॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with'B++' grade

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण–२०२० नुसार पदवी तृतीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२६–२७ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २२ एप्रिल २०२६ रोजी संपन्न झालेल्या मा.विद्यापरिषद बैठकीतील विषय क्र.०८/६४–२०२६ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण–२०२० नुसार पदवी तृतीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२६–२७ पासून लागू करण्यास मा.विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी.एस्सी. तृतीय वर्षाचे खालील विषयाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२६–२७ पासून लागू करण्यात येत आहे.

01	B.Sc. III Year Botany	10	B.Sc. III Year Biochemistry
02	B.Sc. III Year Chemistry	11	B.Sc. III Year Agriculture Microbiology
03	B.Sc. III Year Mathematics	12	B.Sc. III Year Electronics
04	B.Sc. III Year Zoology	13	B.Sc. III Year Seed Technology
05	B.Sc. III Year Microbiology	14	B.Sc. III Year Horticulture
06	B.Sc. III Year Geology	15	B.Sc. III Year Analytical Chemistry
07	B.Sc. III Year Enviornment & Earth Science	16	B.Sc. III Year Agrochemical & Fertilizers
08	B.Sc. III Year Statistics	17	B.Sc. III Year Industrial Chemistry
09	B.Sc. III Year Dairy Science	18	B.Sc. III Year Industrial Microbiology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या www.srtmun.ac.in या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/परिपत्रक/पदवी/बीएस्सी/२०२६–२७/60
दिनांक : १९.०६.२०२६

सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळे) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :–
१) मा. कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. प्र.कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ
३) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
४) मा. संचालक, परिक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
५) मा. प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.

SWAMI RAMANAND TEERTH
MARATHWADA UNIVERSITY, NANDED - 431 606

(Structure and Syllabus of B.A/B.Sc.-III (Mathematics) Degree)

BACHELOR OF ARTS/SCIENCE(BA/BSc-III) Level 5.5

Major **Mathematics (DSC)**

Under the Faculty of
Science and Technology

Effective from Academic year 2026 – 2027
(As per NEP-2020)

Index

From Desk of Chairman, Board of Studies in the Subject Mathematics

Preamble:

In alignment with the transformative vision of higher education under the Learning Outcomes-based Curriculum Framework (LOCF), the present curriculum in Mathematics has been thoughtfully designed to foster a student-centric, flexible, and outcome-driven learning environment. This framework emphasizes conceptual clarity, analytical thinking, skill development, and multidisciplinary exposure, ensuring that learners are equipped to meet the evolving academic and professional demands of the modern world .

Mathematics, being the foundation of science and technology, serves as a universal language that enables precision in reasoning and problem-solving. The revised curriculum for B.A./B.Sc. Mathematics integrates core theoretical knowledge with practical and computational components, thereby nurturing both abstract understanding and real-world applicability. The structure includes fundamental domains such as Algebra, Calculus, Analytical Geometry, Real Analysis, Linear Algebra, and Differential Equations, while also offering advanced and emerging areas like Metric Spaces, Complex Analysis, Numerical Analysis, and Partial Differential Equations.

A distinctive feature of this curriculum is its multidisciplinary and flexible design, incorporating Major, Minor, Generic Electives, Skill Enhancement Courses, and Value-based components such as Indian Knowledge Systems (IKS). Courses like Programming (MATLAB, Python), Data Science essentials, LaTeX for scientific writing, and research-oriented projects ensure that students develop digital proficiency, computational skills, and scientific communication abilities. The inclusion of field projects, internships, and on-the-job training further bridges the gap between academic learning and industry requirements.

The curriculum also provides multiple entry and exit options, enabling learners to pursue education at their own pace while maintaining academic rigor. Elective courses such as Graph Theory, Operations Research, Topology, Probability, and Integral Transforms offer opportunities for

specialization and interdisciplinary exploration, connecting pure mathematics with applied and industrial domains.

The primary objectives of this programme are to cultivate logical reasoning, critical thinking, and problem-solving abilities; to prepare students for higher studies and research; and to enhance their employability across diverse sectors including education, research, IT, finance, and public services. Furthermore, the integration of Indian mathematical heritage with modern concepts promotes a holistic understanding of the subject.

In conclusion, this curriculum reflects a balanced blend of tradition and innovation, theory and application, and knowledge and skills. It aims to develop competent, confident, and socially responsible graduates who can contribute meaningfully to academia, industry, and society.

The overall aim of B.Sc. Mathematics is to:

- Develop broad, balanced knowledge, understanding of definitions, concepts, principles, and theorems.
- Provide students sufficient knowledge and skills enabling them to undertake further studies in mathematics and its allied areas.
- Create deep interest in learning mathematics.
- Encourage the students to develop a range of generic skills helpful in employment, internships, and social activities.
- Familiarize the students with suitable tools of mathematical analysis to handle issues and problems in mathematics and related sciences.
- Enhance Computational skills and Mathematical reasoning
- Qualify competitive examinations like IIT-IAM, NBHM etc
- Promote and apply mathematics knowledge to do Research/Case Study /Field Project etc.

B.Sc. (Mathematics) Programme Outcomes (POs):

PO1	**Disciplinary Knowledge:** Students will acquire comprehensive knowledge of fundamental and advanced areas of Mathematics including Algebra, Calculus, Real Analysis, Geometry, Linear Algebra, Differential Equations, Complex Analysis, Numerical Analysis, Topology, and allied interdisciplinary subjects.
PO2	**Communication and Scientific Writing Skills:** Students will effectively communicate mathematical ideas, concepts, and results through oral presentations, technical writing, mathematical notation, graphical representation, and scientific documentation.
PO3	**Computational and Digital Proficiency:** Students will demonstrate proficiency in mathematical software, programming languages, and computational tools such as MATLAB, Scilab, Python, LaTeX, and data-oriented technologies for mathematical computation and scientific communication.
PO4	**Ability to work Independently:** The Learner completing this program will grow the capacity to do work independently.
PO5	**Critical Thinking and Logical Reasoning:** Students will cultivate critical thinking, abstract reasoning, and the ability to construct mathematical arguments, proofs, and logical conclusions using appropriate mathematical techniques.
PO6	**Ethical Values, Indian Knowledge Systems, and Social Responsibility**: Students will appreciate ethical practices, Indian Knowledge Systems, cultural values, environmental awareness, and social responsibility while applying mathematical knowledge for societal development.
PO7	**Confidence of Learning: The** B.Sc. Programme will develop learners mathematical knowledge and oral, written, and practical skills in a way which will encourage confidence, satisfaction and learning enjoyment.
PO8	**Ability to peruse advanced studies and research**: Students will be motivated high for doing higher education and research in Academically strong institution
PO9	**Skill/Vocational Courses:** Students will have to study skill/Vocational courses related to pure and applied Mathematics.
PO10	**Lifelong Learning and Independent Learning Ability:** Students will develop self-learning ability, intellectual independence, adaptability, and confidence to pursue lifelong learning, advanced studies, and continuous professional development in Mathematics and related areas.

Lt. Dr. Mahesh Sahebrao Wavare

Chairman, Board of Studies of the Mathematics

S.R.T. M. U. Nanded

List of Members in Board of Studies (Mathematics)under the faculty of Science and Technology

Sr No	Name of the Member	Designation	Address	Contact Number and Email ID
1	Prof. Lt. Dr. Mahesh Sahebrao Wavare	BoS Chairman (Ad hoc)under Section26(18) and BoS Member under section *40(2)(c)*	Rajarshi Shahu Mahavidyalaya (Autonomous), Latur, Tq. & Dist. Latur.	9890620620 maheshwavare@gmail.com
2	Prof. Dr. Dnyaneshwar Dadaji Pawar	*VC Nominated BoS Member Under Section 40(2)(a)*	Director School of Mathematical Sciences, SRTM University, Nanded	*9423124662* *dypawar@yahoo.com*
3	Dr. B. Surendranath Reddy	*VC Nominated BoS Member Under Section 40(2)(b)(i)*	School of Mathematical Sciences, SRTM University, Nanded	9096077789 surendra.phd@gmail.com bsreddy@srtmun.ac.in
4	Dr. Arun Babarao Jadhav	*VC Nominated BoS Member Under Section 40(2)(b)(ii)*	DSM's College of Arts, Commerce and Science, Parbhani.	7875118707 arunbjadhao@gmail.com
5	Dr. S. S. Handibag	*BoS Member Under Section 40(2)(b)(ii)*	Mahatma Basweshwar Mahavidylaya, Latur	9011491162 960417748 sujitmaths@gmail.com
6	Prof. Dr. Vandeo Chimnaji Borkar	*BoS Member Under Section 40(2)(b)(iii)*	Yeshwant Mahavidyalaya, Nanded	9421769217 borkarvc@gmail.com
7	Dr. Kishor Ramrao Gaikwad,	*BoS Member Under Section 40(2)(b)(iii)*	Science College, Nanded	9923295556 drkr.gaikwad@yahoo.in
8	Dr. Hemant Kishor Undegaonkar,	*BoS Member Under Section 40(2)(b)(iii)*	Bahairji Smarak College, Basmat, Dist. Hingoli	9822546874 hkundegaonkar@gmail.com
9	Dr. S. S. Bellale	*BoS Member Under Section 40(2)(c)*	Dayanand Science College, Latur, Tq. & Dist. Latur – 413512	9405417417 sidhesh.bellale@gmail.com
10	Dr. Ram Govindrao Metkar	*BoS Member Under Section 40(2)(c)*	Indira Gandhi Sr. College, Cidco, New Nanded, Tq. & Dist. Nanded.:	9822312176 rammetkarmath@gmail.com

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Structure for Four Year Multidisciplinary Degree Program with Multiple Entry and Exit

Subject: Mathematics (Major and Minor)

Year & Level	Semester	Optional-1	Optional -2	Optional -3	Generic Elective (GE) (Basket 2) *(Select one each from Group A and B of Basket 2, should not be related to DSC / DSM in col. 3 and 4)*	Vocational & Skill Enhancement Course (V/SEC) *(Related to DSC Mathematics)*	Ability EnhancementCourse (AEC) (Basket 3 for L2) Value Education Courses (VEC) / Indian Knowledge System (IKS) *(Common across faculty)*	Field Work / Project/ Internship/ OJT/ Apprenticeship / Case Study Or Co-curricular Courses (CC) (Basket 4 for CC) *(Common across faculty)*	Credits	Total Credits
1	2	3	4	5	6	7	8	9	10	
	I	SMATCT1101- Topics in Algebra (2Cr) (Theory) SMATCP1102 Lab Course-I (Calculus Using SAGE) (2Cr) (Practical) **(4cr)**	**Other than Mathematics (4cr)**	**Other than Mathematics (4cr)**	GE-1 SMATGE1101 Foundation of Mathematics (2Cr)	SEC SMATSC1101 (2Cr) Basics of MATLAB /Scilab (2cr)	AECENG1101 (2Cr) ACEMIL1101 (MAR/HIN/URD/KAN /PAL)(2Cr) IKSXXX1101 (2Cr) 6 Credits	--	22	44

1 (4.5)	**II**	SMATCT1151 Analytical Geometry (2Cr) (Theory) SMATCP1152 Lab Course-II (Integral Calculus) (2Cr) (Practical) (4cr)	**Other than Mathematics (4cr)**	**Other than Mathematics (4cr)**	GE-2 SMATGE1151 Basic Algebra (2Cr)	SEC SMATSC1151 (2Cr) Programming Using MATLAB/Scilab (2cr)	**AECENG1101 (2Cr) AECMIL1151 (MAR/HIN/URD/KAN/PAL)(2Cr) VECCOI1151 (2Cr) Constitution of India 6 Credits**	**--**	**22**	
***Exit option*: UG Certificate in Major Mathematics on completion of 44 credits** and additional **4 credits from NSQF / Internship**										
2 (5.0)	**III**	SMATCT1201 (2Cr) (Theory) Real Analysis-I SMATCT1202 (2Cr) (Theory) Group Theory SMATCP1201 (2Cr) (Practical) Lab Course-III (Based on Real Analysis -I) SMATCP1202 (2Cr) (Practical)Lab Course-IV (Based on Group Theory) **8 Credits**	SMATMT1201 Fundamentals of Sequence and Group Theory (2Cr) SMATMP1201 DSM Lab Course-I (On Fundamentals of Sequence and Group Theory) (2Cr) **4 Credits**	--	GE-3 SMATGE1201 (2Cr) Quantitative Aptitude and Logical Reasoning (संख्यात्मक अभियोग्यता आणि तार्किक तर्क) **2 credits**	VSC-1 SMATVC1201 (2Cr) Essential Mathematics for Data Science **2 Credits**	**AECENG1201 (2cr) AECMIL1201 (2Cr) (MAR/HIN/URD/KAN/PAL) 4 Credits**	**CCCXXX1201(2Cr)** (NCC/NSS/ SPT(sports)/ CLS(Cultural Studies) /HWS (Health Wellness)/ YGE(Yoga Education) / FIT(Fitness) **2Credits**	**22**	**44**
	IV	SMATCT1251 (2Cr) (Theory) Real Analysis-II SMATCT1252 (2Cr) (Theory) Ring Theory SMATCP1251 (2Cr) (Practical) Lab Course-V (Based on Real Analysis -II) SMATCP1252(2 Cr) (Practical)Lab Course-VI (Based on Ring Theory) **8 Credits**	SMATMT1251 Introduction to Infinite Series and Ring Theory (2 Cr) SMATMP1251 DSM Lab Course-II (On Introduction to Infinite Series and Ring Theory) **4 Credits**	--	GE-4 SMATGE1251 (2Cr) Mathematics for Competitive Examination (स्पर्धा परीक्षेसाठी गणित) **2 credits**	VSC-2 SMATVC1251 Introduction to R Programming **2 Credits**	**AECENG1201 (2cr) AECMIL1201 (2Cr) (MAR/HIN/URD/KAN/PAL) VECEVS1251 (2Cr) EVS 6 Credits**	**--**	**22**	
Exit option: UG Diploma in Major Mathematics and Minor Mathematics on completion of 88 credits and additional **4 credits NSQF / internship in DSC**										

