॥ 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

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

Fax : (02462) 215572

Phone: (02462)215542

Academic-1 (BOS) Section

website: srtmun

E-mail: bos@srtmun

विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० च्या अनुषंगाने शैक्षणिक वर्ष २०२३–२४ पासून संलग्न महाविद्यालये व विद्यापीठ संकुलांत पदव्युत्तर पदवी प्रथम वर्ष आणि विद्यापीठ संकुले व न्यू मॉडेल डिग्री कॉलेज मध्ये पदवी प्रथमवर्ष अभ्यासक्रम लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, शासन निर्णय क्र. एनईपी २०२०/प. क्र. ०९/विशि–३/शिकाना, दिनांक २० एप्रिल २०२३ व शासन पत्र. क्र एनईपी २०२०/प. क्र. ०९/विशि–३, दिनांक १६ जून २०२३ अन्वये सूचित केल्यानुसार राष्ट्रीय शैक्षणिक धोरण २०२०च्या अनुषंगाने दिलेल्या आराखडया नुसार दिनांक १६ जून २०२३ रोजी संपन्न झालेल्या मा. विद्यापरिषदेच्या बैठकीत ऐनवेळचा विषय क्र. ०५/५६–२०२३ अन्वये मान्यता दिल्यानुसार प्रस्तुत विद्यापीठाच्या विज्ञान व तंत्रज्ञान विद्याशाखा अंतर्गत खालील पदव्युत्तर पदवी अभ्यासक्रम (AICTE, PCL, BCI, CoA, NCTE इ. सारख्या नियमक संस्थाची मान्यता आवश्यक असलेले अभ्यासक्रम वगळून) संलग्न महाविद्यालये, विद्यापीठ परिसर व उपपरिसर संकुलांमध्ये आणि पदवी प्रथम वर्ष अभ्यासक्रम विद्यापीठ परिसर व उपपरिसर संकुले व विद्यापीठ संचलित न्यू मॉडेल डिग्री कॉलेज, हिंगोली येथे शैक्षणिक वर्ष २०२३–२४ पासून लागू करण्यात येत आहे.

1) M.Sc. Biotechnology (1st Year) - Campus School
2) M.Sc. Biotechnology (1st Year) – Affiliated colleges
3) B.Sc. Biotechnology (1st Year) – New Model Degree College, Hingoli
4) M.Sc. Botany (1st Year) - Campus School
5) M.Sc. Botany (1st Year) – Affiliated colleges
6) M.Sc. Herbal Medicine (1st Year) - Affiliated colleges
7) M.Sc. Chemistry (1st Year) - Campus School
8) M.Sc. Chemistry (1st Year) - Affiliated colleges
9) M.Sc. Computer Science / Computer Network / Computer Applications (1st Year) University campus, sub campus Latur
10) M.Sc. System Administration & Networking (1st Year) – Affiliated colleges
11) M.Sc. Computer Management (1st Year) – Affiliated Colleges
12) M.Sc. Computer Science (1st Year) – Affiliated Colleges
13) M.Sc. Dairy Science (1st Year) - Affiliated colleges
14) M.Sc. Electronic (1st Year) - Affiliated colleges
15) M.Sc. Geology (1st Year) – University Campus
16) M.Sc. Geography (1st Year) – University Campus
17) M.Sc. Applied Mathematics (1st Year) – Affiliated Colleges
18) M.Sc. Mathematics (1st Year) – Affiliated Colleges
19) M.Sc. Microbiology (1st Year) - University Campus
20) M.Sc. Microbiology (1st Year) – Affiliated colleges

21) M.Sc. Physics (1st Year) - University Campus
22) M.Sc. Physics (1st Year) – Affiliated Colleges
23) M.Sc. Statistics (1st Year) - University Campus
24) M.Sc. Statistics (1st Year) – Affiliated colleges
25) M.Sc. Biochemistry (1st Year) – Affiliated Colleges
26) M.Sc. Zoology (1st Year) – Affiliated Colleges

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/एनइपी२०२०/S&T/अक/२०२३–२४/ 130

सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

दिनांक : ३०.०६.२०२३.

प्रत : १) मा. प्राचार्य, सर्व संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
२) मा. संचालक, सर्व संकुले परिसर व उपपरिसर, प्रस्तुत विद्यापीठ
३) मा. प्राचार्य, न्यु मॉडेल डिग्री कॉलेज हिंगोली.
४) मा. समन्यवक, कै. श्री उत्तमराव राठोड आदिवासी विकास व संशोधन केंद्र, किनवट.

