences. Characterization of adherent points and limit points in terms of convergent sequences. Convergence in products. Convergence in Euclidean spaces. Cluster points of a sequence. Subsequences. Cluster points and convergent subsequences. Algebra of convergent real sequences. Spaces of sequences.	15
ш	Continuity at a point. Continuity over a space. Continuity of composite, graph and projection maps. Algebra of real valued continuous functions in a metric space. Homeomorphisms. Isometries. Relation between isometries and Homeomorphism. Uniform continuity. Complete metric spaces. Completeness and Continuous mappings. Completeness and subspaces. Cantor's Intersection Theorem. Contraction Mapping Principle. Connectedness: Connected metric spaces. Connected sets. Characterization of connected subsets of the real line. Properties of Connectedness.	15
ſV	Compact spaces and Compact subsets. Compact subsets of the real line. Sequential compactness and its characterization. Countable compactness, Bolzano-Weierstrass property. Sequential characterization of BWP. Equivalence of BWP and sequential compactness. Covering characterization of the BWP. Bolzano-Weierstrass Property and Total boundedness, BolzanoWeierstrass Property and compactness. Lebesgue covering lemma. Compactness and completeness, Compactness and uniform continuity. Boundedness of continuous real-valued functions on compact metric spaces	15
Teaching Leas	ning Process: Class discussions/ demonstrations, Power point presentations, using e-content, Class activitie	es/assignments, etc
2. Dieudonne J. 3. Kasriel "R. H. 1. Kumaresan S. Suggested Continuous	Metric Spaces, Cambridge tracts, 2010. Foundation of Modern Analysis, Academic Press, New York, 1960. Metric Spaces, Dover Publications, New York, 2009. Topology of Metric Spaces, 2 nd Edition, Narosa (2011). Evaluation Methods: Continuous internal evaluation through internal tests, quizzes and Presentation.	
Suggested equivalent of libraries, e-PG Pathshaala	nline courses: There are online courses on the channels such as Swayam Prabha, Moocs and NPTEL. E- etc	contents from different online
Further Suggestions:		

Max Marke

	COMPULSORY COURSE-I : Topology	
Programme/Class: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Eight
Course Code: 0820321	Course Title: Topology	Theory
topological spaces; to an spaces; to be able to wor including Analysis, Topol Course outcomes: CO1: To show how the theo CO2: Differentiate between CO3: Use the Bannch fixed CO4: Apply the theory in th CO5: Metric spaces are vita	ct is to gain proficiency in dealing with abstract concepts, with emphasis on clear explanations of such concepts to others; to introdu ow how the theory and concepts grow naturally from idea of distance; to be able to give examples which show that metric spaces are the with continuous functions, and to recognize whether spaces are connected, compact or complete. Metric spaces are vital prerequisites fo logy, Measure Theory, Complex Analysis etc. any and concepts grow naturally from idea of distance functions that define a metric on a set and those that do not. point theorem to demonstrate the existence and uniqueness of solutions to differential equations are convect to solve a variety of problems at an appropriate level of difficulty prerequisites for many mathematics courses including Analysis, Topology, Measure Theory, Complex Analysis etc. By compact spaces, Countable compactness, BWP and compactness and explain the relation between the three types of companiess in met	nore general than Euclidean r many mathematics courses
Credits: 4	Core Compulsory	Max Marks (Int. + Ext.): 25+75 Total = 18 Minimum Marks: 40
	Teaching Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Five Hours in a week) or 60 Lecture Hours in a Semester	
Unit	Course Topic	No. of Lectures Hours
I	Definition and examples of topological space, Closed sets, Closure, Dense subset, Neighborhoods, interior, exterior, boundary and accumulation points, Derived sets, Bases and sub-bases. Subspaces, product spaces and relative topology.	15
II	Continuous functions, homeomorphisms, the pasting lemma, Connected and disconnected sets, connectedness on the real line, components, locally connected spaces.	15
ш	Countability axioms - First and second countable spaces, Lindelof's theorems, Separable spaces, second countability and separability. Separation axioms - T0, T1, T2, T3, T3/4, T4, their characterizations and basic properties. Urysohn's lemma and Teitze extension theorem, Statement of Urysohn's metrization theorem.	15
IV	Compactness - Continuous functions and compact sets, basic properties of compactness, compactness and finite intersection property, sequentially and countably compact sets, local compactness and one point compactification. Statements of Tychonoff's Product theorem and Stone-cech compactification theorem.	15
т	caching Learning Process: Class discussions/ demonstrations, Power point presentations, using e-content, Class activities/ assignments, e	te
 Dieudonne ,J.: F Munkres. James Kumaresan S. Te 	Introduction to Topology and Modern Analysis, Tata McGraw Hill, India,2016 oundation of Modern Analysis, Academic Press, New York, 1960. .: Topology, 2# Edition, Pearson Education, 2021. opology of Metric Spaces, 2 nd Edition, Narosa (2011). valuation Methods: Continuous internal evaluation through internal tests, quizzes and Presentation.	