3 (5.5)	**V**	SMATCT1301 Metric Space (3Cr) SMATCT1302 Linear Algebra(3Cr) SMATIK1303 Ancient Indian Mathematics (2cr) MATCP1301 (2Cr) Lab Course-V (Based on Metric Space and Linear Algebra) MATCP1302 Lab Course-VI (Based on Ordinary Differential Equations) (2cr) (12 Credits)	**(A)SMATET1301 (B)SMATET1302 (C)SMATET1303 (3Cr T+1Cr P)** Elective-I: (A)Vector Calculus (B)Graph Theory (C) Operation Research (C) Any equivalent course from SWAYAM-NPTEL/MOOC **(3T+1P Credits)**	--	--	--	VSC-3 SMATVC1301 (4Cr) LaTeX for Scientific Writing **(2 Credits)**	--	FP SMATFP1301 Field Project **4 Credits**	**22**	**44**
	VI	**SMATCT1351 (3Cr)** Complex Analysis **SMATCT1352 (3Cr) Numerical Analysis SMATCT1353 (2 Cr)** Partial Differential Equations **SMATCP1351 (2Cr)** Lab Course-VII (Based on Complex Analysis) **SMATCP1352**	**(A)SMATET1351 (B)SMATET1351 (C)SMATET1351 (3Cr T+1Cr P)** Elective -II (A) Integral Transform (B) Topology (C) Probability Theory Any equivalent course from SWAYAM-NPTEL/MOOC **(3Cr T+1Cr P)**		--		VSC-4 **SMATVC1351** Python Programming (2cr)	--	SMATOJ1351 (4Cr) **(OJT)** **4 Credits**	**22**	

		(2Cr) Lab Course-VIII (Based on Numerical Analysis) **(12 Credits)**									
Exit option: Bachelor in Science with Major in Mathematics and Minor in DSM											**130**
4 (6.0)	**VII**	SMATCT1401 (4Cr) Abstract Algebra SMATCT1402 (4Cr) Advanced Calculus SMATCT1403 (4Cr) Complex Analysis SMATCT1404 (2Cr) **Multivariable Calculus Credits** 14	SMATET1401 **(3Cr T+1Cr P)** (A)Mathematical Modeling (B) Dynamics and Continuum Mechanics-I (C) Theory of Probability (D) Any equivalent course from SWAYAM-NPTEL/MOOC **(3Cr T+1Cr P)**	*RM-1 Research Methodology* **SMATRM401** (4Cr) **4 Credits**		--	--	--	--	**22**	**44**
	VIII	SMATCT1451 (4Cr) Linear Algebra SMATCT1452 (4Cr) Measure and Integration Theory SMATCT1453 (4Cr) Topology SMATCT1454 (2Cr) Introduction to Scilab **14 Credits**	SMATET1451 **(3Cr T+1Cr P)** (A)Applied Partial Differential Equation (B) Dynamics and Continuum Mechanics-I I (C) Combinatorics **(3Cr T+1Cr P=4Cr)**	--		--	--	--	SMATOJ451 (4Cr) **(OJT)** **4 Credits**	**22**	
Exit option: Bachelor of Science with Major in MATHS (Honors) and Minor in DSM											**172**
4 (6.0)	**VII**	SMATCT1401 (4Cr)	SMATEC1401 (4Cr)	*Research Methodology*		--	--	--	Research Project	**22**	

		Abstract Algebra SMATCT1402 (4Cr) Advanced Calculus SMATCT1403 (2Cr) Multivariable Calculus **10 Credits**	(A)Applied Partial Differential Equations (B) Dynamics and Continuum Mechanics-I (C) Theory of Probability (D) Any equivalent course from SWAYAM-NPTEL/MOOC **4 Credits**	**SVECRM1401** (4Cr) **4 Credits**					**SMATRP1401 (4Cr)**		**44**
	VIII	SMATCT1451 (4Cr) Linear Algebra SMATCT1452 (4Cr) Topology SMATCT1453 (2Cr) **Introduction to Scilab 10 Credits**	SMATEC1451 (4Cr) (A) Partial Differential Equation (B) Dynamics and Continuum Mechanics-I I (C) Combinatorics **4 Credits**	--		--	--	--	Research Project **SMATRP1451 (8Cr)**	**22**	
Exit option: Bachelor of Science with Major in MATHS (Honours with Research) and Minor in Mathematics											**176**
Total Credits		**Major -92/84**		**Minor1 -12 + RM – 04**	**Minor-2 08**	**GE/OE - 08**	**V-08 + S-06**	**AEC-8 +MIL-08 VEC-4 + IKS-2 Total 22**	**(CC-04+FP/CS-04+OJT-04+RP-12) 24**	**176**	

B.A./B. Sc. Third Year Semester V *(Level 5.5)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major Theory	SMATCT1301	Metric Space	03	--	**03**	03	--
	SMATCT1302	Linear Algebra	03	--	**03**	03	--
IKS	SMATIK1303	Indian Knowledge Systems: Mathematical Foundations	02	--	**02**	02	--
Major Practical	MATCP1301	Lab Course-V (Based on Metric Space and Linear Algebra)	--	02	**02**	--	04
	MATCP1302	Lab Course-VI (Ordinary Differential Equations)	--	02	**02**	--	04
Elective -I	(A)SMATET1301 (B)SMATET1302 (C)SMATET1303	(A)Vector Calculus (B)Graph Theory (C) Operation Research (D) Any equivalent course from SWAYAM-NPTEL/MOOC	03	--	**03**	03	--
Elective - Practical	A)SMATEP1301 (B)SMATEP1302 (C)SMATEP1303	Lab Course Based on Elective -I	--	01	**01**	--	02
VSC-3	SMATVC1301	LaTeX for Scientific Writing	--	02	**02**		04
Field Project	SMATFP1301	Field Project		04	**04**		08
Total Credits			**11**	**11**	**22**	**11**	**22**

B.A/B. Sc. Third Year Semester V *(Level 5.5)*

Examination Scheme

[40% Continuous Assessment (***CA***) and 60% End Semester Assessment (***ESA***)]

	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major Theory	SMATCT1301	Metric Space	30	30	30	45	--	--	--
	SMATCT1302	Linear Algebra	30	30	30	45	--	--	--
IKS	SMATIK1303	Ancient Indian Mathematics	20	20	20	30	--	--	--
Major Practical	MATCP1301	Lab Course (Based on Metric Space and Linear Algebra)	--	--	--	--	20	30	50
	MATCP1302	Lab Course (Ordinary Differential Equations)	--	--	--	--	20	30	50
Elective -I	(A)SMATET1301 (B)SMATET1302 (C)SMATET1303	(A)Vector Calculus (B)Graph Theory (C) Operation Research (D) Any equivalent course from SWAYAM-NPTEL/MOOC	15	15	30	45	--	--	--
Elective -I Practical	A)SMATEP1301 (B)SMATEP1302 (C)SMATEP1303	Lab Course Based on Elective -I	--	--	--	--	10	15	25
VSC-3	SMATVC1301	LaTeX for Scientific Writing	--	--	--	--	20	30	50
Field Project	SMATFP1301	Field Project	--	--	--	--	40	60	100

B.A./B. Sc. Third Year Semester VI *(Level 5.5)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major Theory	SMATCT1351	Complex Analysis	03	--	**03**	03	--
	SMATCT1352	Numerical Analysis	03	--	**03**	03	--
	SMATCT1353	Partial Differential Equations	02	--	**02**	02	--
Major Practical	SMATCP1351	Lab Course-V (Based on Complex Analysis)	--	02	**02**	--	04
	SMATCP1352	Lab Course-VI (Based on Numerical Analysis)	--	02	**02**	--	04
Elective -I	(A)SMATET1351 (B)SMATET1352 (C)SMATET1353	(A) Integral Transform (B)Topology (C)Probability Theory	03	--	**03**	03	--
Elective -II Practical	(A)SMATEP1351 (B)SMATEP1352 (C)SMATEP1353	Lab Course Based on Elective -I (A/B/C)	--	01	**01**	--	02
VSC-4	SMATVC1351	Python Programming	--	02	**02**		04
OJT	SMATOJ1351	On Job Training		04	**04**		08
Total Credits			**11**	**11**	**22**	**11**	**22**

B.A/B. Sc. Third Year Semester V *(Level 5.5)*

Examination Scheme

[40% Continuous Assessment (***CA***) and 60% End Semester Assessment (***ESA***)]

	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major Theory	SMATCT1351	Complex Analysis	15	15	30	45	--	--	--
	SMATCT1352	Numerical Analysis	15	15	30	45	--	--	--
	SMATCT1353	Partial Differential Equations	10	10	20	30	--	--	--
Major Practical	SMATCP1351	Lab Course-V (Based on Complex Analysis)	--	--	--	--	20	30	50
	SMATCP1352	Lab Course-VI (Based on Numerical Analysis)	--	--	--	--	20	30	50
Elective -II	(A)SMATET1351 (B)SMATET1352 (C)SMATET1353	(A) Integral Transform (B)Topology (C)Probability Theory	15	15	30	45	--	--	--
Elective -II Practical	(A)SMATEP1351 (B)SMATEP1352 (C)SMATEP1353	Lab Course Based on Elective -I	--	--	--	--	10	15	25
VSC-4	SMATVC1351	Python Programming	--	--	--	--	20	30	50
OJT	SMATOJ1351	On Job Training	--	--	--	--	40	60	100

Abbreviations:

1.	DSC	: Discipline Specific Core (Major)
2.	CC/CT	: Core Course /Core Theory(Related Major)
3.	CP	: Core Practical
4.	DSE	: Discipline Specific Elective (Major)
5.	EC /ET	: Elective Course /Elective Theory
6.	EP	: Elective Practical
7.	MC /MT	: Minor Course /Minor Theory
8.	MP	: Minor Practical
9.	DSM	: Discipline Specific Minor
10.	GE/OE	: Generic/Open Elective
11.	VSEC	: Vocational Skill and Skill Enhancement Course
12.	VSC	: Vocational Skill Courses
13.	VC	: Vocational Course
14.	SEC	: Skill Enhancement Course
15.	SC	: Skill Course
16.	AEC	: Ability Enhancement Course
17.	IKS	: Indian Knowledge System
18.	VEC	: Value Education Courses
19.	OJ	: On Job Training
20.	FP	: Field Projects
21.	CC	: Co-Curricular Courses
22.	RP	: Research Project/Dissertation
23.	FP	: Field Project
24.	IP	: Internship Program
25.	CS	: Case Study

26. CLS : Cultural Studies

27. FIT : Fitness

28. HWS : Health and Wellness

29. YGE : Yoga

30. NCC : National Cadet Core

31. NSS : National Service Scheme

32. SPT : Sports

33. MIL : Modern Indian languages

34. RM : Research Methodology

Programme:- Degree Course in Mathematics BA/ B Sc.	Year – Third Level:- 5.5	Course Type : DSC Theory	Semester-V
Prerequisite:-: Fundamental Concepts, of Set Theory , Functions and Relations			
Course Code: SMATCT1301		Course Title: Metric Spaces	

Course Outcomes:

After successful completion of the course student will be able to

CO1. Understand and apply the concept of a metric space, including definitions, examples, and properties such as the diameter of a set.

CO2. Analyse topological properties of metric spaces, including open and closed sets, neighbourhoods, limit points, closure, interior, boundary, and classify sets such as dense, perfect, and separable sets.3. Understand the concepts of open and closed sets.

CO3.Examine convergence concepts in metric spaces, including Cauchy sequences and completeness, and apply important results such as Cantor's Intersection Theorem, Baire Category Theorem (statement), and Banach Fixed Point Theorem, along with understanding continuity and uniform continuity.

CO4. Understand and apply the concepts of compactness and connectedness, including key theorems such as the Heine–Borel Theorem (statement), and analyze properties like finite intersection property and relative compactness.