प्रत माहितीस्तव :
१) मा. कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. कुलसचिव, प्रस्तुत विद्यापीठ.
३) मा. सर्व आधिष्ठाता, प्रस्तुत विद्यापीठ.
४) सर्व प्रशासकीय विभाग प्रमुख साहाय्यक, प्रस्तुत विद्यापीठ.
५) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

SWAMI RAMANAND TEERTH
MARATHWADA UNIVERSITY, NANDED - 431 606

(R-2023)

TWO YEAR MASTERS PROGRAMME IN SCIENCE

M. Sc. First Year

Subject: **MATHEMATICS**
(Affiliated Colleges)

Under the Faculty of
Science and Technology

(As per NEP-2020)

With effect from academic year 2023-24

From the Desk of the Dean, Faculty of Science and Technology

Swami Ramanand Teerth Marathwada University, Nanded, enduring to its vision statement "***Enlightened Student: A Source of Immense Power",*** is trying hard consistently to enrich the quality of science education in its jurisdiction by implementing several quality initiatives. Revision and updating curriculum to meet the standard of the courses at national and international level, implementing innovative methods of teaching-learning, improvisation in the examination and evaluation processes are some of the important measures that enabled the University to achieve the **3Es, the *equity, the efficiency and the excellence*** in higher education of this region. To overcome the difficulty of comparing the performances of the graduating students and also to provide mobility to them to join other institutions the University has adopted the *cumulative grade point average* (CGPA) system in the year 2014-2015. Further, following the suggestions by the UGC and looking at the better employability, entrepreneurship possibilities and to enhance the latent skills of the stakeholders the University has adopted the *Choice Based Credit System* (CBCS) in the year 2018-2019 at graduate and post-graduate level. This provided flexibility to the students to choose courses of their own interests. To encourage the students to opt the world-class courses offered on the online platforms like, NPTEL, SWAYM, and other MOOCS platforms the University has implemented the credit transfer policy approved by its Academic Council and also has made a provision of reimbursing registration fees of the successful students completing such courses.

SRTM University has been producing a good number of high caliber graduates; however, it is necessary to ensure that our aspiring students are able to pursue the right education. Like the engineering students, the youngsters pursuing science education need to be equipped and trained as per the requirements of the R&D institutes and industries. This would become possible only when the students undergo studies with an updated and evolving curriculum to match global scenario.

Higher education is a dynamic process and in the present era the stakeholders need to be educated and trained in view of the self-employment and self-sustaining skills like start-ups. Revision of the curriculum alone is not the measure for bringing reforms in the higher education, but invite several other initiatives. Establishing industry-institute linkages and initiating internship, on job training for the graduates in reputed industries are some of the important steps that the University would like to take in the coming time. As a result, revision of the curriculum was the need of the hour and such an opportunity was provided by the New Education Policy 2020. National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. As a result the students will acquire expertise in specialized areas of interest, kindle their intellectual curiosity and

scientific temper, and create imaginative individuals.

The curriculum given in this document has been developed following the guidelines of NEP-2020 and is crucial as well as challenging due to the reason that it is a transition from general science-based to the discipline-specific-based curriculum. All the recommendations of the ***Sukanu Samiti*** given in the **NEP Curriculum Framework-2023** have been followed, keeping the disciplinary approach with rigor and depth, appropriate to the comprehension level of learners. All the Board of Studies (BoS) under the Faculty of Science and Technology of this university have put in their tremendous efforts in making this curriculum of international standard. They have taken care of maintaining logical sequencing of the subject matter with proper placement of concepts with their linkages for better understanding of the students. We take this opportunity to congratulate the Chairman(s) and all the members of various Boards of Studies for their immense contributions in preparing the revised curriculum for the benefits of the stakeholders in line with the guidelines of the Government of Maharashtra regarding NEP-2020. We also acknowledge the suggestions and contributions of the academic and industry experts of various disciplines.

We are sure that the adoption of the revised curriculum will be advantageous for the students to enhance their skills and employability. Introduction of the mandatory ***On Job Training, Internship*** program for science background students is praise worthy and certainly help the students to imbibe first-hand work experience, team work management. These initiatives will also help the students to inculcate the workmanship spirit and explore the possibilities of setting up of their own enterprises.

Dr. L. M. Waghmare, *Dean,* *Faculty of Science and Technology*
Dr. M. K. Patil, *Associate Dean,* *Faculty of Science and Technology*

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

Preamble:

Taking into consideration the rapid changes in science and technology and new approaches in different areas of Mathematics and related subjects, Board of studies in Mathematics after a thorough discussion with the teachers of Mathematics from Swami Ramanand Marathwada University Nanded and experts from industry as well as other Academic institutions has preparedthe syllabus of M.A./M.Sc. I (w.e.f. 2023-24) Mathematics course under the NEP2020.

Program Educational Objectives (PEOs):

PEO1: To equip students with knowledge, abilities and insight in mathematics and related fields.
PEO2: Have the ability to pursue interdepartmental research in Universities in India and abroad.
PEO3: To develop the ability to utilize the mathematical problem-solving methods such as analysis, modeling, programming and mathematical software applications in addressing the practical and heuristic issues.
PEO4: To enable them to work as a mathematical professional or qualify for training as scientificresearcher.
PEO5: To enable students to recognize the need for society and the ability to engage in life-longlearning.