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	COMPULSORY COURSE-II : Advanced Complex Analysis	
Programme/Class: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Eight
Course Code: 0820322	Course Title: Advanced Complex Analysis	Theory
show how complex analysis can Course outcomes: CO1. Know the fundamental co CO2. Prove the Cauchy-Riemar CO3. Extend their knowledge to	in equations and apply them to complex functions in order to determine whether a given continuous function is complex differentiable.	a complex variable, and to
Credits: 4	Core Compulsory	Max Marks (Int. + Ext.): 25+75 Total = 10 Minimum Marks: 40
	Teaching Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Five Hours in a week) or 60 Lecture Hours in a Semester	
Unit	Course Topic	No. of Lectures Hours
I	Complex integration, Regular Arc, Contour, Cauchy-Goursat theorem, Simply connected domains, Multiply connected domains, Cauchy's integral formula, An extension of the Cauchy's integral formula, Significance of Cauchy's integral formula, Morera's Theorem, Cauchy's integrality, Liouville's theorem and its applications, The fundamental theorem of Algebra, Maximum modulus principle.	15
α	Properties and classifications of bilinear transformations, Bilinear transformation as conformal mappings, Riemann- Mapping Theorem, Examples of conformal mappings, Meromorphic functions, Entire functions, Taylor's theorem and its applications, Laurent's Theorem and its applications.	15
311	Singularities, Categorization of Singularities using Laurent's series, Isolated singularities, Residues, Cauchy's residue theorem, Evaluation of integrals, Many valued functions, branch points, branch cuts and branches of many valued functions, and with special reference to ang z, log z and z ^a , The argument principle, Rouche's theorem. Analytic continuation, Uniqueness of direct analytic continuation, Uniqueness of analytic continuation along a curve, Power series method of analytic continuation.	15
ïv	Canonical products, Jensen's formula, Poisson-Jensen formula, Hadamard's three circles theorem, Order of an entire function, Exponent of convergence, Borel's theorem, Hadamard's factorization Theorem.	15
Te	aching Learning Process: Class discussions/ demonstrations, Power point presentations, using e-content, Class activities/ assignments, etc	
 Brown, J., Churchill, F Conway, J. B.; Function 	Analysis, McGraw Hill Education; 3rd Edition, 2017. LV;: Complex Variable and Applications, McGraw-Hill Education; 9th Edition, 2013. ns of One Complex Variable, Springer-Verlag, International student Edition, 2 nd Edition, 1996. ction to Complex Analysis, Oxford University Press, 2008.	

Suggested equivalent online courses: There are online courses on the channels such as Swayarn Prabha, Moocs and NPTEL. E-contents from different online libraries, e-PG Pathshaala etc

Further Suggestions:

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Program	me/Class: B.Sc.	Year: B.Sc Mathematics Honours	Semester: Eight
Course	Code: 0820323	Course Title: Number Theory	Theory
proofs of many importa- theorem, Quadratic recip to detect the primality o Course outcomes: CO1.Identify the challe CO2. Formulate and pro- the Well Ordering Princ CO3. Apply the knowle	nt results that have been used b procity, etc. It will supply meth f a large integer. It will show b nging problems in modern mat we conjectures about numeric pail in the proof of theorems. dge of Number theory and Cry	ost all basic concepts of number theory and to demonstrate applications of number theory. It will help stude bods to solve linear Diophantine equations, linear congruences, system of linear congruences, quadratic cor ow various number theoretic concepts and theorems are applicable in cryptography. hematics and find their appropriate solutions. patterns, and produce rigorous arguments centered on the material of number theory, most notably in the u ptography to attain a good mathematical maturity and enables to build mathematical thinking and skill. Diophantine equations for solving different types of problems, for example, sum of two and four squares	rem, Wilson's theorem, Legrange gruences, etc. Students will be abl
Credits: 4		Core Elective	Max Marks (Int. + Ext.): 25+75 Tota) = 10 Minimum Marks: 40
	Teaching Hours =	- Lecture-Tutorial-Practical (L-T-P): 4-0-0 (Five Hours In a week) or 60 Lecture Hours in a Semeste	er in the second se
Unit		Tapics	No. of Lectures Total 60
I	Euclidean algorithm, Dis conjecture, Consequence	Definition and theory of the GCD, Euclid's Lemma, Definition and theory of the LCM, the extended stribution of primes, the fundamental theorem of arithmetic, The Sieve of Eratosthenes, The Goldbach so of Dirichlet theorem, Statement of Prime Number theorem, Solutions of word problems using the time equation, Solution of simultaneous system of linear congruences.	15
ņ		tions: The number (), sum (), and product of the divisors, Multiplicative function, Mobius function, Mobius inversion formula and its applications, The greatest integer function, Legendre formula and its	
ш	The order of an integer primitive roots of a prin non-linear congruences,	modulo n and order of higher powers of the integer modulo n, Primitive roots for primes, Finding all ne, Composite numbers having primitive roots, The theory of indices, Properties of index, Solutions of Euler's criterion, Solutions of quadratic congruences with prime moduli	15
īv		ute pseudoprimes, Perfect numbers, even perfect numbers, The Fibonacci sequence and its properties, presentation of rational number as a finite simple continued fraction, Solution of linear Diophantine nple continued fractions	15
Teaching Learning Pro	cess: Class discussions/ demon	nstrations, Power point presentations, Class activities/ assignments, etc.	
2. Dudley U.: Elementa 3. E. George. Andrews: Suggested Continuous	ry Number Theory (2nd editi Number Theory, Dover Publ	ications, 1994.	