Credits: (3Cr T)	DSC
Max. Marks: 75	Min. Passing Marks:30
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0	

Metric Spaces		
Module	Topic	No of Lectures
I	**Fundamentals of Metric Spaces:** Definition of Metric Space, Examples of Metric Space, Diameter of a nonempty Set,	08
II	**Topological Properties of Metric Spaces:** Open and Closed Sets: Open and Closed Spheres, Neighbourhood of a Point, Open Sets, Equivalent Metrics, Limit Points, Closed Sets, Subspaces, Closure of a Set, Definition of Interior, Exterior, Frontier and Boundary Point, Dense set, Perfect set, Separable set	12
III	**Convergence, Completeness and Continuity in Metric Spaces:** Cauchy Sequence, Complete Metric Space, Cantor's Intersection Theorem Baire's Cate-gory Theorem(Statement Only) Continuity and Uniform Continuity: Definitions, Examples, Theorems on Continuity and Uniform Continuity, Banach Fixed Point Theorem	12
IV	**Compactness and Connectedness in Metric Spaces:** Definitions and Theorems on Compactness, Heine-Borel Theorem (Statement Only) Compactness and Finite Intersection Property(Definition only), Relative Compactness(Definition only), Connected sets Definition and Examples basic results.	13
Text Books		
1	S.C.Malik and Savita Arora, Mathematical Analysis, New Age International (P) Ltd, Second Edition 1992 (Reprint 2014)	

	Scope: **Module I:** Chapter 19: Art. 1, **Module-II:** 2, 2.1, 2.2, 2.3 (lemma and Theorem 2 Statement only), 2.4, 2.5, 2.6, 2.7, 2.8 (only definitions and examples), **Module-III**: Chapter 19: Art. 3(Theorem 11 and 12 Statement Only), 4 (Theorem 16 statement only), 4.1. **Module-IV:** Chapter 19: Art. 5 (Theorem 21 Statement only), 5.1, 5.2(Theorems 23 to 28 Statements only) .6, Theorem (34,35 36 37) Example 46
2	**Reference Books**
	1. R. Goldberg, Methods of Real Analysis, Oxford & IBH Pub. Co.PVT Ltd. 2. Somasundaram & Chaudhary,A First Course in Mathematical Analysis, Narosa Pub. House New Delhi. 3. Shantinarayan & M.D. Raisinghania, Elements of Real Analysis, S. Chand. Co.Ltd. 4. E. T. Copson, Metric Spaces, Cambridge University Press. Universal Book Co. New Delhi. 5. T. M. Apostol, Mathematical Analysis, Narosa Pub. House New Delhi. 6. T. M. Karade, Lecturers on Analysis, Sonu Nilu Pub. Nagpur. 7. U.S.Rana, Mathematics for Degree Students, S.Chand &Company Ltd. New Delhi.

Programme: Degree Course in Mathematics Class: B.A./B.Sc. III	Year: III Level 5.5	Course Type DSC Theory	Semester: V

Prerequisites: Students should have a foundational understanding of algebra and basic mathematical concepts, including familiarity with real numbers, algebraic manipulation, equations and inequalities, basic set theory, and functions, along with prior exposure to matrices and systems of linear equations. They should also possess basic logical reasoning and problem-solving skills required for abstract mathematical thinking.

Course Code: MATCT1302	Course Title: Linear Algebra

Course Outcomes:

CO1: Analyse vector spaces and subspaces, determine span, linear dependence and independence, and compute basis and dimension of finite-dimensional vector spaces.

CO2: Define and analyse linear transformations, determine kernel, and range, and apply the Rank–Nullity Theorem to solve problems in linear algebra.

CO3: Examine invertibility of linear transformations, apply consequences of the Rank–Nullity Theorem, and perform operations such as composition and solving operator equations in the space L(U, V).

CO4: Represent linear transformations using matrices, compute determinants, eigenvalues, and eigenvectors, and analyse inner product spaces including orthogonal and unitary matrices.

Credits: 3	DSC
Max. Marks: 75	Min. Passing Marks:30

Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0

Linear Algebra

Module	Topic	No of Lectures
I	**Vector spaces:** Vector spaces, Subspaces, Span of a set, More about subspaces, Linear Dependence, Independence, Dimension and Basis.	10
II	**Linear transformations I:** Definition and Examples of Linear transformations, Range and Kernel of a linear map, Rank and Nullity.	12
III	**Linear transformations II:** Inverse of a linear transformation, Consequences of Rank-Nullity theorem, The space L(U, V); composition of linear maps, operator equations.	11
IV	**Matrices:** Matrix associated with a linear map, Linear map associated with a matrix, Linear operators in $M_{n,n}$, Determinants: Eigenvalues, Eigenvectors, More matrix theory: Inner product spaces, Orthogonal and unitary matrices	12

Text Books

V. Krishnamurthy, V.P. Mainra, J.I Arora, "An introduction to Linear Algebra", Affiliated East-west press PVT. LTD. New Delhi 2002.

Scope:

Module I: Chapter 3: art 3.1 to 3.6
Module-II: Chapter 4: art 4.1 to 4.3
Module-III: Chapter 4: art 4.4 to 4.8
Module-IV: Chapter 5: art 5.1 to 5.3, Chapter 6: art 6.8, Chapter 7: art 7.2, 7.3

Reference Books	
1	V.K. Khanna, S.K. Bhambri, “A course in Abstract Algebra", S. Chand publications.
2	A. R. Vasishtha, ‘Linear Algebra" Krishna Prakashan media (p) LTD.
3	P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, “First course in Linear Algebra" New age International 1983.
4	Lipschutz, S., & Lipson, M. (2013). *Linear Algebra—Schaum's Outlines* (5th ed.). New York: The McGraw-Hill Companies, Inc.

Programme: Degree Course in Mathematics Class: B.A./B.Sc. III	Year: III Level 5.5	Course Type IKS Theory	Semester: V

Prerequisites: Students enrolling in this course are expected to have a basic understanding of elementary mathematics, including arithmetic, algebra, and geometry at the school level, along with familiarity with number systems and simple algebraic operations. They should possess general awareness of Indian history and scientific heritage, as well as logical reasoning and problem-solving skills. An interest in exploring ancient mathematical texts, traditional methods, and their relevance to modern mathematics will be beneficial for effectively understanding the course content.

Course Code: SMATIK1303	Course Title: Ancient Indian Mathematics

Course Outcomes:

CO1: Understand the foundations of the Indian Knowledge System, including ancient number systems such as the Bhutasankhya system and significant geometric contributions from Sulbasutras including Boudhayan's formulation of the Pythagorean theorem and geometric constructions.

CO2: Analyze the development of arithmetic and number theory in ancient India, including the concept of zero, operations with integers, evolution of the Indian numeral system, and methods like kuttaka and Chakravala Method for solving indeterminate equations.

CO3: Apply techniques from ancient Indian mathematics to solve algebraic equations and explore early ideas of calculus, including approximation of π and infinite series as seen in classical texts.

CO4: Examine combinatorial methods and astronomy-related mathematics in Indian tradition, including Pingala's binary system, Hemachandra's sequence, and trigonometric concepts such as sine tables used in astronomical calculations.

Credits: 2	IKS
Max. Marks: 50	Min. Passing Marks:20
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 2-0-0	

Ancient Indian Mathematics		
Module	Topic	No of Lectures
I	**Introduction to IKS and Contribution to Geometry:** Overview of Indian Knowledge System significance, sources, Number Systems, Bhutasankhya Number System, Contributions to Geometry, Some important Geometric contributions of Sulbasutras, Bodhayana -Pythagoras Theorem. Doubling, Squaring and circling square, More results on Geometry	09
II	**Contributions to Arithmetic and Number Theory:** Concept of zero its history and Developments, Operations with negative numbers, algebraic identities, Development of Indian numeral system and its impact, kuttaka method for solving indeterminate equations, Chakrawala Method to solve Pell's Equation	07
III	**Algebra and Calculus: Solution** of linear and quadratic equations, Some standard problems from ancient books, Approximation of πInfinite Series, early Concepts of Calculus.	07
IV	**Combinatorics and Astronomy-Related Mathematics:** Binomial Coefficients and early combinatorial methods, Pingala's Algorithm for Binary Number System, Hemachandra-Fibonacci sequence in Indian	07

	Texts, Astronomy in vedic period, sine functions and tables.	

Reference/Recommended Books

1)The Mathematics of India, Concept, Methods, Connections by P. P. Divakaran, Springer

2) The Baudhayana Sulba Sutra (translated by Satya Prakash)

3)The Aryabhatiya of Aryabhata (translated by Walter Eugene Clark)

4) Indian Mathematics: A Historical Study by S. N. Sen

5) The History of Indian Mathematic by George G. Joseph

6) https://iksindia.org/index.php

7) B. Datta and A. N. Singh, History of Hindu Mathematics (Volumes 1 and 2), Bharatiya Kala Prakashan.

8) Balachandra Rao, Indian Mathematics and Astronomy-Some Landmarks, 6th Edition, Bhavan's Gandhi Centre for Science and Human Values, Bangaluru, 2017.

9) Bhaskar Kamble, The Imperishable Seed: How Hindu Mathematics Changed the World and Why This History Was Erased, Garuda Prakashan, New Delhi, 2022.

10) C. N. Srinivasiengar, The History of Ancient Indian Mathematics, World Press, 1967.

11) B. Sury, Chakravala - a modern Indian method.

https://www.isibang.ac.in/sury/chakravala.pdf

BA/ B.Sc. III (Semester V)

Programme:- Degree Course in Mathematics BA/ B Sc.	Year – Third Level:- 5.5	Course Type : DSC Practical	Semester-V
Prerequisite:-: Fundamental Concepts, of Set Theory , Functions and Relations			
Course Code: MATCP1301		Course Title: Lab Course Based on Based on Metric Space and Linear Algebra	

Course Outcomes:

After successful completion of the course student will be able to

CO1. Apply fundamental concepts of metric spaces including metric properties, open and closed sets, limit points, dense sets, and equivalent metrics to analyze the topological structure of sets and subspaces.

CO2. Examine convergence-related concepts such as Cauchy sequences, completeness, continuity, compactness, and fixed-point results to solve theoretical and applied problems in metric spaces.

CO3. Apply the concepts of vector spaces, subspaces, linear dependence, span, basis, dimension, and linear transformations (including kernel and range) to analyze and solve algebraic problems.

CO3.Demonstrate understanding of matrix representations, eigenvalues, eigenvectors, and inner product spaces (including orthogonality) to solve theoretical and applied problems in linear algebra.

Credits: (2Cr)	DSC Practical
Max. Marks: 50	Min. Passing Marks:20
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4	

Lab Course Based on Based on Metric Space and Linear Algebra		
Practical Number	List of Practical's	No of Examples
1.	Verification of Metric Properties	02
2	Study of Open and Closed Sets	02
3	Limit Points and Dense Sets	02
4	Cauchy Sequences and Completeness	02
5	Continuity, Compactness and Fixed Point	02
6	Equivalent Metrics and Subspace Topology	02
7	Vector Space Verification and Subspaces	02
8	Linear Dependence, Span, Basis, and Dimension	02
9	Linear Transformations – Kernel and Range	02
10.	Matrix Representation of Linear Transformations	02
11.	Eigenvalues, Eigenvectors and Applications	02
12.	Inner Product Spaces and Orthogonality	02
Text Books		
1	S.C.Malik and Savita Arora, Mathematical Analysis, New Age International (P) Ltd, Second Edition 1992 (Reprint 2014) V. Krishnamurthy, V.P. Mainra, J.I Arora, "An introduction to Linear Algebra", Affiliated East-west press PVT. LTD. New Delhi 2002.	
2	**Reference Books**	
	1. R. Goldberg, Methods of Real Analysis, Oxford & IBH Pub. Co.PVT Ltd. 2. Somasundaram & Chaudhary,A First Course in Mathematical Analysis, Narosa	

	Pub. House New Delhi. 3. Shantinarayan & M.D. Raisinghania, Elements of Real Analysis, S. Chand. Co.Ltd. 4. E. T. Copson, Metric Spaces, Cambridge University Press. Universal Book Co. New Delhi. 5. T. M. Apostol, Mathematical Analysis, Narosa Pub. House New Delhi. 6. T. M. Karade, Lecturers on Analysis, Sonu Nilu Pub. Nagpur. 7. U.S.Rana, Mathematics for Degree Students, S.Chand &Company Ltd. New Delhi. 8. V.K. Khanna, S.K. Bhambri, "A course in Abstract Algebra", S. Chand publications. 9. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, "First course in Linear Algebra" New age International 1983. 10Lipschutz, S., & Lipson, M. (2013). Linear Algebra—Schaum's Outlines (5th ed.). New York: The McGraw-Hill Companies, Inc. 11. A. R. Vasishtha, 'Linear Algebra" Krishna Prakashan media (p) LTD.