PROGRAMME OUTCOMES (POs):

After the completion of the program, students will able to:

PO1: Identify, formulate, and analyze the complex problems using the principles of Mathematics.

PO2: Solve critical problems by applying the Mathematical tools.

PO3: Apply the Mathematical concepts, in all the fields of learning including higher research, andrecognize the need and prepare for lifelong learning.
PO4: Able to crack competitive examinations, lectureship and fellowship exams approved by UGClike CSIR-NET and SET.
PO5: Apply ethical principles and commit to professional ethics, responsibilities, and norms in thesociety.

PO6: Gain the knowledge of software which will be useful in Industry.

PO7: To maintain updated curriculum**.**

PROGRAM SPECIFIC OUTCOMES (PSOs):
PSO1: To understand the basic concepts of advanced mathematics.
PSO2: To develop the problems solving skills and computational skills.**PSO3:** To enhance self-learning and improve own erformance.
PSO4: To formulate mathematical models.

Dr. Mahesh Sahebrao Wavare

Chairman, Board of Studies of the Mathematics

S.R.T. M. U. Nanded

Members of the Board of Studies in the subject of Mathematics under the faculty of Science and Technology

Sr No	Name of the Member	Designation	Address	Contact Number and Email ID
1	Prof. 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 arunbjadhav@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

Credit Framework for Two Year PG Program (MA/M.Sc. Mathematics)

Subject: Mathematics (MAT)

Year & Level 1	Sem. 2	Major Subject		RM 5	OJT / FP 6	Research Project 7	Practicals 8	Credits 9	Total Credits 10
		(DSC) 3	(DSE) 4						
1	1	**SMATC401 (4 Cr)** Algebra **SMATC402 (4 Cr)** Real Analysis **SMATC403 (4 Cr)** Complex Analysis	**SMATE401** **(Choose any one)** A. Ordinary Differential Equations B. Discrete Mathematics C, Dynamics and Continuum Mechanics-I D. Theory of Probability E. NPTEL/SWAYM MOOCs Equivalent Course (4 Cr)	**SVECR 401** *Research Methodology* **(3 Cr)**	--		**SMATP401** Latex Typesetting **(3Cr)**	22	44
	2	**SMATC451 (4 Cr)** Linear Algebra **SMATC452 (4 Cr)** Measure & Integration Theory **SMATC453 (4 Cr)** Topology	**SMATE451** **(Choose any one)** A. Partial Differential Equations B. Combinatorics C. Dynamics and Continuum Mechanics-II D. Operation Research E. NPTEL/SWAYM MOOCs Equivalent Course (4 Cr)	---	**SDSCOJ 451 (3 Cr)**	--	**SMATP451** Introduction to Scilab **(3Cr)**	22	
Exit option: Exit Option with PG Diploma *(after 2024-25)*									

2	**3**	**SMATC501 (4 Cr)** Field Theory **SMATC502 (4 Cr)** Functional Analysis **SMATC503 (4 Cr)** Analytical Number Theory	**SMATE501 (4 Cr)** **(Choose any one)** A. Integral Transforms B. Fluid Mechanics-I C. Fractional Calculus and its Applications-I D. Fuzzy Sets and their Applications-I E. Coding Theory F. NPTEL/SWAYM MOOCs Equivalent Course (***From same Department / School)***	--		Research Project **SMATR551 (4Cr)**	**SMATP501 (2 Cr)** Python Programming	**22**	**44**
	4	**SMATC551 (4 Cr)** Numerical Analysis **SMATC552 (4 Cr)** Classical Mechanics	**SMATE551 (4 Cr)** **(Choose any one)** A. Integral Equations B. Fluid Mechanics-II C. Fractional Calculus and its Applications-II D. Fuzzy Sets and their Applications-II E. Cryptography F. NPTEL/SWAYM MOOCs Equivalent Course (***From same Department / School)***	**SVECP 551** Publication Ethics (2 Cr)		Research Project **SMATR552** **(6 Cr)**	**SMATP551 (2Cr)** MATLAB Programming	**22**	
Total Credits		**44**	**16**	**05**	**03**	**10**	**10**	**88**	

M.A/M. Sc. First Year Semester I *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SMATC401**	Algebra	04	--	**04**	04	--
	SMATC402	Real Analysis	04	--	**04**	04	--
	SMATC403	Complex Analysis	04	--	**04**	04	--
Practical	**SMATP401**	Latex Typesetting	--	03	**03**	--	06
Elective (DSE)	**SMATE401**	(Choose any one) A. Ordinary Differential Equations B. Discrete Mathematics C. Dynamics and Continuum Mechanics-I D. Theory of Probability E. NPTEL/SWAYM MOOCs equivalent Course	04	--	**04**	04	--
Research Methodology	**SVECR401**	Research Methodology	03	--	**03**	03	
Total Credits			**19**	**03**	**22**	**19**	**06**