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		Core-Elective (Group - 1) COURS	SE-1 : Mechanics	
Programme/Class	s: B.Sc.	Year: B.Sc. Mathematics Honours	Semester;	Eight
Course Code: 08	320324	Course Title: Mechanics	Theor	y
ajors. The core is to purse outcomes: D1. To distinguish D2. To frame the n D3. To understand D4. To differentiat D5. To determine D6. To identify the D7. To apply fundi D8. To use advance	lest branch of the Physics disci- he new formulation of mechar- between inertia frame of refer- nethematical constraints on the the mechanics of a system of 1 between Newtonian, Lagrang the Lagrangian and Hamilton conserved quantities, if any, a mental conservation principle of theoretical techniques to so	pline and is as well important in the discipline of Mathematic ies and the substantial range of new techniques in the applica- ence and non-inertial frame of reference. bases of physical restrictions imposed on a system, which si articles falling under classical mechanics, gian, Hamiltonian and Routhian approach of solving a mecha- an of mechanical systems and use these functions to obtain ssociated with the mechanical system. i to analyze mechanical systems. we mechanical problems like use of canonical transformation ackets to solve mechanical problems.	ations. implifies the process of solution of a physical problem. anical problem. in the solutions of even complicated mechanical systems	
	1		Мах Ма	rks
Credits: 4		Core Elective	(Int. + Ext.): 25+7	75 Total = 100
			Minimum Ma	arks: 40
	Teaching Hou	s = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Five Hou	rs in a week) or 60 Lecture Hours in a Semester	
Unit		Course Topic		No. of Lectures Hours
1	Constraints and constrained systems, Degree of Freedo momentum), Generalized fo Definition of the Lagrangiar	of particles, Conservation laws for the system of particle motion, classification of constraints: Holonomic versus non m. generalized velocity, generalized acceleration, general ce Lagrangian Mechanics: Physics in configuration space v Euler-Lagrange equitions of motion. Derivation of Euler-I ple applications of the Lagrangian formulation to systems wi	n-holonomic systems, Scleronomic versus meonomic sized potential, generalized momentum (Conjugate with generalized coordinates as independent variable, Lagrange equations from differential principle i.e., by	15
п	Hamiltonian (brough Leger coordinates as well, Hamilto Hamilton's principle by diffi- Hamilton's principle, Simple	sics in phase space with generalized coordinates and momer dre's transformation) and its relation to the energy, Hamili ris principle, Derivation of Hamilton's equations by integra rential principle i. e. by D'Alembert's principle, Derivation applications of Hamilton's equations of motion. Cyclic (ignouth outhan. Routh's equations of motion and energy function	ton's canonical equations in cylindrical and spherical Il principle i.e. by Hamilton's principle, Derivation of n of Lagrange's equations from integral principle i.e. gnorable) coordinates and conservation laws Routhian	15
ur	, dependent variables (ii) high	application to Mechanics: Euler's equation for functions of or er order derivatives, Applications of calculus of variation: ion, Brachistochrone problem, Isoperimetric problem, Geode	Shortest distance between two points on a plane,	15
IV	Hamilton Jacobi theory: Han simple applications.	ilton Jacobi equation, Jacobi theorem, Method of separation	of variables in Hamilton Jacobi equation and its	15
	Teaching Learning Pr	occss: Class discussions/ demonstrations, Power point prese	mtations, using e-content, Class activities/assignments, c	te
Goldstein	I.M., Fomin S.V. and Silver H. H.: Classical Mechanics (3rd	man ,R.A.: Calculus of Variations, Prentice Hall,2000 Edition), Pearson New International Edition, 2014, ISBN 12 echanics, Tata McGraw Hilt, New Delhi, 1991, ISBN-10: 01		
ggested Continu	ious Evaluation Methods: (onlinuous internal evaluation through internal tests, quizze	es and Presentation.	
ggested equival	ent online courses: There are	online courses on the channels such as Swayam Prabha, I	Moors and NPTEL. E-contents from different online life	braries, c-PG Pathshaala et
uggested Reading 1. Colfond, 2. Goldstein 1. Rana, N. uggested Continu uggested continu	Teaching Learning Pr gs: L.M., Fornin S.V. and Silven I. H.: Classical Mechanics (3r C. and Joag, P.S.: Classical M rous Evaluation Methods: C ent online courses: There are	man, R.A.: Calculus of Variations, Prentice Hall,2000 Edition), Pearson New International Edition, 2014, ISBN 11 echanics, Tata McGraw Hill, New Delhi, 1991, ISBN-10:00 ontinuous internal evaluation through internal tests, quizze	3: 9780201657029/ ISBN 10: 0201657023 074603159/ ISBN-13: 9780074603154 es aud Presentation.	-



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Programme/Cl	ass: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Eigh	at .
Course Code:	0820325	Course Title: Financial Mathematics	Theory	
problem-solving s Course outcomes CO1: Demonstrat CO2. Demonstrat CO3. Employ me CO4. Apply logic CO5. Use approp	kills with a particular e understanding of be understanding of co thods related to these		siness. This also highlights the inter-relationshi	ips of the mathematics a
Credits	4	Core Elective	Max Marks (Int. + Ext.): 25+75 To Minimum Marks:	
	То	eaching Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Five Hours in a week)	or 75 Lecture Hours in a Semester	
Unit		Course Topic		No. of Lectures Hour
I		efinitions and Terminology, Basic option theory: single and multi-period binomial p choles formula for potion pricing as a limit of CCR model.	pricing models, Cox-Ross-Rubinstein (CCR)	15
II	Brownian ad (ian ad Geometric Brownian Motion, Theory of Martingales, Stochastic Calculus, Stochastic differential Equations.		15
ш	Ito's formula to and Black Scho	"s formula to solve SDE"s, FeymannKae theorem, Application of stochastic calculus in option pricing, Black Scholes partial differential equations d Black Scholes formula.		15
IV	Mean Variance rate derivatives	portfolio theory: Markowitz model for Portfolio optimization and Capital Asset Pricing	Model (CAPM), Interest rates and interest	15
	Teaching	Learning Process: Class discussions/ demonstrations, Power point presentations, using	e-content, Class activities/ assignments, etc	
1. Roman 1. Ross,S	J.C., Stochastic Pro S. An Introduction An Introduction to	cess and Financial Markets, Alpha Science International, 2003. the Mathematics of Finance, Springer, 1st Edition, 2000 Mathematical Finance, Cambridge University press,3rd Edition, 2011. Methods: Continuous internal evaluation through internal tests, quizzes and Presental	iion.	