DSC

Programme: Degree Course in Mathematics Class: B.A./B.Sc. III	Year: Third Level 5.5	Course Type DSC Practical	Semester: V
Prerequisites: Basic knowledge of algebra, functions, limits, differentiation, and integration is required. Familiarity with matrices, determinants, and problem-solving techniques is helpful.			
Course Code:	Course Title: Lab Course on Ordinary Differential Equations		
Course Outcomes: **CO1:**Understand basic concepts of differential equations and learn different methods to solve them **CO2:**To find solution differential equations using various methods. **CO3**: Construct linearly independent solutions of linear homogeneous ODEs and realize the idea of Wronskian and related theorems. **CO4:** Verify the existence and uniqueness of solutions for ODEs of first order.			
Credits: 2	DSC Practical		
Max. Marks: 50	Min. Passing Marks:20		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4			

Lab Course on Ordinary Differential Equations		
Module	Topic	No of Hours
I	**Linear equation of first order** Introduction, Differential equations, Problem associated with differential equations, Linear equation of the first order, The equation $y' + ay = 0$, The equation $y' + ay = b(x)$	15
II	**Linear equations with constant coefficients** Introduction, The second order homogeneous equation, Initial value problem for second order equations , Linear dependence and independence, A formula for Wronskain	15
III	**The non-homogeneous equation of order two** The non-homogeneous equation of order two, The homogeneous equation of order n, Initial value problems for n-th order equations, A special method for solving the non-homogeneous equation	15
IV	**Linear Equations with Variable Coefficients** Introduction, Initial value problem for the homogeneous equation, Solutions of the homogeneous equation. Existence and Uniqueness of solutions to first order equations Introduction, Equations with variables separated, Exact equations	15
Text Books: Earl A. Coddington : An Introduction to Ordinary Differential Equations, Prentice Hall of India Learning Private Limited, New Delhi.		

	Scope: Module I :Chapter 1: Article:1, 2,3, 4, 5, 6 Module II: Chapter2: Article: 1,2,3,4,5 Module III: Chapter 2: Article: 6,7,8,11 Module Iv: Chapter 3: Article: 1,2,3,4, Chapter 5: Article:1,2,3
	Reference Books
1	M.D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand and Company Limited.
2	G. Birkhoff and G. C. Rota, Ordinary Differential Equations, John Wiley and sons.
3	D. Somasundaram , Ordinary Differential Equations: A First Course, Narosa Publishing House.

Practical Number	**List of Practical's**	No of Examples
1.	Solve first order linear differential equations using integrating factor method.	02
2	Solve homogeneous differential equations of the form $y' + \alpha y = 0$	02
3	Solve non-homogeneous first order equations $y' + \alpha y = b(x)$	02
4	Form differential equations from given families of curves.	02
5	Solve separable differential equations with applications.	02
6	Solve exact differential equations and verify exactness condition.	02
7	Find integrating factors and solve non-exact differential equations.	02
8	Solve second order linear homogeneous differential equations with constant coefficients.	02
9	Solve second order differential equations using initial conditions (IVP problems).	02
10.	Verify linear dependence and independence of solutions using Wronskian.	02
11.	Solve non-homogeneous second order differential equations using method of undetermined coefficients.	02
12.	Solve non-homogeneous differential equations using variation of parameters method	02

B.A. / B.Sc. III (SEMESTER-V)

Programme: Degree Course in Mathematics Class: B.A./B.Sc. III	Year: III Level 5.5	Course Type DSE Theory	Semester: V
Prerequisite: Students should have basic knowledge of calculus (limits, derivatives, and integration), understanding of vectors and three-dimensional geometry, and familiarity with partial differentiation.			
Course Code:(A)SMATET1301	Course Title: (A)Vector Calculus		
Course Outcomes: After completing this course, students will be able to: **CO1:** Understand vector functions and apply differentiation techniques to scalar and vector point functions, including gradient and directional derivatives. **CO2:** Analyze divergence and curl of vector fields and interpret their physical significance. **CO3:** Evaluate line, surface, and volume integrals and apply them to practical problems. **CO4:** Apply major integral theorems (Green's, Stokes', and Gauss') to relate different types of integrals.			
Credits: 3	(A)DSE-I		
Max. Marks: 75	Min. Passing Marks:30		
Total No. of Lectures , Tutorials, Practical (in hours per week): L-T-P: 3-0-0			

(A)Vector Calculus		
Module	Topic	No of Lectures
I	**Vector Functions and Differentiation:** Vector function, Differentiation of Vectors, Formulae of Differentiations, Examples, Scalar & Vector Point Functions, Gradient of Scalar Point Functions, Geometrical Meaning of Gradient, Normal, Normal & Directional Derivative examples	10
II	**Divergence and Curl of Vector Fields:** Divergence of vector function, Physical meaning of divergence, Examples, Curl, Physical meaning of curl, Examples	12
III	**Line, Surface, and Volume Integrals:** Line Integral, Examples, Surface Integral, Examples, Volume Integral, Examples	12
IV	**Integral Theorems of Vector Calculus:** Green's Theorem (for a plane), Area of plane region by Green's Theorem, Examples, Stoke's Theorem (Relation between line integral & surface integral) Examples, Gauss's Theorem of divergence (Relation between surface integral & volume integral),Examples	11
Text Books		
1	**Advanced Engineering Mathematics By H. K. Das S. Chand & Company Pvt. Ltd.** Module I : Articles 5.22 to 5.28 Module II : Articles 5.29 to 5.32 Module III: Articles 5.33 to 5.35 Module IV : Articles 5.36 to 5.38	
	Reference Books	
1	Murray R. Spiegel ,Vector Analysis ,McGraw,Hill ,2009	

2	James Stewart ,Calculus (Multivariable Calculus) ,Cengage Learning ,2015
3	Marsden & Tromba ,Vector Calculus ,W. H. Freeman ,2012
4	H. M. Schey ,Div, Grad, Curl and All That ,W. W. Norton ,2005
5	Hubbard & Hubbard ,Vector Calculus, Linear Algebra and Differential Forms ,Matrix Editions ,2009
6	Michael Spivak ,Calculus on Manifolds ,Addison,Wesley ,1965
7	E. B. Wilson ,Vector Analysis ,Dover Publications ,2012
8	Shanti Narayan ,Vector Algebra ,S. Chand ,2014
9	A. R. Vasistha ,Vector Algebra ,Krishna Prakashan ,2010

Programme: Degree Course in Mathematics Class: B.A./B.Sc. III	Year: III Level 5.5	Course Type DSE Theory	Semester: V
Prerequisite:- Students are expected to have prior knowledge of set theory, relations and functions, basic algebra including matrices, and fundamental concepts of discrete mathematics. Familiarity with logical reasoning, proof techniques, and basic algorithmic thinking is essential. Elementary programming skills will be helpful for implementing graph algorithms.			
Course Code: (B)MATET1302	Course Title: (B)Graph Theory		
Course Outcomes: After successful completion of the course student will be able to CO1: Apply fundamental concepts of graph theory such as graphs, subgraphs, paths, cycles, and matrix representations to model and analyze real-world problems. CO2: Analyze properties of trees and connectivity, including spanning trees, shortest path problems, and identification of bridges and cut vertices in graphs. CO3: Evaluate and solve traversal and optimization problems involving Euler tours, Hamiltonian cycles, the Travelling Salesman Problem, and the Chinese Postman Problem. CO4: Apply matching theory and optimization techniques to solve problems such as bipartite matching and assignment problems using appropriate algorithms.			
Credits: 3	(B)DSE-I		
Max. Marks: 75	Min. Passing Marks:30		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0			

(B)Graph Theory		
Module	Topic	No of Lectures
I	**An introduction to Graphs:** The definition of a Graph, Graphs as Models, More Definitions, Vertex Degrees, Subgraphs, Paths and Cycles, The Matrix representation of Graphs	10
II	**Trees and Connectivity:** Definition and Simple Properties, Bridges, Spanning Trees, Connector Problems, Shortest path Problems, Cut vertices and Connectivity	12
III	**Eulers Tours and Hamiltonian Cycles:** Euler Tours, The Chinese Postman Problem, Hamiltonian Graphs, The Travelling Salesman Problem	12
IV	**Matching** Matching and Augmenting Paths, The Marriage Problem, The Personal Assignment Problem, The Optimal Assignment Problem, The Chinese Postman Problem Post Script	11
Text Books		
1	A first look at Graph Theory, John Clark and Derek Holton. Allied Publisher Ltd with World Scientific **Scope:** Module I Chapter 1 Article 1.1 to 1.7 Module II Chapter 2 Complete Module III Chapter 3 Complete	

	Module IV Chapter 4 Complete
	Reference Books
1	Introduction to Graph Theory, Douglas B. West, Prentice Hall of India / Pearson Education 2nd Edition, 2001
2	Graph Theory, J.A. Bondy and U.S.R. Murty, Springer Graduate Texts in Mathematics, 2008 (Reprint)
3	Graph Theory with Applications, J.A. Bondy and U.S.R. Murty, North-Holland / Elsevier 1976 (Reprinted Edition)
4	Discrete Mathematics and Its Applications, Kenneth H. Rosen McGraw-Hill Education Edition: 7th Edition, 2012
5	Graph Theory, Frank Harary Addison-Wesley Publishing Company 1969
6	Introduction to Graph Theory, Richard J. Trudeau, Dover Publications, Reprint Edition, 1993
7	Graph Theory with Applications to Engineering & Computer Science, Narsingh Deo, Dover Publications, Inc. Mineola, New York.

Programme: Degree Course in Mathematics Class: B.A./B.Sc. III	Year: First Level 5.5	Course Type DSE Theory	Semester: V
Prerequisites: Basic knowledge of Linear Algebra, Calculus, and elementary Statistics is required. Familiarity with solving simultaneous equations, matrices, and basic optimization concepts will be helpful.			
Course Code: (C)MATET1303	Course Title: (C)**Operations Research**		
Course Outcomes: **CO1:** Understand the fundamental concepts of Operations Research, formulate real-life problems into linear programming models, and solve them using graphical methods. **CO2:** Apply the Simplex Method, including artificial variables and degeneracy handling, to obtain optimal solutions of linear programming problems and related computational procedures. **CO3**: Analyze and solve Transportation Problems using appropriate methods, including formulation, feasibility conditions, and optimization techniques. **CO4:** Formulate and solve Assignment Problems using standard algorithms while addressing special cases and practical applications.			
Credits: 3	(C)DSE-I		
Max. Marks: 75	Min. Passing Marks:30		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0			

(c)Operations Research		
Module	Topic	No of Lectures
I	**Introduction to OR, Mathematical Formulation and Graphical Solution Method:** Origin of Operations Research, Scientific Method in Operation Research, Methodology of Operations Research, Operations Research and Decision Making, Linear Programming Problem, Mathematical Formulation of LPPs, Illustrations on Mathematical Formulation of LPPs. Graphical Solution Method, Some Exceptional Cases, General Linear Programming Problem, Canonical and Standard Form of LPP.	14
II	**Simplex Method:** Introduction, Fundamental Properties of Solutions, The Computational Procedure, Use of Artificial Variables, Degeneracy in Linear Programming, Solution of Simultaneous Linear Equations, inverting a Matrix using Simplex Method, Applications of Simplex Method.	10
III	**Transportation Problem:** Introduction, LP Formulation of the Transportation Problem, Existence of Solution in T.P., Duality in Transportation Problem, The Transportation Table, Loops in Transportation Tables.	11
IV	**Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Solution Methods of Assignment Problem, Special Cases in Assignment Problems, A Typical Assignment Problem.	10
Text Book: Kanti Swarup, P.K. Gupta and Man Mohan, "Operations Research", Fourteenth Thoroughly Revised Edition, S. Chand & Sons. Educational Publishers, New Delhi.		
1	**Scope:** **Module I:** Chapter-1: Articles 1.1, 1.2, 1.4, 1.8, 1.9,Chapter-2: Articles 2.1, 2.2, 2.3, 2.4.	

	Module II: Chapter-3: Articles 3.1, 3.2, 3.3, 3.4, 3.5. ,Chapter-4: Articles 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8. **Module -III** Chapter-10: Articles 10.1, 10.2, 10.3, 10.4, 10.5, 10.6. **Module IV:** Chapter-11: Articles 11.1, 11.2, 11.3, 11.4, 11.5.
	Reference Books
1	Hiller and Lieberman "Introduction to Operation Research", Tata Mc Graw Hill.
2	H. A. Taha "Operation Research an Introduction", Eight Edition Pearson Prentice Hall, Pearson Education Inc.
3	Er. Prem Kumar Gupta, D. S. Hira "Problems in Operations Research (Principles and solutions)", S. Chand & Company, Ram Nagar, New Delhi.
4	R. K. Gupta, "Operation Research", Krishna Prakashan Media Ltd.
5	J. K. Sharma, "Operation Research: Theory and Applications", Second Edition. 2006, Macmillan India Ltd.