M.A/M. Sc. First Year Semester I *(Level 6.0)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

Subject (1)	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	**SMATC401**	Algebra	20	20	20	80	--	--	100
	SMATC402	Real Analysis	20	20	20	80	--	--	100
	SMATC403	Complex Analysis	20	20	20	80	--	--	100
Practical	**SMATP401**	Latex Typesetting	--	--	--	--	15	60	75
Elective (DSE)	**SMATE401**	(Choose any one) A. Ordinary Differential Equations B. Discrete Mathematics C. Dynamics and Continuum Mechanics-I D. Theory of Probability E. NPTEL/SWAYM MOOCs	20	20	20	80	--	--	100
Research Methodology	**SVECR401**	RESEARCH Methodology	15	15	15	60	--	--	75

M.A/M. Sc. First Year Semester II *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SMATC451**	Linear Algebra	04	--	**04**	04	--
	SMATC452	Measure & Integration Theory	04	--	**04**	04	--
	SMATC453	Topology	04	--	**04**	04	--
Practical	**SMATP451**	Introduction to Scilab	--	03	**03**	--	06
Elective (DSE)	**SMATE451**	(Choose any one) A. Partial Differential Equations B. Combinatorics C. Dynamics and Continuum Mechanics-II D. Operation Research E. NPTEL/SWAYM MOOCs	04	--	**04**	04	--
On Job Training	**SMATO451**	ON Job Training	**	03	**03**	--	03
Total Credits			**16**	**06**	**22**	**16**	**09**

M.A/M. Sc. First Year Semester II *(Level 6.0)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

Subject (1)	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	**SMATC451**	Linear Algebra	20	20	20	80	--	--	100
	SMATC452	Measure & Integration Theory	20	20	20	80	--	--	100
	SMATC453	Topology	20	20	20	80	--	--	100
Practical	**SMATP451**	Introduction to Scilab	--	--	--	--	15	60	75
Elective (DSE)	**SMATE451**	(Choose any one) A. Partial Differential Equations B. Combinatorics C. Dynamics and Continuum Mechanics-II D. Operation Research E. NPTEL/SWAYM MOOCs	15	15	15	60	--	--	75
On Job Training	**SMATO451**	ON Job Training	--	--	--	--	15	60	75

Course Structure: *DSC/DSE - Teaching Scheme*

Course Code	Course Name (Paper Title)	Teaching Scheme (Hrs.)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
DSC/DSE	DSC/DSE per Course	04	--	04	--	04
DSC	DSC per course	--	--	--	06	06

DSC/DSE - Assessment Scheme

Course Code (2)	Course Name (3)	Theory				Practical		Total [Col (6+7) / Col (8+9)] (10)
		CA			ESA (7)			
		Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)		CA (8)	ESA (9)	
DSC/DSE	DSC/DSE per Course	20	20	20	80	--	--	100
DSC	DSC per Course	--	--	--	--	15	60	75

M.A/M. Sc. First Year Semester-I *(Level 6.0)*

SMATC401: Algebra

Course objectives:

To introduce the concepts and to develop working knowledge on Groups, Normal Subgroups, Automorphism groups, Solvable groups, Cyclic Decomposition, Finitely Generated Abelian Groups and types of Rings.

Course outcomes:

After completing this course, the student will be able to:

- Identify the concept of Normal subgroups, Quotients groups and Isomorphism.
- Analyze Permutation groups and cyclic decomposition.
- Explain Fundamental theorem of finite Abelian group and its applications.
- Provide information on ideals and Quotient rings, Integral domain, PID, UFD and ED.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Semi groups and groups, Subgroups and Cosets,	
	1.2	Cyclic groups, Generators and relations,	
	1.3	Normal subgroup and quotient group,	
	1.4	Isomorphism theorems, Automorphism.	
2.0			**15**
	2.1	Conjugacy and *G*-sets, Normal series,	
	2.2	Solvable groups, Nilpotent groups, Permutation Groups,	
	2.3	Cyclic decomposition, alternating group□□.	
3.0			**15**
	3.1	Structure of groups, Direct product,	
	3.2	Finitely Generated Abelian Groups,	
	3.3	Invariants of a finite abelian group.	
4.0			**15**
	4.1	Rings, Examples of rings, Types of rings,	
	4.2	Subrings and Characteristic of a ring, Ideals and homomorphisms,	
	4.3	Maximal and Prime Ideals, Principal ideal, Nilpotent and Nil ideals,	
	4.4	Unique Factorization Domains, Principal Ideal Domains, Euclidean Domains.	
		Total	**60**

Text Book:

1. **P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul**, "Basic Abstract Algebra", (Second Ed.), Cambridge Univ. Press (Indian Ed.1995).