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		Core-Elective (Group-1) Course - III : FLUID DYNA	T	
Program	me/Class: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Eigh	
Course	Code: 0820326	Course Title: FLUID DYNAMICS	Theory	
formulate pby CO1. To know, CO2. To know, CO3. To convo CO4. To frame CO5. To descri CO6. To under CO6. To under CO6. To apply CO8. To under CO10. To imake CO10. To imake CO11. To apply CO12. To defir	skel problems encountered in diff understand and apply the basic cos- be the physical properties of a fluid rt physical laws of conservation of and describe the flow through pote be the motion of ideal and real flui stand stress-struin relationship in N Bernoulli equations in their domain stand the singularities of the flow fi dimensional analysis and use it to o flow behavior with non-dimensions set as the singularity of set up to the similitude concept and set up 1	nass, momentum, moment of momentum and energy into mathematical equations and apply then thial function and stream function. Is with different techniques including complex variable technique. ewtonian fluids. of validity for fluid flow rate measurement. cld. envice the dimensionless numbers. I parameters he relation between a model and a prototype. requaritions, such as the Navies-Stukes equations to evaluate velocity, pressure drop in simple get	n to describe the fluid motion.	
ows at pipes :	Credits: 4	Core Elective	Max Marks (Int. + Ext.): 25+75 Tota Minim Marks: 4	
	Teaching Hours ≈	Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Four Hours in a week	() or 60 Lecture Hours in a Seme	ster
Unit		Topics		No. of Lectures Total 6
ı	descriptions of fluid motion,	stics, continuum concept and basic properties of fluids, Newtonian law of viscosity, Ki Equivalence of Lagrangian and Eulerian methods, General motion of a fluid element: (angular deformation) and Deformation (volumetric or extensional strain/ shear strain), nd boundary surface.	Translation (Acceleration of a fluid particle	15
п	system, Symmetry of stress Conservation laws by the 0 Equivalence of the mass cor	real fluid: Normal stress, Shearing stress, Transformation of stress components from o tensor, Plane stresses, Principal directions and Principal values of stress tensor, C Control Volume approach: Mass conservation equation in rectangular cartesian, cyli servation equations derived by Lagrangian method and Eulerian method, Equation of n), Equation of conservation of moment of momentum, Equation of conservation of	onstitutive equation for Newtonian fluid, ndrieal and spherical coordinate systems, conservation of momentum (NavierStokes	15
អា	flow theory, Theorems about Gauss theorem, Kelvin's cu	mentary properties of vortex motion, Stream function for two-dimensional incompte- t rotational and irrotational flows of inviscid and incompressible flows - Stokes' the culation theorem, Uniqueness of irrotational flows. Bernoulli's equation for incompt amine for steady and unsteady flows, Applications of Bernoulli's equation for irrotatio Pitot tube, Venturi meter.	orem, Kelvin's minimum energy theorem, ressible and inviscid flows: Integration of	15
īv	singularities: Sources, Sinks applications of source, sink a	I incompressible flows (Complex variable technique and its applications): Blasius th and Doublets in two dimensions, Images of a source/ sink/ doublet with respect to a nd doublet. Dimensional analysis, Buckingham Pi theorem, Dimensionless numbers (R dift number) and their properties Basic introduction to Newtonian and non-Newtonian r	line and with respect to a circle, Simple eynold number, Pressure coefficient, Mach	
eaching Learn	ning Process: Class discussions/ d	emonstrations, Power point presentations, Class activities/ assignments, etc.		
Charlton, F.: Raisinghanis Rathy, R.K.:	K. An Introduction of Fluid Mecha Text Book of Fluid Dynamics, CB A. M.D.: Fluid Dynamics: with Con An Introduction of Fluid Dynamics	nics, Oxford University Books, NewDelki, 2000. 5 Publishers, Delhi, 2004. plote Hydrodynamics and Boandary Layer Theory, S. Chand Publishing, 2014, ISBN 13: 97881 , Oxford and IBH Publishing Co., New Delhi, 1903. entice Hall of India Private Limited, New-Delki, 1988. ISBN 10: 0133298132/ ISBN-13: 978-01		
	tinuous Evaluation Methods: Co	ntinuous internal evaluation through internal tests quizzes and Presentation.		
uggested Con		udent must have had the subject Mathematics in UG Lovel		
	uisites: To study this course, a st	aucht mist mit mit mit stoffet mittachattes in vo berein		