BA/ B.Sc. III (Semester V)

Programme:- Degree Course in Mathematics BA/ B Sc.	Year – Third Level:- 5.5	Course Type : DSE Practical	Semester-V
Prerequisite: Students should have basic knowledge of calculus (limits, derivatives, and integration), understanding of vectors and three-dimensional geometry, and familiarity with partial differentiation.			
Course Code: (A) SMATEP1301		Course Title: Lab Course Based on Vector Calculus	
Course Outcomes: After successful completion of the course student will be able to CO1: Apply vector differentiation concepts such as gradient and directional derivatives in problem-solving. CO2: Analyze divergence and curl of vector fields and interpret their physical significance. CO3: Evaluate line, surface, and volume integrals using appropriate techniques. CO4: Verify and apply Green's, Stokes', and Gauss divergence theorems in practical problems.			
Credits: (1Cr)	(A)DSE-I Practical		
Max. Marks: 25	Min. Passing Marks:10		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-2			

Lab Course Based on Based on(A) Vector Calculus		
Practical Number	List of Practical's	No of Examples
1.	To compute derivatives of vector functions and verify standard differentiation rules.	02
2	To evaluate scalar and vector point functions with examples.	02
3	To find gradient of scalar functions and interpret its geometrical meaning.	02
4	To compute directional derivatives and verify maximum rate of change.	02
5	To calculate divergence of vector fields and interpret physical meaning.	02
6	To evaluate curl of vector fields and study its properties.	02
7	To verify identities involving divergence and curl.	02
8	To evaluate line integrals for given vector fields.	02
9	To compute surface integrals over simple surfaces.	02
10.	To evaluate volume integrals in different coordinate systems.	02
11.	To verify Green's Theorem for a plane region.	02
12.	To verify Stokes' and Gauss Divergence Theorems	02
Text Books		
1	**Advanced Engineering Mathematics By H. K. Das S. Chand & Company Pvt. Ltd.**	
	Reference Books	
1	Murray R. Spiegel ,Vector Analysis ,McGraw,Hill ,2009	
2	James Stewart ,Calculus (Multivariable Calculus) ,Cengage Learning ,2015	
3	Marsden & Tromba ,Vector Calculus ,W. H. Freeman ,2012	
4	H. M. Schey ,Div, Grad, Curl and All That ,W. W. Norton ,2005	
5	Hubbard & Hubbard ,Vector Calculus, Linear Algebra and Differential Forms ,Matrix Editions ,2009	
6	Michael Spivak ,Calculus on Manifolds ,Addison,Wesley ,1965	

7	E. B. Wilson ,Vector Analysis ,Dover Publications ,2012
8	Shanti Narayan ,Vector Algebra ,S. Chand ,2014
9	A. R. Vasistha ,Vector Algebra ,Krishna Prakashan ,2010

BA/ B.Sc. III (Semester V)

Programme:- Degree Course in Mathematics BA/ B Sc.	Year – Third Level:- 5.5	Course Type : DSE Practical	Semester-V
Prerequisite:-: Students are expected to have prior knowledge of set theory, relations and functions, basic algebra including matrices, and fundamental concepts of discrete mathematics. Familiarity with logical reasoning, proof techniques, and basic algorithmic thinking is essential. Elementary programming skills will be helpful for implementing graph algorithms.			
Course Code: (B) SMATEP1302		Course Title: Lab Course Based on (B) Graph Theory	

Course Outcomes:

After successful completion of the course student will be able to

CO1: Apply fundamental concepts of graph theory such as graphs, subgraphs, paths, cycles, and matrix representations to model and analyze real-world problems.

CO2: Analyze properties of trees and connectivity, including spanning trees, shortest path problems, and identification of bridges and cut vertices in graphs.

CO3: Evaluate and solve traversal and optimization problems involving Euler tours, Hamiltonian cycles, the Travelling Salesman Problem, and the Chinese Postman Problem.

CO4: Apply matching theory and optimization techniques to solve problems such as bipartite matching and assignment problems using appropriate algorithms.

Credits: (1 Cr)	(B)DSE-I Practical
Max. Marks: 25	Min. Passing Marks:10
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-2	

Lab Course Based on Based on (B)Graph Theory		
Practical Number	Practical Examples based on	No of Examples
1.	Graph Representation using Adjacency Matrix and List	02
2	Degree of Vertices and Verification of Handshaking Lemma	02
3	Study of Subgraphs, Paths, and Cycles	02
4	Verification of Properties of Trees	02
5	Construction of Spanning Trees and Minimum Spanning Tree	02
6	Analysis of Connectivity, Bridges, and Cut Vertices	02
7	Shortest Path Problem using Dijkstra's Algorithm	02
8	Determination of Euler Paths and Euler Circuits	02
9	Identification of Hamiltonian Paths and Cycles	02
10.	Solution of Travelling Salesman Problem and Chinese Postman Problem	02
11.	Maximum Matching in Bipartite Graphs using Augmenting Paths	02
12.	Optimal Assignment Problem using Hungarian Method	02
Text Books		
1	A first look at Graph Theory, John Clark and Derek Holton. Allied Publisher Ltd with World Scientific	
	Reference Books	
1	Introduction to Graph Theory, Douglas B. West, Prentice Hall of India / Pearson Education 2nd Edition, 2001	
2	Graph Theory, J.A. Bondy and U.S.R. Murty, Springer Graduate Texts in Mathematics, 2008 (Reprint)	

3	Graph Theory with Applications, J.A. Bondy and U.S.R. Murty, North-Holland / Elsevier 1976 (Reprinted Edition)
4	Discrete Mathematics and Its Applications, Kenneth H. Rosen McGraw-Hill Education Edition: 7th Edition, 2012
5	Graph Theory, Frank Harary Addison-Wesley Publishing Company 1969
6	Introduction to Graph Theory, Richard J. Trudeau, Dover Publications, Reprint Edition, 1993
7	Graph Theory with Applications to Engineering & Computer Science, Narsingh Deo, Dover Publications, INC. Mineola, New York

BA/ B.Sc. III (Semester V)

Programme:- Degree Course in Mathematics BA/ B Sc.	Year – III Level:- 5.5	Course Type : DSE Practical	Semester-V
Prerequisites: Basic knowledge of Linear Algebra, Calculus, and elementary Statistics is required. Familiarity with solving simultaneous equations, matrices, and basic optimization concepts will be helpful.			
Course Code: (C)SMATEP1303		Course Title: Lab Course Based on (C) Operations Research	

Course Outcomes:

After successful completion of the course student will be able to

CO1: Understand the fundamental concepts of Operations Research, formulate real-life problems into linear programming models, and solve them using graphical methods.

CO2: Apply the Simplex Method, including artificial variables and degeneracy handling, to obtain optimal solutions of linear programming problems and related computational procedures.

CO3: Analyze and solve Transportation Problems using appropriate methods, including formulation, feasibility conditions, and optimization techniques.

CO4: Formulate and solve Assignment Problems using standard algorithms while addressing special cases and practical applications.

Credits: (1Cr)	(C)DSE-I Practical
Max. Marks: 25	Min. Passing Marks:10
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-2	

Lab Course Based on Based on (C) Operations Research		
Practical Number	List of Practical's	No of Examples
1.	Formulation of Linear Programming Problem (LPP) from real-life situations.	02
2	Graphical solution of LPP (maximization case).	02
3	Graphical solution of LPP (minimization case) and identification of feasible region.	02
4	Graphical solution of LPP involving special cases (multiple optimal solutions, infeasible and unbounded solutions).	02
5	Conversion of general LPP into canonical and standard form.	02
6	Solution of LPP using Simplex Method (basic problems).	02
7	Solution of LPP using Simplex Method with artificial variables (Big-M or Two-Phase method).	02
8	Handling degeneracy in Simplex Method.	02
9	Solving system of linear equations and matrix inversion using Simplex Method.	02
10.	Solution of Transportation Problem using North-West Corner Rule and Least Cost Method.	02
11.	Solution of Transportation Problem using Vogel's Approximation Method (VAM) and optimality test.	02
12.	Solution of Assignment Problem using Hungarian Method (including special cases like unbalanced problems and maximization).	02
Text Books		

1	**Text Book**: Kanti Swarup, P.K. Gupta and Man Mohan, "Operations Research", Fourteenth Thoroughly Revised Edition, S. Chand & Sons. Educational Publishers, New Delhi.
	Reference Books
1	Hiller and Lieberman "Introduction to Operation Research", Tata Mc Graw Hill.
2	H. A. Taha "Operation Research an Introduction", Eight Edition Pearson Prentice Hall, Pearson Education Inc.
3	Er. Prem Kumar Gupta, D. S. Hira "Problems in Operations Research (Principles and solutions)", S. Chand & Company, Ram Nagar, New Delhi.
4	R. K. Gupta, "Operation Research", Krishna Prakashan Media Ltd.
5	J. K. Sharma, "Operation Research: Theory and Applications", Second Edition. 2006, Macmillan India Ltd.

Programme: Degree Course in Mathematics Class: B.A./B.Sc. III	Year: III Level 5.5	Course Type VSC	Semester: V
Prerequisites: Basic computer knowledge and familiarity with text editors, along with an understanding of file handling and elementary mathematical notation.			
Course Code: MATVC1301	Course Title: LaTeX for Scientific Writing		
Course Outcomes: After Successful Completion of this Course Students will able to **CO1:** Demonstrate the ability to create, compile, and structure professional documents using LaTeX syntax and environments. **CO2:** Apply formatting techniques for text, paragraphs, sections, and references to produce well-organized documents. **CO3:** Design and customize lists, tables, and tabbing environments for effective presentation of structured information. **CO4:** Construct and represent mathematical expressions, equations, matrices, and scientific notations accurately using LaTeX.			
Credits: 2	VSC-III		
Max. Marks: 50	Min. Passing Marks:20		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4			

LaTeX for Scientific Writing		
Module	Topic	No of Hours
I	**Introduction to LaTeX:** Definition and application of LaTeX, Preparation and Compilation of LaTeX input file, LaTeX Syntax, Keyboard Characters in LaTeX.	15
II	**Formatting Words, Lines, and Paragraphs:** Text and Math Mode Fonts, Emphasized and Colored Fonts, Sectional Units, Labeling and Referring Numbered Items, Texts Alignment and Quoted text, New Lines and Paragraphs, Creating and Filling Blank Space, Producing Dashes within Texts.	15
III	**Listing and Tabbing Texts:** Listing Texts and Tabbing Texts Through the tabbing Environment, Table Through the tabular Environment, Vertical Positioning of Tables, Sideways (Rotated) Texts in Tables, Adjusting Column Width in Tables, Additional Provisions for Customizing Columns of Tables, Merging Rows and Columns of Tables.	15
IV	**Equation Writing:** Basic Mathematical Notations and Delimiters. Mathematical Operators Mathematical Expressions in Text-Mode, Simple Equations, Array of Equations, Left Aligning an Equation, Sub-numbering a Set of Equations, Texts and Blank Space in Math-Mode, Conditional Expression, Evaluation of Functional Values Splitting an Equation into Multiple Lines Vector and Matrix	15
Text Books		

1	LaTeX in 24 Hours, A Practical Guide for Scientific Writing, Dilip Datta, Springer International Publishing AG 2017. **Scope:** **Module I:** Chapter-1 (Article 1.1 to 1.6) **Module II:** Chapter-2 (Article 2.1 to 2.4) Chapter-3 (Article 3.1 to 3.7) **Module III:** Chapter 6 (Article 6.1 and 6.2) Chapter 7 (Article 7.1 ,7.3 to 7.7) **Module IV:** Chapter 11(Article 11.1 to 11.7) Chapter 12(Article 12.1 to 12.5)
	Reference Books
1	LaTeX, A Document Preparation System, User's Guide and Reference Manual, Leslie Lamport, Addison-Wesley Publishing Company, Inc., 1994.
2	LaTeX Beginner's Guide, Stefan Kottwitz, Packt Publishing Ltd, 2011.
3	LATEX and Friends, M.R.C. van Dongen, Springer-Verlag Berlin Heidelberg, 2012 Math into LaTeX, George Gratzer, Springer Science Business Media New York, 1996

Sr	List of Practical's
1	Introduction to LaTeX, Syntax and Keyboard Characters, Fonts in LaTex
2	Sections, Labelling and Text Alignment in LaTeX.
3	New Lines, Paragraphs, Blank Space and Dashes in LaTeX
4	Listing Texts, Tabbing Texts
5	Table Through the tabular Environment, tabularx Environment
6	Commands and Environment for Inserting Figures.
7	Mathematical Notations, Operators and Expression in LaTeX.
8	Array of Equations, Alignment and numbering a Set of Equations.
9	Texts, Blank Space and Conditional Expression in Math mode, Evaluation of functional Values.
10	Creating Vector and Matrix of any Order.
11	Creating Research Paper using LaTeX
12	Practice using LaTeX Packages including those for citations, References, Indexing