Scope:

Unit I – Chapter 4 (Art. 1, 2, 3, 4, 5, 6), Chapter 5 (Art. 1, 2, 3)
Unit II – Chapter 5 (Art. 4), Chapter 6 (Art. 1, 2, 3), Chapter 7 (Art. 1, 2).
Unit III –Chapter 8 (Art 1, 2, 3, 4, 5).
Unit IV – Chapter 9 (Art. 1, 2, 3, 4), Chapter 10 (Art. 1, 2, 3, 4, 5), Chapter 11 **(**Art. 1,2,3,4).

Reference Books:

1. **Joseph A. Gallian**, "Contemporary Abstract Algebra", (Fourth Ed.), Narosa, 1999.
2. **S. Luthar and I. B. S. Passi**, "Algebra-Vol. 1: Groups", Narosa, New Delhi, 1996.
3. **V. K. Khanna, S. K. Bhambri**, "A Course in Abstract Algebra", Vikas Publicing House. (Second Edition)
4. **David Dummit and Richard Foote**, "Abstract Algebra", John Wiley and Sons.

SMATC402: Real Analysis

Course objectives:

To introduce the concept of continuous, differentiable and Riemann stieltjes integrable functions and its properties, fundamental theorem of calculus, pointwise and uniform convergence of sequence and series of functions, directional derivative, inverse and implicit function theorem.

Course outcomes:

After completing this course, the student will be able to:

- Discuss the continuity, differentiability and Integrability of functions and its properties.
- Understand the concept of pointwise and uniform convergence.
- Study the Stone-Weierstrass theorem and its applications.
- Study derivative, directional derivative, inverse and implicit function theorem.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	The Riemann Stieltjes Integral: Definition and existence of integral,	
	1.2	Properties of the integral, Theorem on change of variable,	
	1.3	Integration and Differentiation, The fundamental theorem of calculus, integration by parts,	
	1.4	Integration of vector-valued functions, Rectifiable curves, Examples.	
2.0			**15**
	2.1	Sequence and series of functions: Pointwise convergence of a sequence and series of functions, Discussion of main problem,	
	2.2	Uniform Convergence, Cauchy criterion for uniform convergence, Weierstrass M-Test for sequence and series of functions,	
	2.3	Uniform Convergence and Continuity, Uniform Convergence and Integration, Uniform Convergence and Differentiation.	
3.0			**15**
	3.1	Equicontinuous Families of Functions,	
	3.2	The Stone-Weierstrass theorem (Statements only), Examples, Power Series,	

	3.3	Abel's and Taylor's theorems, Uniqueness theorem for power series.	
4.0			**15**
	4.1	Derivative, Directional Derivative, Examples,	
	4.2	Continuously differentiable functions, Mean Value Theorem, Chain rule, Examples,	
	4.3	Inverse function theorem and examples	
	4.4	Implicit function theorem and examples.	
		Total	**60**

Text Books:

1. **Walter Rudin**, "Principles of Mathematical Analysis", Third Edition, McGraw Hill, International Editions.

Scope: Unit-I Chapter 6 (Article 6.1 to 6.27).
Unit-II Chapter 7 (Article 7.1 to 7.18).
Unit-III Chapter-7 (Article 7.19 to 7.28) & Chapter-8 (Article 8.1 to 8.5).

2. **J. R. Munkres**, "Analysis on Manifolds", Addison-Wesley Publishing Company.

Scope: Unit-IV Chapter 2.

Reference Books:

1. **Robert G. Bartle, Donald R. Sherbert**, "Introduction to Real Analysis", Wiley India Edition.
2. **N.L. Carothers**, "Real Analysis", Cambridge University Press.
3. **H.L. Royden**, "Real Analysis', PHI Learning Pvt. Ltd.(Third Edition).

SMATC403: Complex Analysis

Course objectives:

To introduce the Rectangular and Polar representation of Complex numbers, mappings, complex valued functions, continuity and differentiability, Cauchy–Riemann Equations, Analyticity, Harmonic Functions, Domain, Parameterizations, Line Integrals, Cauchy's Theorem and Cauchy's Integral Formula.

Course outcomes:

After completing this course, the student will be able to:

- Describe the Rectangular and Polar representation of Complex numbers.
- Comprehend the various mappings and complex functions.
- Analyse C-R Equations, Analytic functions, harmonic functions.
- Evaluate the line integrals and different forms of Cauchy's Theorem.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Complex Number, Algebra of complex numbers, Rectangular and Polar representation of Complex numbers,	
	1.2	De-Moivre's Theorem, Mappings (Translation, Rotation, Rotation and Magnification, Rotation and Contraction,	
	1.3	Linear Transformation, Inversion (definitions only)) Linear Fractional Transformation, cross ratio. The Exponential Function, Mapping Properties, The Logarithmic Function,	
	1.4	Branches of Logarithm, Principal Branch of Logarithm, Complex Exponents.	
2.0			**15**
	2.1	Continuity, Differentiability, Cauchy–Riemann Equations, Analyticity, Harmonic Functions, Curves,	
	2.2	Initial and terminal points, simply and multiply connected domains, contour integration, Parameterizations, M-L Inequality,	
	2.3	Line Integrals, Green's Theorem, Fundamental theorem of Integration. Cauchy's weak Theorem, Cauchy's main theorem, Examples.	
3.0			**15**
	3.1	Cauchy's Integral Formula, Cauchy's Generalized Integral Formula. Taylor's Theorem, Cauchy's Inequality,	