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Programme/Class: B.Sc.	Year: B.Sc. Mathematics Honours	Semester: Eight
Course Code: 0820327	Course Title: Linear Algebra	Theory
eigenvectors, the minimal polyno Linear algebra finds applications didvanced contents of the ubove-n Course outcomes: CO1: Understand the notion of a CO2: Understand the concept of CO3: Find the eigenvectors and i	is to develop theoretical as well us working knowledge of the central ideas of linear algebra like linear transformations, invertibility & in coding theory, cryptography, graph theory and linear programming. Thus, after completing this course, students shall bear a good neutioned courses. vector space and linear transformation and to determine basis and dimension of a vector space. linear transformation and to find the range space and null space of the linear transformation Eigen-value of a square matrix and to know diagonalization of the matrix sis using the Gram-Schmidt process.	
Credits: 4	Core Elective	Max Marks (Int. + Ext.): 25+75 Total = 10 Minineum Marks: 40
	Teaching Hours = Lecture-Tutorial-Practical (L-T-P): 4-0-0 (Five Hours in a week) or 60 Lecture Hours in a Semester	
Unit	Course Topic	No. of Lectures Hours
I	Linear transformations, Isomorphism, Range and null space, The matrix representation of linear transformations, Linear functional, Double dual.	15
и	Invertibility and Isomorphisms, The change of coordinate matrix, The transpose of a linear transformations, Polynomial ideals, Prime factorization of polynomials, Inner product spaces, Bessel's inequality, Normal and unitary operators.	15
u	Elementary canonical forms: Annihilating polynomials. The minimal polynomial, Invariant subspaces. Simultaneous triangulation, Simultaneous diagonalization, Direct-sum decomposition, Invariant direct sums, The primary decomposition theorem.	15
ĨŃ	Orthogonal and unitary reduction of quadratic and Hermitian form. Positive definite quadratic forms, simultaneous reduction. Bilinear forms, Matrix of a bilinear form, Classification of bilinear forms: Symmetric bilinear forms, Skew-symmetric bilinear forms	15
caching Learning Process: Cla	as discussions/ demonstrations, Power point presentations, using e-content, Class activities/ assignments, etc	
 Hoffman, K., Kunze R.; I Friedberg, S.H., Insel, A Strang, G. Linear Algebra Sahal, V. and Bist, V.; Lin 	ay and Judi J.MC Donald; Lincar Algebra and hts Applications, 6 th Edition Pearson Education 2021. Lincar Algebra (2 ^{ed} Edition), Pearson, 2017. a, Spence, L.E.: Lincar Algebra Pearson, Education India, 2015. and its Applications (4 th Edition), Cengage Lumping, 2007. ear Algebra (2 th Edition), Narosa Publishing House, 2013.	
Suggested Continuous Evalua	ition Methods: Continuous internal evaluation through internal tests, quizzes and Presentation.	