Programme: Degree Course in Mathematics Class: B.A./B.Sc. III	Year: III Level 5.5	Course Type DSC	Semester: VI
Prerequisites: Knowledge of algebra, trigonometry, calculus (limits, differentiation, integration), and basic sequences and series.			
Course Code: SMATCT1351	Course Title: Complex Analysis		
Course Outcomes: **CO1:** Understand and apply concepts of complex numbers, exponential form, regions in the complex plane, and mappings of complex functions. **CO2:** Demonstrate the ability of limit, continuity, analyticity of a function, Find the derivative and integral of a complex variable function. **CO3**: Evaluate contour integrals and apply fundamental theorems such as Cauchy Integral Theorem, Cauchy Integral Formula, and properties of simply and multiply connected domains. **CO4:** Develop and analyze series expansions of complex functions using Taylor and Laurent series, and apply Liouville's theorem and the Fundamental Theorem of Algebra.			
Credits: 3	DSC		
Max. Marks: 75	Min. Passing Marks:30		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0			

Complex Analysis		
Module	Topic	No of Lectures
I	**Complex Numbers and Analytic Functions**: Functions: Complex Numbers: Exponential form, Roots of complex numbers, Regions in the complex plane, Analytic functions: Functions of complex variables, Mappings, Mappings by the exponential Function, Limits, Theorems on limits, Limit involving, The point at infinity, Continuity, Derivatives, Differentiation formulae, Analytics Functions.	12
II	**Elementary Functions:** Cauchy- Riemann equations, Sufficient conditions for derivability, polar co-ordinates, Analytic functions, Harmonic functions, Elementary functions: The exponential functions, The logarithmic functions, Branches and Derivatives of logarithms, Some identities involving logarithms, Complex exponents.	11
III	I**ntegrals:** Derivatives of functions w(t), Definite integrals of functions w(t); Contours, Contour Integrals, Upper bounds for moduli of contour integrals, Antiderivatives, Simply and Multiply connected domains	10
IV	**Integrals and Series:** Integrals: Cauchy integral formula, Derivatives of analytic functions, Liouville's theorem and the Fundamental theorem of algebra, Series: Convergence of sequences, Convergence of series, Taylor series, Laurent series.	12
Text Books: J W. Brown and R.V. Churchill, "Complex variables and Applications", International Students' edition 2009, 7th edition.		

1	**Scope:** ModlueI: Chapter 1: art 6, 8 to 10 Chapter 2: art 11 to 20 Module-II: Chapter 2: art 21 to 25 Chapter 3: art 28 to 32 Module-III: Chapter 4: art 36 to 42. Module-IV: Chapter 4: art 46 to 49 Chapter 5: 51 to 56
	Reference Books
1	S. Punnusamy," Complex Analysis", Narosa Publishing house, 2nd edition.
2	A. R. Shastri," An introduction to Complex Analysis", Macmillan.
3	H. S. Kasana," Complex Variables" PHI Learning PVT. limited New Delhi.
4	M.R.Spiege, S. Lipschut, J.J. Schiller, D. Spellman,"Complex Variables", Schaum's Outlines, Tata McGraw Hill education Private Limited New Delhi.
5	A.R. Vasishtha, Complex Analysis, Krishna Prakashan Media Pvt. Ltd., Meerut, 2014
6	B.S. Grewal Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2018
7	S. Ganguly, Elements of Complex Analysis, Narosa Publishing House, New Delhi, 2011

Programme: Degree Course in Mathematics Class: B.A./B.Sc. III	Year: III Level 5.5	Course Type DSC	Semester: VI
Prerequisites: Basic knowledge of calculus, algebra, and functions is required. Students should be familiar with derivatives, series expansion, and elementary differential equations.			
Course Code:SMATCT1352	Course Title: **Numerical Analysis**		
Course Outcomes: **After successful completion of this course, students will be able to:** **CO1:** Understand concepts of finite differences, operators, and their applications in polynomial representation. **CO2:** Apply interpolation techniques (Newton–Gregory, Lagrange, and divided differences) for equal and unequal intervals. **CO3:** Use numerical integration methods such as Trapezoidal, Simpson's, and Weddle's rules to approximate definite integrals. **CO4:** Solve first-order ordinary differential equations using numerical methods like Euler's, Modified Euler's, Picard's, and Taylor series methods.			
Credits: 3			
Max. Marks: 75	Min. Passing Marks:30		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0			

Numerical Analysis		
Module	Topic	No of Lectures
I	**Finite Differences and Interpolation:** Finite Differences: Introduction, Differences, Theorem, Factorial Notation, Factorial Function, Representation of a given Polynomial, The operator E and Δ The operators D and ∇ and their relation, Interpolation with equal intervals, Newton-Gregory formula for forward interpolation, Newton-Gregory formula for backward interpolation,	12
II	**Interpolation with unequal intervals**: Equidistant terms with one or more missing terms, Interpolation with unequal intervals: Introduction, Divided differences with unequal arguments, Divided differences when two or more arguments are same or coincident, Properties of divided differences (Theorem 4statement only) Newton's formula for unequal intervals, Lagrange's interpolation formula for unequal intervals, Lagrange's interpolation formula for equal intervals	11
III	. **Applications** Numerical Quadrature or Numerical Integration: Introduction, A general quadrature formula for equidistant ordinates, Some important approximate quadrature formulae, The Trapezoidal rule, Simpson's one third rule, Simpson's three eighth rule, Weddle's rule	12
IV	**Numerical Solution of O.D.E.:** Introduction, Equation of First order, Euler's Method, Euler's Modified Method, Picard's method, Talyor's Series Method.	10
Text Book : H.C. Saxena, Finite Differences and Numerical Analysis, S. Chand & Co.reprint 2001.		

	Scope: **Chapter 1** : 1.1, 1.2, 1.3, 1.5.1, 1.5.3, 1.5.4, 1.6, 1.6.1, 1.6.2, 1.7.1, 1.8, 1.8.1, 1.8.2 . 1.8.3 **Chapter 2** : 2.1, 2.2, 2.2.1, 2.2.2 (Theorem 4 statement only), 2.3, 2.4.1, 2.4.2 **Chapter 6** : 6.1, 6.2, 6.3, 6.3.1, 6.3.2, 6.3.3, 6.3.4,6.3.5 **Chapter 16** : 16.1, 16.2, 16.2.1, 16.2.2, 16.2.3, 16.2.4(a).
Reference Books	
1	S.S. Sastry, Introductory Methods of Numerical Analysis" Prentice-Hall of India Private Ltd. (Second Edition) 1997.
2	E.V. Krishnamurthi & Sen, Numerical Algorithm", Affliate East, West press Private Limited 1986.
3	M.K. Jain, SRK Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computations", New Age International Limited
4	C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, Pearson Education Ltd. (2009).
5	S A. Mollah Numerical Analysis and Computational Methods" Books &Allid (P) Ltd 20007.

BA/ B.Sc. III (Semester VI)

Programme:- Degree Course in Mathematics BA/ B Sc.	Year – Third Level:- 5.5	Course Type : DSC	Semester-VI
Prerequisite:- Students should have a basic understanding of concepts from earlier mathematics courses, including differential calculus, integral calculus, and ordinary differential equations. Familiarity with partial differentiation, functions of several variables, and basic algebraic methods is also essential for effectively learning partial differential equations.			
Course Code: **SMATCT1353**		Course Title: Partial Differential Equations	
Course Outcomes: After successful completion of the course student will be able to CO1: Understand the concept of partial differential equations, their order, formation, and solve first-order PDEs using direct integration, Lagrange's method, and multipliers. PDE of first and second order. CO2: Solve non-linear first-order PDEs using Charpit's method and analyze linear homogeneous PDEs of higher order with constant coefficients. CO3: Apply systematic procedures to obtain complementary functions and particular integrals for linear PDEs. CO4: Solve non-homogeneous PDEs using separation of variables and apply PDE techniques to physical models such as vibrating string problems.			
Credits: (02 Cr)	DSC		
Max. Marks: 50	Min. Passing Marks:20		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 2-0-0			

Partial Differential Equations		
Module	Topic	No of Lectures
I	Partial differential equation (PDE), Order, and method of forming PDE, solution of equations by direct integration, Lagrange's linear equations, method of multipliers.	08
II	Partial differential equations non-linear in p and q; Charpit's method, Linear homogeneous PDE of nth order with constant coefficients,	08
III	Rules for finding the complementary functions, Rules for finding the particular integral.	07
IV	Non-homogeneous linear equations, Method of separation of variables, Equations of Vibrating string,	07
Text Books		
1	H. K. Dass, Advanced Engineering Mathematics S.Chand and Company Ltd.(2004). **Scope Module** I: Chapter 9: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7. Module-II: Chapter 9: 9.8, 9.9, 9.10, 9.11, 9.12. Module-III: Chapter 9: 9.13, , Module IV: , 9.15 9.16, 9.17,	
2	**Reference Books**	
	1. D.A.Murray, Introductory course in Differential equation, New York Longmans and Green Co. London and Bombay. 2. M.D. Raisinghania, Ordinary and Partial Differential equations, S.Chand and Co. 3. T.M.Karade, Lectures on Differential equation, Sonu-Nilu Pub.Nagpur. 4. I.N.Sneddon, Elements of Partial Differential Equation, Mc Graw Hill co. 5. Peter Olver, Introduction to Partial Differential equation Springer Cham Heidelberg New York Dordrecht London. 6. A. Singaravelu, Engineering Mathematics, Engineering Mathematics, Meenakshi Agency Chennai.	

	7. W.E. Williams, Partial Differential equations, Claredon Press Oxford. 8. M.E.Tayor, Partial Differential equations, Springer Cham Heidelberg New York Dordrecht London.

BA/ B.Sc. III (Semester VI)

Programme:- Degree Course in Mathematics BA/ B Sc.	Year – Third Level:- 5.5	Course Type : DSC Practical	Semester-VI
Prerequisite: Basic knowledge of complex numbers, Argand plane, calculus, elementary functions, and sequences & series.			
Course Code: SMATCP1351		Course Title: Lab Course Based on Complex Analysis	

Course Outcomes:

After successful completion of the course student will be able to

CO1: Apply concepts of complex numbers and mappings to represent and visualize regions in the complex plane.

CO2: Verify analyticity of functions using Cauchy–Riemann equations and construct analytic functions from harmonic functions.

CO3: Evaluate contour integrals and apply related results such as ML-inequality and Cauchy Integral Formula.

CO4: Develop series expansions of complex functions using Taylor and Laurent series for analysis of functions.

Credits: (2Cr)	DSC Practical
Max. Marks: 50	Min. Passing Marks:20
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4	

Lab Course Based on Based on Complex Analysis		
Practical Number	List of Practical's	No of Examples
1.	To express complex numbers in exponential form and find roots of complex numbers.	02
2	To plot and identify regions in the complex plane.	02
3	To study mappings of complex functions.	02
4	To verify Cauchy–Riemann equations in Cartesian form.	02
5	To verify Cauchy–Riemann equations in polar form.	02
6	To find harmonic conjugate and construct analytic functions.	02
7	To evaluate contour integrals along simple paths.	02
8	To estimate upper bounds of contour integrals (ML-inequality).	02
9	To study simply connected and multiply connected domains.	02
10.	To apply Cauchy Integral Formula.	02
11.	To expand functions using Taylor series.	02
12.	To expand functions using Laurent series.	02
Text Books		
1	J W. Brown and R.V. Churchill, "Complex variables and Applications", International Students' edition 2009, 7th edition.	
	Reference Books	
1	S. Punnusamy," Complex Analysis", Narosa Publishing house, 2nd edition.	
2	A. R. Shastri," An introduction to Complex Analysis", Macmillan.	
3	H. S. Kasana," Complex Variables" PHI Learning PVT. limited New Delhi.	
4	M.R.Spiege, S. Lipschut, J.J. Schiller, D. Spellman,"Complex Variables", Schaum's Outlines, Tata McGraw Hill education Private Limited New Delhi.	
5	A.R. Vasishtha, Complex Analysis, Krishna Prakashan Media Pvt. Ltd., Meerut, 2014	

6	B.S. Grewal Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2018
7	S. Ganguly, Elements of Complex Analysis, Narosa Publishing House, New Delhi, 2011.