	3.2	Applications of Cauchy's Inequality, Liouville's Theorem and Applications, Picard Theorem, Identity Theorem,	
	3.3	Maximum Modulus Theorem, Gauss' Mean Value Theorem	
4.0			
	4.1	Laurent Series, Laurent's Theorem, Singularities, Isolated Singularity, Non- Isolated Singularity, Riemann's Theorem,	**15**
	4.2	Casorati –Weierstrass Theorem, Principle and Analytic Part of Laurent Series, Residue of function, Residue Theorem,	
	4.3	Residue Theorem for $\mathbb{C}\infty$, Evaluation of real Integrals, The Argument Principle, Rouche's Theorem,	
	4.4	Comparison with Analytic functions, Conformal Mapping, Isogonal Mapping.	
		Total	**60**

Text Book:

1. **S. Ponnusamy and Herb Silverman**, "Complex Variables with Applications", Birkhauser Publication, 2006.

Scope:

Unit 1- chapter 1, chapter 3: 3.1, 3.2, Chapter 4 complete
Unit 2- Chapter 5 complete, Chapter 7 Complete
Unit 3- Chapter 8 complete
Unit 4- Chapter 9 complete, Chapter 10: art. 10.1, Chapter 11: art 11.1.

Reference Books:

1. **John B. Convey**, "Function of one complex variable", Narosa Publication, House, 1980.
2. **S. Ponnusamy**, "Foundations of Complex Analysis", Narosa Publishing House.
3. **Lars V. Ahlofors**, "Complex Analysis", McGraw Hill Company.
4. **Silverman Herb**, "Complex Analysis".

SMATE401 (A): Ordinary Differential Equations

Course objectives:

To study linear differential equations with constant and variable coefficients, Wronskian, linear equations with regular singular points, Bessel equation, existence and uniqueness of solutions to first order equation.

Course outcomes:

After completing this course, the student will be able to:

- Introduction to linear differential equations with constant coefficients.
- Understanding the concept of Wronskian, linear dependent and Independent, Legendre equation.
- Comprehend the Euler equations, the Bessel equation and Regular singular points.
- Study existence and uniqueness of solutions to first order linear differential equations.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Linear Equations with Constant Coefficients: Linear dependence and independence,	
	1.2	A formula for the Wronskian, the non-homogeneous equation of order two, the homogeneous equation of order n,	
	1.3	Initial value problems for nth order equations, equations with real constants,	
	1.4	The non-homogeneous equation of order n, a special method for solving the non-homogeneous equation.	
2.0			**15**
	2.1	Linear Equations with variable Coefficients: Initial value problems for the homogeneous equations,	
	2.2	Solution of homogeneous equation, the Wronskian and linear independence, reduction of the order of homogeneous equation,	
	2.3	The non-homogeneous equation, homogeneous equation with analytic coefficients, the Legendre equation.	
3.0			**15**

	3.1	Linear Equations with Regular Singular Points: the Euler equation,	
	3.2	second order equations with regular singular points-an example,	
	3.3	Second order equations with regular singular points-the general case, the Bessel equation.	
4.0			
	4.1	Existence and Uniqueness of Solutions to first order Equations: equations with variable separated,	**15**
	4.2	exact equations, the method of successive approximations,	
	4.3	The Lipschitz condition and convergence of successive approximation.	
		Total	**60**

Text Book:

1. **E. A. Coddington**, "An Introduction to Differential Equation", Prentice Hall of India Private Limited.

Scope:

Unit I- Chapter 2.4 – 2.12.
Unit II- Chapter 3.1 – 3.8.
Unit III- Chapter 4.1 – 4.6.
Unit IV- Chapter 5.1 to 5.7.

Reference Books:

1. **G. F. Simmons and S.G. Krantz**, Differential Equations, Tata McGraw Hill publication.
2. **Daniel A., Murray,** Introductory course in Differential Equation, University Press.
3. **William F. Trench.** Elementary Differential Equations with Boundary value problems**.**

SMATE401 (B): Discrete Mathematics

Course objectives:

This course introduce the concepts of Lattices, basic properties of algebraic system, digital networks, switching circuits, brief history of graph theory, the travelling salesman problem, trees, fundamental circuits and cut-sets, matrix representation of graphs, some types of diagraphs.