Deserve (Clip D. C	Core-Elective (Group-2) COURSE-II : Data Structure with C	
Programme/Class: B.S.	Year: B.Se. Mathematics Honours	Semester: Eight
Course Code: 0820328	Course Title: Data Structure with C	Theory
 Programming langu. Studying programming Choose the most app I. A programming langu. Programming langu. Course outcomes: CO1. Understanding a funct CO2. Ability to define and n CO3. Ability to work with to CO4. Students will be able t 	e of programming languages is to provide instructions to a computer ages differ from most other forms of human expression in that they require a greater degree of precision and completeness. Ing languages will help the students be better at their job, make more money, and be a happier, more fulfilled and more informed citrzen, bec- propriate language for a given task. uges lets the students to express computational tasks in certain ways. uges often produce more efficient code through optimization for specific system architecture. ional hierarchical code organization. anage data structures based on problem subject domain. extual information, characters and strings. o develop logics which will help them to create programs, applications in <i>C</i> . assic programming constructs they can easily switch over to any other Language in future.	ause they will team to:
Credits: 4	Core Elective	Max Marks ({nt. + Ext.): 25+75 Total = 10 Minimum Marks: 40
	Teaching Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Five Hours in a week) or 60 Lecture Hours in a Semester	
Unit	Course Topie	No. of Lectures Hours
1	Introduction to the C Language: Writing a Simple C Program: Learning the format of a C program, declaring variables, designing program flow and control, defining and using functions, data types, using standard terminal I/O functions.	15
п	Conditional Program Execution: Applying if and switch statements, nesting if and else, restrictions on switch values, use of break and default with switch. Program Loops and Iteration: Uses of while, do and for loops, multiple loop variables, assignment operators, using break and continue. Modular Programming, Arrays and Structures in Passing arguments by value, scope rules and global variables, separate compilation, and linkage, building your own modules. Array notation and representation, manipulating array elements, using multidimensional arrays, arrays of unknown or varying size.	15
ш	Structures: Purpose and usage of structures, declaring structures, assigning of structures. Unions: Components in overlapping memory, declaring and using unions. h vs. private c files, hiding private variables and functions	15
IV	Functions and Pointers to Objects: Simple C-functions, passing arguments to functions, returning values from functions, reference arguments, overloaded functions, returning by reference, Constant function arguments, runtime memory management. Pointer and address arithmetic, pointer operations and declarations, using pointers as function arguments, Dynamic memory allocation	15
	Teaching Learning Process: Class discussions/ demonstrations, Power point presentations, using e-content, Class activities/ assignments, e	elc
Suggested Readings: 1.Budd, "Object Oriented J 2.Balaguruswamy, "Progr 3.Kauetkar, Yashwant "P 4.Schield, Herbert, Comp 1. Yashwant Kanetkar,"	ofiniters in C" lete Reference in C," TMH	
Suggested Continuous Ev	aluation Methods: Continuous internal evaluation through internal tests, quizzes and Presentation.	
	ac courses: There are online courses on the channels such as Swayam Prabha, Moocs and NPTEL. E-contents from different online lib	



Programme/Class: B.Sc.		Year: B.Sc. Mathematics Honours	Semester: Eight
Course Code: 0820329		Course Tifle: Dynamical Systems	Theory
differential equations different analytic too CO1. To introduce s forms, phase portraits CO2. To provide a bu	a. usually nonlinear at ls. Course outcomes: tudents to the basic r s, and bifurcations. ief introduction to the	serfbe the time evolution of systems which arise from mathematics, physics, biology, chemistry and other areas. As mat ad therefore not usually able to explicitly solved. The aim of the course is to see how to make a qualitative analysis of nathematical skills for the qualitative solving of low dimensional systems of ordinary differential equations in continu way ordinary differential equation can be used to model, explain and interpret real world problems. theory and concepts that under pin the field of dynamical systems.	of a dynamical system using man
Credits: 4		Core Elective	Max Marks (Tat. + Ext.): 25+75 Total = 100 Minimum Marks: 40
	Teachir	g Hours = Lecture-Tutorial-Practical (L-T-P) : 4-0-0 (Four Hours in a week) or 60 Lecture Hours in a Semester	
Unit		Course Topic	No. of Lectures Hours
Ľ	The orbit of a	nap, fixed point, equilibrium point, periodic point, circular map, configuration space and phase space.	15
ш	Origin of bifurcation. Stability of a fixed point, equilibrium point. Concept of limit cycle and torus. Hyperbolicity. Quadratic map. Feigenbaum's universal constant.		15
811	Turning point, trans critical, pitch work. Hopf bifurcation. Period daubting phenomena. Nonlinear OscillatorsConservative system. Hamiltonian system. Various Type of escillators in nonlinear system. Solutions of nonlinear differential equations.		15
IV	Phenomena of losing stability. Quasiperiodic motion. Topological study of nonlinear differential equations. Poincare map.		15
Teaching Learning P	rocess: Class discuss	ons/ demonstrations, Power point presentations, using e-content, Class activities/ assignments, etc	
 Arrowosmith. Robert L.Day 	ynamical Systems, Ca D.K., Introduction to artey. An Introduction	mbridge University Press, 1993. Dynamical Systems, Cambridge University Press, 1990. to Chaotic Dynamical Systems, Addison-Wesley Publishing Co. 1989.	
		ods: Continuous internal evaluation through internal tests, quizzes and Presentation. e, a student must have had the subject Mathematics in UG degree.	



UG MATHEMATICS