BA/ B.Sc. III (Semester VI)

Programme:- Degree Course in Mathematics BA/ B Sc.	Year – Third Level:- 5.5	Course Type : DSC Practical	Semester-VI
Prerequisite: Students undertaking this course should have a foundational understanding of mathematics, particularly in differential and integral calculus, including limits, derivatives, and basic integration techniques. They should be familiar with algebraic concepts such as polynomials, functions, and series expansions, along with basic graph interpretation. Prior exposure to elementary ordinary differential equations and basic numerical computation skills will be beneficial for understanding approximation methods and performing calculations effectively.			
Course Code: SMATCP1352		Course Title: Lab Course Based on Numerical Analysis	
Course Outcomes: After successful completion of the course student will be able to **CO1:** Construct and analyze finite difference tables for given datasets. **CO2:** Apply interpolation techniques (Newton–Gregory, Lagrange, and divided differences) to estimate unknown values. **CO3:** Use numerical integration methods (Trapezoidal and Simpson's rules) to approximate definite integrals. **CO4:** Solve first-order ordinary differential equations using numerical methods such as Euler's method.			
Credits: (2Cr)	DSC Practical		
Max. Marks: 50	Min. Passing Marks:20		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4			

Lab Course Based on Based on Numerical Analysis		
Practical Number	List of Practical's	No of Examples
1.	Construction of Forward Difference Table	02
2	Construction of Backward Difference Table	02
3	Verification of Polynomial using Finite Differences	02
4	Newton–Gregory Forward Interpolation Method	02
5	Newton–Gregory Backward Interpolation Method	02
6	Lagrange's Interpolation Formula	02
7	Newton's Divided Difference Interpolation Method	02
8	Interpolation with Missing Terms	02
9	Numerical Integration using Trapezoidal Rule	02
10.	Numerical Integration using Simpson's 1/3 Rule	02
11.	Numerical Integration using Simpson's 3/8 Rule	02
12.	Numerical Solution of ODE using Euler's Method	02
Text Books		
1	H.C. Saxena, Finite Differences and Numerical Analysis, S. Chand & Co.reprint 2001.	
	Reference Books	
1	S.S. Sastry, Introductory Methods of Numerical Analysis" Prentice-Hall of India Private Ltd. (Second Edition) 1997.	
2	E.V. Krishnamurthi & Sen, Numerical Algorithm", Affliate East, West press Private Limited 1986.	

3	M.K. Jain, SRK Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computations", New Age International Limited
4	C. F. Gerald and P. O. Wheatley, Applied Numerical Analysis, Pearson Education Ltd. (2009).
5	S A. Mollah Numerical Analysis and Computational Methods" Books &Allid (P) Ltd 20007.

B.A. / B.Sc. III (SEMESTER-VI)

Programme: Degree Course in Mathematics Class: B.A./B.Sc. III	Year: III Level 5.5	Course Type DSE Theory	Semester: VI
Prerequisites: Basic knowledge of calculus (limits, derivatives, and integration) and ordinary differential equations is essential. Familiarity with complex numbers, trigonometry, and infinite series is also required. Understanding of basic algebra and functions will help in applying Laplace and Fourier transforms effectively.			
Course Code: (A) SMATET1351	Course Title: (A)Integral Transform		
Course Outcomes: After completing this course, students will be able to: **CO1:** Understand and compute Laplace transforms and their properties. **CO2:** Apply inverse Laplace transforms using various methods including convolution and partial fractions. **CO3:** Solve differential equations using Laplace transform techniques. **CO4:** Analyse and apply Fourier transforms in solving boundary value problems and signal analysis.			
Credits: 3	(A)DSE-II		
Max. Marks: 75	Min. Passing Marks:30		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0			

(A)Integral Transform		
Module	Topic	No of Lectures
I	**Laplace Transformation:** Introduction, Laplace Transform , Important Formulae, Properties Of Laplace Transforms, Laplace Transforms of the Derivative of f(t), Laplace Transforms of the Derivative of Order n, Laplace Transforms of the Integral of f(t),Laplace Transforms of t.f(t) (Multiplication By t), Laplace Transforms of $\frac{1}{t}f(t)$(Division By t),Unit Step Functions , Periodic Functions ,Evaluation of Integrals	11
II	**Inverse Laplace Transform:** Definition, Important Formulae, Multiplication By s, Division By s (Multiplication by $\frac{1}{s}$), First Shifting Property, Second Shifting Property, Inverse Laplace Transform of Derivatives, Inverse Laplace Transform of Integrals, Partial Fractions Method, Convolution Theorem, Inverse Laplace Transform by Convolution	12
III	**Applications of Laplace Transform:** Solution of Differential Equations by Laplace Transform, Solution of Simultaneous Differential Equations by Laplace Transform, Inversion Formula for Laplace Transform	11

IV	**FOURIER TRANSFORMS:** Introduction, Fourier Integral Theorem, Fourier Sine and Cosine Integrals, Fourier Complex Integral, Fourier Transforms, Fourier Sine and Cosine Transforms Properties of Fourier Transforms, Convolution, Parseval's Identity for Fourier Transforms, Fourier Transforms of Derivatives, Relationship Between Fourier and Laplace Transforms, Solution of Boundary Value Problems By Using Integral Transforms	11
	Text Book: Advanced Engineering Mathematics by H. K. Das S. Chand & Company Pvt. Ltd.	
1	**<u>Scope</u>:** Module I : Articles 13.1 to 13.12 , 13.14 , 13.17 . Module II : Articles 13.20 to 13.28 , 13.15 , 13.29 . Module III : Articles 13.30 to 13.32 . Module IV : Articles 14.1 to 14.15 .	
	Reference Books	
1	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2011	
2	R. K. Jain & S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House, 2016	
3	Murray R. Spiegel, Laplace Transforms (Schaum's Outline Series), McGraw-Hill Education, 2017	
4	Ruel V. Churchill & James Ward Brown, Fourier Series and Boundary Value Problems, McGraw-Hill Education, 2011	
5	Ian N. Sneddon, The Use of Integral Transforms, McGraw-Hill, 1972	
6	D. V. Widder, The Laplace Transform, Princeton University Press, 1946	
7	R. V. Churchill, Operational Mathematics, McGraw-Hill, 1972	

BA/ B.Sc. III (Semester VI)

Programme:- Degree Course in Mathematics BA/ B Sc.	Year – Third Level:- 5.5	Course Type : DSE Theory	Semester-VI
Prerequisite: Students should have a clear understanding of set theory including operations on sets, relations, and functions. Knowledge of real number systems and basic properties of functions from calculus is essential. Familiarity with mathematical reasoning, proofs, and elementary logic will help in understanding abstract topological concepts effectively.			
Course Code: (B)SMATET1352		Course Title: (B)Topology	
Course Outcomes: After successful completion of the course student will be able to **CO1:**Understand the concept of topological spaces and construct topologies using bases. **CO2:**Analyze and differentiate between various standard topologies such as order, product, and subspace topologies. **CO3**:Apply concepts of closed sets, limit points, closure, interior, and identify Hausdorff spaces. **CO4:**Examine continuous functions and homeomorphisms, and apply results like the pasting lemma in constructing continuous mappings.			
Credits: (3Cr)	(B)DSE-II		
Max. Marks: 75	Min. Passing Marks:30		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0			

(B)Topology		
Module	Topic	No of Lectures
I	**Fundamentals of Topological Spaces:** Topological Spaces and Continuous Functions: Topological Spaces, Basis for Topology.	08
II	**Standard Topologies:** The Order Topology, The Product Topology, The Subspace Topology.	12
III	**Set Properties in Topology:** Closed Sets and Limit Points, Closure and Interior of a Set, Limit Points, Hausdroff Spaces.	13
IV	**Continuous Functions and Mappings:** Continuous functions, Homeomorphisms , Constructing Continuous functions ,Pasting Lemma , and Coordinate Maps	12
Text Books		
1	R. Munkres, "**Topology: A First Course**" Fourth Indian reprint 2003, PHI of India. **Scope:** Module I: Chapter 2: Art. 12,13, 13.1, 13.2, 13.3, 13.4 Module-II: Chapter 2: Art. 14,15,15.1,15.2, 16, 16.1, 16.2, 16.3, 16.4 Module-III: Chapter 2: Art. 17,17.1,17.2,17.3,17.4,17.5,17.6,17.7,17.8 17.917.1017.11 Module-IV:18, 18.1, 18.2, 18.3, 18.4	
2	**Reference Books**	
	1. John Horvath, Topological Vector Spaces & Distribution", Addison-Wesely, Publishing Company 1966. 2. F. Treves, Topological Vector spaces, Distribution, Kernel", Academic Press, Inc. ,New York, 1967. 3. G. Kothe, Topological Vector spaces", Vol.1, Springer, New York, 1969. 4. R. Larsen, Functional Analysis", Marcel Dekker, Inc., New York, 1973. 5. Walter Rudin, Functional Analysis", TMH edition, 1974.	

B.A. / B.Sc. III (SEMESTER-VI)

Programme: Degree Course in Mathematics Class: B.A./B.Sc. III	Year: III Level 5.5	Course Type DSE	Semester: VI
Prerequisites: Basic knowledge of algebra, functions, and elementary statistics, including familiarity with permutations and combinations.			
Course Code: (C)SMATET1353	Course Title: (C)Probability Theory		
Course Outcomes: After successful completion of this course, students will be able to: **CO1:** Understand fundamental concepts of probability, including sample space, events, and rules such as addition, multiplication, conditional probability, and Bayes' Theorem. **CO2:** Apply the concept of random variables and analyse discrete and continuous probability distributions, including joint distributions and statistical independence. **CO3:** Compute and interpret mathematical expectation, variance, covariance, and apply results like Chebyshev's Theorem to analyse data variability. **CO4:** Analyse and apply standard probability distributions such as Binomial, Poisson, Normal, and Exponential distributions to solve real-world problems and perform approximations.			
Credits: 3	(C)DSE		
Max. Marks: 75	Min. Passing Marks:30		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 3-0-0			

(C) Probability Theory		
Module	Topic	No of Lectures
I	**Probability:** Sample Space, Events, Counting Sample Points, Probability of an Event, additive Rule, Conditional Probability, Multiplicative Rules, Rule of elimination and Bayes Rule	10
II	**Random Variables and Probability Distributions:** Concept of Random Variable, Discrete Probability Distributions, Continuous Probability Distributions, Joint Probability Distributions and Statistical Independence.	12
III	**Mathematical Expectation:** Mean of a Random Variables, Variance and Covariance, Means and Variances of Linear Combinations of Random Variables, Chebyshev's Theorem	11
IV	**Some Discrete and Continuous Probability Distributions:** Introduction, Discrete Uniform Distribution., Binomial and Multinomial Distribution, Hypergeometric Distribution, Poisson Distribution, Normal Distribution, Area under normal curve, Applications of Normal Distribution, Normal Approximation to Binomial, Gamma and Exponential Distribution	12
Text Book. Ronald E Walpole, Raymond H Myers Probability and Statistics for Engineers and Scientists, Fourth Edition, Macmillan Publishing Company		

1	**Scope:** Module II : Chapter 1 Complete Module II :Chapter 2 Art 2.1,2.2,2.3,2.5 Module III: Chapter 3 Complete Module IV : Chapter 4 Article 4.1,4.2,4.3,4.4,4.6 Chapter 5 Art 5.1,5.2,5.3,5.5,5.6
	Reference Books
1	Fundamental of Mathematical Statistics, by S.C. Gupta, V.K. Kapur, S. Chand and Co. Ltd.
2	Mathematical Statistics, by S. C. Saxena, S. Chand and Co. Ltd.
3	Modern Theory of probability, by B R Bhat, Narosa
4	Theory of Probability by P Mukhopadhyay, Narosa.
5	Introduction to Probability and Statistics for Engineers and Scientists – Sheldon M. Ross
6	An Introduction to Mathematical Statistics and Its Applications – Richard J. Larsen
7	Fundamentals of Mathematical Statistics – S. C. Gupta and V. K. Kapoor
8	Miller and Freund's Johnson Jonson HA , Probability and Statistics for Engineer and Scientist, PHI

BA/ B.Sc. III (Semester VI)

Programme:- Degree Course in Mathematics BA/ B Sc.	Year – Third Level:- 5.5	Course Type :DSE Practical	Semester-VI
Prerequisite: Basic knowledge of calculus (differentiation & integration), ordinary differential equations, algebra, and functions.			
Course Code: (A)SMATEP1351		Course Title: Lab Course on Integral Transform	
Course Outcomes: After successful completion of the course student will be able to: **CO1:** Perform Laplace transform computations accurately. **CO2:** Apply inverse techniques including convolution and partial fractions. **CO3:** Solve differential equations using transform methods. **CO4:** Use Fourier transforms for practical problem-solving in physics and engineering.			
Credits: 1 Cr	(A)DSE -II (Practical)		
Max. Marks: 25	Min. Passing Marks:10		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-2			

Lab Course on (A)Integral Transform		
Practical Number	List of Practical's	No of Problems
1	Verification of basic Laplace transform formulae.	02
2	Computation of Laplace transforms using properties.	02
3	Laplace transform of derivatives and integrals.	02
4	Problems on unit step and periodic functions.	02
5	Evaluation of definite integrals using Laplace transform.	02
6	Inverse Laplace transform using partial fractions.	02
7	Inverse Laplace transform using convolution theorem.	02
8	Solving first-order differential equations using Laplace transform.	02
9	Solving second-order differential equations using Laplace transform.	02
10	Solution of simultaneous differential equations.	02
11	Computation of Fourier sine and cosine transforms.	02
12	Application of Fourier transforms to boundary value problems.	02
Text Books		
1	Advanced Engineering Mathematics by H. K. Das S. Chand & Company Pvt. Ltd.	
	Reference Books	
1	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2011	
2	R. K. Jain & S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House, 2016	
3	Murray R. Spiegel, Laplace Transforms (Schaum's Outline Series), McGraw-Hill Education, 2017	
4	Ruel V. Churchill & James Ward Brown, Fourier Series and Boundary Value Problems, McGraw-Hill Education, 2011	
5	Ian N. Sneddon, The Use of Integral Transforms, McGraw-Hill, 1972	
6	D. V. Widder, The Laplace Transform, Princeton University Press, 1946	
7	R. V. Churchill, Operational Mathematics, McGraw-Hill, 1972	