Course outcomes:

After completing this course, the student will be able to:

- Study design and implementation of digital network and switching circuits.
- Analyze Hamiltonian paths, circuits, Euler graphs, connected and disconnected graphs.
- Understanding the different properties of trees and fundamental circuits.
- To introduce matrix representation of graphs.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Lattices and Algebraic systems, Principle of duality, Basic properties of Algebraic systems defined by lattices,	
	1.2	Distributive and Complemented lattices, Boolean lattices and Boolean algebras,	
	1.3	Uniqueness of finite Boolean algebras, Boolean functions and Boolean expressions, Propositional Calculus,	
	1.4	Design and Implementation of Digital Networks, Switching Circuits.	
2.0			**15**
	2.1	What is a Graph, Application of Graphs, Finite and Infinite Graphs, Incidence and Degree, Isolated Vertex, Pendant Vertex, and Null Graph, Brief History of Graph Theory.	
	2.2	Paths and Circuits: Isomorphism, Subgraphs, Walks, Paths and Circuits, Connected graphs, Disconnected Graphs, and Components, Euler Graphs,	

	2.3	Operations of Graphs, More on Euler Graphs, Hamiltonian Paths and Circuits, The Travelling Salesman Problem.	
3.0			**15**
	3.1	Trees and Fundamental Circuits: Trees, Some Properties of Trees, Pendant Vertices in a Tree, Distance and Centre in a Tree, Rooted and Binary Tree, On Counting Trees,	
	3.2	Spanning Trees, Fundamental Circuits, Finding all Spanning trees of a Graph, Finding Spanning Trees in Weighted Graph,	
	3.3	Cut-Sets and Cut-Vertices: Cut-sets, Some properties of Cut-sets, All cut-sets in a graph, Fundamental Circuits and Cut-sets, Connectivity and Separability, Network Flows	
4.0			**15**
	4.1	Matrix representation of graphs, Incidence matrix, Sub matrices of A(G), Circuit matrix, Fundamental circuit matrix and its rank,	
	4.2	An application to a switching network, Adjacency matrix, What is a Directed graph,	
	4.3	Some types of digraphs, Digraphs and binary relations, Directed paths and Connectedness, Euler digraphs.	
		Total	**60**

Text Book:

1. **C L Liu**, "Elements of Discrete Mathematics", Tata McGraw-Hill, Publishing Company (Second Edition).
   Scope: Chapter 12: Complete

2. **Narsingh Deo**, "Graph theory with applications to engineering and computer science", Prentice –Hall of India Pvt. Ltd.
   Scope: Chapter 1: Complete
   Chapter 2: Complete
   Chapter 3: Complete
   Chapter 4: 4-1 to 4-6
   Chapter 7: 7-1 to 7-5
   Chapter 9: 9-1 to 9-5

Reference Books:

1. **J.P. Tremblay, R. Manohar**, "Discrete mathematical structures with applications to computer science", Tata-McGraw Hill Education Pvt. Ltd.
2. **Kenneth N Rosen**, "Discrete Mathematics and its applications with combinatorics and graph theory", Tata-McGraw Hill Education Pvt.Ltd.
3. **Sanjeev Kumar, Sanjay Chaudhary**, "Applied Discrete Mathematics Theory and applications", Ram Prasad and Sons (India) Educational Publishers.

SMATE401 (C): Dynamics and Continuum Mechanics-I

Course objectives:

This course introduce the basic concepts and describe various motion of a rigid body, Newton's law of motion, moments and products of inertial, kinetic energy of a rigid body, problems illustrating the law of motion and impulsive motion.

Course outcomes:

After completing this course, the student will be able to:

- Study vector moment about a point and scalar moment about an axis.
- Study Newton's law of motion, various forces and angular momentum.
- Describe the theorem of parallel and Perpendicular axes.
- Illustrating the law of motion, the law of conservation of energy and impulsive motion.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Vector moment about a point and scalar moment about an axis, Vector and scalar couples,	
	1.2	Centroids, Vector calculus, Velocity and acceleration of a Particle along a curve,	
	1.3	Motion in plane radial and transverse components, Relative velocity and acceleration.	
2.0			**15**
	2.1	Vector angular velocity, General motion of rigid body, Moving axes, Mass, Momentum, Force,	
	2.2	Newton's laws of motion, Work, Energy and Power, Conservative forces, Potential energy,	
	2.3	Impulsive forces, Linear momentum of system of particles.	
3.0			**15**
	3.1	Angular momentum, Rate of change of angular momentum, Use of centroids, Moving origin, Impulsive force,	

	3.2	Moments and products of Inertia, The theorem of parallel and perpendicular axes,	
	3.3	Angular Momentum, Principal axes, Kinetic Energy of a rigid body.	
4.0			
	4.1	Momental Ellipsoid, Coplanar distribution, General motion of a rigid body,	**15**
	4.2	Problems illustrating the laws of motion, Problems illustrating the law of conservation of energy,	
	4.3	Problems illustrating impulsive motion.	
		Total	**60**

Text Book:

1. **F. Chorlton**, "A text book of Dynamics", (E.L.B.S.)(2nd Edition), 1983.
   Scope: Unit I: Chapter1: 1.7, 1.8, 1.9, 1.11; Chapter 2: 2.1-2.3, 2.5, 2.6, 2.9.
   Unit II: Chapter3: 3,1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.8.
   Unit III: Chapter 6: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6.
   Unit IV: Chapter 7: 7.1, 7.2, 7.3,7.4 7.5,7.6,7.77.8.