BA/ B.Sc. III (Semester VI)

Programme:- Degree Course in Mathematics BA/ B Sc.	Year – Third Level:- 5.5	Course Type :DSE Practical	Semester-VI
Prerequisite:-: Fundamental Concepts, of Set Theory , Logic Functions, Relations, Real Numbers			
Course Code: (B)SMATEP1352		Course Title: Lab Course on (B)Topology	
Course Outcomes: After successful completion of the course student will be able to **CO1**:Develop the ability to construct and verify different types of topologies using sets and bases. **CO2**:Apply concepts of order, product, and subspace topologies in problem-solving. **CO3**:Analyze topological properties such as closure, interior, limit points, and Hausdorff condition. **CO4**:Evaluate continuity and homeomorphism of functions and construct continuous mappings using standard theorems.			
Credits: 1 Cr	(B)DSE -II(Practical)		
Max. Marks: 25	Min. Passing Marks:10		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-2			

Lab Course on (B)Topology		
Practical Number	List of Practical's	No of Problems
1	To verify properties of a topological space with given collections of subsets.	02
2	To construct a topology using basis and verify its validity.	02
3	To study and construct discrete and indiscrete topologies.	02
4	To construct and analyze the order topology on a given ordered set.	02
5	To verify properties of the product topology on two topological spaces.	02
6	To construct and study the subspace topology from a given topological space.	02
7	To determine closure and interior of subsets in a given topology.	02
8	To find and analyze limit points of a set.	02
9	To verify whether a space is a Hausdorff space.	02
10	To check whether a given function is continuous between topological spaces.	02
11	To verify whether a function is a homeomorphism.	02
12	To apply the Pasting Lemma to construct continuous functions.	02
Text Books		
1	R. Munkres, " **Topology: A First Course** "Fourth Indian reprint 2003, Prentice Hall of India. **Scope:** Module I: Chapter 2: Art. 12,13, 13.1, 13.2, 13.3, 13.4 Module-II: Chapter 2: Art. 14,15,15.1,15.2, 16, 16.1, 16.2, 16.3, 16.4 Module-III: Chapter 2: Art. 17,17.1,17.2,17.3,17.4,17.5,17.6,17.7,17.8 17.917.1017.11 Module-IV:18, 18.1, 18.2, 18.3, 18.4	
2	**Reference Books**	
	1. John Horvath, Topological Vector Spaces & Distribution", Addison-Wesely, Publishing Company 1966. 2. F. Treves, Topological Vector spaces, Distribution, Kernel", Academic Press, Inc. ,New York, 1967. 3. G. Kothe, Topological Vector spaces", Vol.1, Springer, New York, 1969.	

	4. R. Larsen, Functional Analysis", Marcel Dekker, Inc., New York, 1973. 5. Walter Rudin, Functional Analysis", TMH edition, 1974.

BA/ B.Sc. III (Semester VI)

Programme:- Degree Course in Mathematics BA/ B Sc.	Year – Third Level:- 5.5	Course Type :DSE Practical	Semester-VI
Prerequisite:- Basic knowledge of algebra, functions, and set theory, along with understanding of permutations and combinations. Familiarity with fundamental probability concepts and simple statistical measures is desirable. Basic skills in calculator/Excel (or any statistical tool) will be helpful for computations.			
Course Code: (C)SMATEP1353		Course Title: Lab Course on(C) Probability Theory	
Course Outcomes: After successful completion of the course student will be able to **CO1:** Demonstrate understanding of basic probability concepts such as sample space, events, and apply rules including addition, multiplication, conditional probability, and Bayes' Theorem in problem-solving. **CO2:** Construct and analyse discrete and continuous probability distributions, including joint distributions and verify statistical independence. **CO3:** Compute and interpret statistical measures such as mean, variance, covariance, and apply results like Chebyshev's Theorem. **CO4:** Apply standard probability distributions (Binomial, Poisson, Normal, Exponential, Gamma) to solve practical problems and interpret results in real-life contexts.			
Credits: 1 Cr	(C)DSE-II(Practical)		
Max. Marks: 25	Min. Passing Marks:10		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-2			

Lab Course on(C) Probability Theory		
Practical Number	List of Practical's	No of Problems
1	Study of Sample Space and Types of Events	02
2	Problems on Addition and Multiplication Rules of Probability	02
3	Conditional Probability and Bayes' Theorem	02
4	Construction of Discrete Probability Distribution (PMF)	02
5	Study of Continuous Probability Distribution (PDF & CDF)	02
6	Joint Probability Distribution and Statistical Independence	02
7	Computation of Mean and Variance of Random Variables	02
8	Covariance and Linear Combinations of Random Variables	02
9	Applications of Chebyshev's Theorem	02
10	Binomial Distribution and Poisson Distribution	02
11	Normal Distribution and Area under Curve	02
12	Exponential and Gamma Distribution	02
Text Books		
1	Ronald E Walpole, Raymond H Myers Probability and Statistics for Engineers and Scientists, Fourth Edition, Macmillan Publishing Company	
	Reference Books	
1	Fundamental of Mathematical Statistics, by S.C. Gupta, V.K. Kapur, S. Chand and Co.Ltd.	
2	Mathematical Statistics, by S. C. Saxena, S. Chand and Co. Ltd.	
3	Modern Theory of probability, by B R Bhat, Narosa	

4	Theory of Probability by P Mukhopadhyay, Narosa.
5	Introduction to Probability and Statistics for Engineers and Scientists – Sheldon M. Ross
6	An Introduction to Mathematical Statistics and Its Applications – Richard J. Larsen
7	Fundamentals of Mathematical Statistics – S. C. Gupta and V. K. Kapoor
8	Miller and Freund's Johnson Jonson HA , Probability and Statistics for Engineer and Scientist, PHI

Programme: Degree Course in Mathematics Class: B.A./B.Sc. III	Year: III Level 5.5	Course Type VSC	Semester: VI
Prerequisites: Students should have a basic understanding of computer operations and fundamental concepts such as input, output, and file usage. Logical thinking and problem-solving ability are essential for writing programs. Familiarity with basic mathematical concepts (like arithmetic operations and simple data handling) will be beneficial. Prior exposure to programming is not mandatory, making this course suitable for beginners.			
Course Code: MATVC1351	Course Title: Python Programming		
Course Outcomes: After completing this course, students will be able to: **CO1:** Understand Python fundamentals, including syntax, variables, data types, and I/O operations. **CO2:** Apply control structures and functions to develop logical and modular programs. **CO3:** Use data structures (lists, tuples, sets, dictionaries) and perform file handling with exception handling. **CO4:** Utilize basic Python libraries such as NumPy, Pandas, and Matplotlib for data manipulation and visualization.			
Credits: 2	VSC-4		
Max. Marks: 50	Min. Passing Marks:20		
Total No. of Lectures – Tutorials – Practical (in hours per week): L-T-P: 0-0-4			

Python Programming		
Module	Topic	No of Hours
I	**Introduction to Python:** Introduction of Python and its applications, History, Installing Python and setting up (IDLE), Writing and running Python programs, Variables, data types, and type conversion, Input and output operation.	15
II	**Control Structures and Functions:** Conditional statements (if, if-else, if-elif-else),Iteration (for, while loops),Loop control statements (break, continue, pass),Functions: Defining, calling, arguments, and return values, Anonymous functions (lambda),Importing and creating modules	15
III	**Data Structures and File Handling:** Lists, tuples, sets, and dictionaries, List and dictionary comprehensions, String manipulation and string functions, File handling: Opening, reading, writing, and modes (r, w, a),Exception handling (try-except)	15
IV	**Introduction to Libraries:** NumPy: Arrays and basic operations, Pandas: Data Frames and basic data manipulation, Matplotlib: Data visualization basics (plots, histograms, line charts)	15
	Recommended/Reference Books	
1	Core Python Programming -Dr. R Nageswara Rao (Dreamtech Press)	
2	Learning Python -Mark Lutz, O'Reilly, 5Th edition	
3	Starting Out with Python plus My Programming lab-Tony Gaddis, Pearson	
4	Programming in Python A Complete Introduction to Python Language	

Sr	List of Practical's
1	Write a Python program to demonstrate basic input/output operations.
2	Program to perform arithmetic operations using variables and data types.
3	Implement conditional statements (if, if-else, if-elif-else) with examples.
4	Program to demonstrate loops (for, while) and loop control statements.
5	Write a program to define and call functions with arguments and return values.
6	Program to demonstrate lambda functions and module creation/import.
7	Implement operations on lists, tuples, sets, and dictionaries.
8	Write programs using list and dictionary comprehensions.
9	Perform string manipulation using built-in functions.
10	Write a program for file handling (read, write, append modes).
11	Implement exception handling using try-except.
12	Create simple programs using NumPy, Pandas, and Matplotlib (basic data analysis and plotting).

Guidelines for Course Assessment:

A. Continuous Assessment (CA) Theory (40% of the Maximum Marks):

This will form 40% of the Maximum Marks and will be carried out throughout the semester. It may be done by conducting **Two Tests** (Test I on 40% curriculum) and **Test II** (remaining 40% syllabus). Average of the marks scored by a student in these two tests of the theory paper will make his **CA** score (col 6).

B. Continuous Assessment (CA) Practical (40% of the Maximum Marks):

This will form 40% of the Maximum Marks and will be carried out throughout the semester for practical. It may be done by considering Attendance, Record Book and Test on 80% practical's

Credits	Continuous Assessment		Total	ESA
1 Cr	Record Book (2) + Attendance (3) =05	Overall Performance (05)	10	15
2 Cr	Record Book (5) + Attendance (5) =10	Overall Performance (10)	20	30

C. Semester End Assessment (ESA) Practical (60% of the Maximum Marks):

Lab Course(DSC/DSE) ESA Examination (1 Credit) 15 Marks [Time 45 minutes]

Q1. Oral/ Viva [03 Marks]

Q2 Answer any **Three** of the following (Covering entire Syllabus) 4 Each [12 Marks]

a. Practical question

b. Practical question

c. Practical question

d. Practical question

DSC/VSC Practical End Semester Assessment (ESA)Examination (2 Credit)

Maximum Marks :30 Marks **[Time 2 hrs]**

Q1. Oral/ Viva [05Marks]

Q2 Answer any one of the following (Covering entire Syllabus) 5 each [05 Marks]

a. Practical question

b. Practical question

Q3 Answer any Two of the following (Covering entire Syllabus) 10 each [20 Marks]

a. Practical question

b. Practical question

c. Practical question

End Semester Examination DSC/IKS Theory (2 credits and 30 Marks) [02 hrs]

Note : Q 1 is Compulsory however student can attempt any two from Q2 to Q5

(For Questions Q.2 to Q.5, the paper setter may ask either **one question carrying 10 marks** or **two questions carrying 5 marks each**, depending upon the nature and scope of the question.)

Q1. Answer all questions [10 Marks]

a. Module I

b. Module II

c. Module III

d. Module IV

Q.2. (Module I) Answer the following [10 Marks]

Q.3. (Module II) Answer the following [10 Marks]

Q.4. (Module III) Answer the following [10 Marks]

Q.5. (Module IV) Answer the following [10 Marks]

End Semester Examination DSC/DSE Theory (3 credits and 45 Marks) [2 hrs]

Note : Q 1 is Compulsory however student can attempt any **two** from Q2 to Q5

Q1. Answer all questions [15 Marks]

a. Module I

b. Module II

c. Module III

d. Module IV

Q.2. (Module I) Answer the following [15 Marks]

a. Theory /Example 07 Marks

b. Theory /Example 08 Mark

Q.3. (Module II) Answer the following [15 Marks]

a. Theory /Example 07 Marks

b. Theory /Example 08 Mark

Q.4. (Module III) Answer the following [15 Marks]

a. Theory /Example 07 Marks

b. Theory /Example 08 Mark

Q.5. (Module IV) Answer the following **[15 Marks]**

a. Theory /Example 07 Marks

b. Theory /Example 08 Marks

Credits	Continuous Assessment (CA) (40%)	End Semester Assessment (ESA) (60%)	Total Marks (100%)
1	10	15	25
2	20	30	50
3	30	45	75
4	40	60	100

Note: **Number of lectures required to cover syllabus of a course depends on the number of credits assigned to a particular course. One credit of theory corresponds to 15 Hours lecturing and for practical course one credit corresponds to 30 Hours. For example, for a course of two credits 30 lectures of one hour duration are assigned, while that for a three-credit course 45 lectures.**