Reference Books:

1. **J.L. Synge and Griffith**, "Principles of Mechanics", New York, McGraw-Hill, 1949.
2. **Atkin R.H**., "Classical Dynamics",William Heinemann Ltd., 1959.

SMATE401 (D): Theory of Probability

Course objectives:

To study the mathematical and statistical probability, conditional probability, Baye's theorem, distribution function, discrete and continuous random variable, variance, moment generating function, binomial distribution function, Poisson and normal distribution.

Course outcomes:

After completing this course, the student will be able to:

- Discuss the multiplication theorem of probability for independent events and its Examples.
- Understand Moment Generating function Technique and its applications.
- Study recurrence relation for moments of binomial and Poisson distribution.
- Analyze the normal distribution as a limiting form of binomial distribution.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Basic Definitions, Mathematical and statistical probability, Axiomatic approach, Theorems on probability,	
	1.2	Conditional probability, Multiplication theorem of probability, independent events,	
	1.3	Multiplication theorem of probability for independent events, Baye's theorem.	
2.0			**15**
	2.1	Distribution Function, Discrete and Continuous Random variable,	
	2.2	Mathematical Expectation of a Random Variable, Properties of expectation, Properties of Variance,	
	2.3	Moment Generating function, Properties of Moment generating function, Cumulants and its properties.	
3.0			**15**
	3.1	Binomial distribution, Moments of Binomial distribution, Recurrence relation for Moments of Binomial distribution,	
	3.2	Poisson distribution, Moments of Poisson distribution, Recurrence relation for Moments of Poisson distribution,	

	3.3	MGF of Poisson distribution, Cumulants of Poisson distribution.	
4.0			**15**
	4.1	Normal distribution, Normal Distribution as a limiting form of Binomial Distribution,	
	4.2	MGF and CGF of Normal Distribution,	
	4.3	Area Property.	
		Total	**60**

Text Book:

1. **S .C. Gupta, V. K. Kapoor**, "Fundamentals of Mathematical Statistics", S. Chand and Sons, New Delhi.

   Scope: Chapter 3: 3.1 to 3.13, Chapter 4: 4.2, Chapter 5: 5.1 to 5.4, 5.4.1, Chapter 6: 6.1 to 6.5, Chapter 7: 7.1, 7.2, 7.2.1, Chapter 8: 8.1 to 8.3, 8.4, 8.4.1, 8.4.2, 8.5, 8.5.1, 8.5.2, 8.5.4, 8.5.5, 8.5.7, Chapter 9: 9.1, 9.2, 9.2.1, 9.2.5, 9.2.6, 9.2.7, 9.2.11

Reference Books:

1. **Rohatgi V.K.**, Introduction to Probability and Mathematical Statistics, Wiley Eastern Ltd. New Delhi. Student Edition.
2. **Dudewicz E.J. & Mishra S.N.,** Modern Mathematical Statistics, Wiley Series.
3. **S. C. Saxena**, "Mathematical Statistics", S. Chand and Co. Ltd.

SMATP401: Latex Typesetting

Course objectives:

To prepare a Latex document, to make scientific article and project report, book, include figures and tables in a Latex document, make conference proceedings and presentations, the preamble of LaTeX file to define document class and layout options, Use BibTeX to maintain bibliographic information and to generate a bibliography for a particular document and beamer for beautiful presentations

Course outcomes:

After completing this course, the student will be able to:

- Typesetting of complex mathematical formulae using LaTeX.
- Use various methods to either create or import graphics into a LaTeX document.
- Typesetting of journal articles, technical reports, thesis, books, and slide presentations.
- Automatic generation of table of contents, bibliographies and indexes.

Curriculum Details:

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Latex Environment**	**5L+10P**
	1.1	Introduction to LaTeX, Installation of LaTeX, Layout Design,	
	1.2	LaTeX input files, Input file structure, document classes,	
	1.3	Packages, environments, page styles, Typesetting texts,	
	1.4	Fancy Header, tables.	
2.0		**Mathematical Expressions in Latex**	**5L+10P**
	2.1	Inline math formulas and displayed equations, Math symbols and fonts,	
	2.2	Delimiters, matrices, arrays, Typesetting Mathematical formulae: fractions,	
	2.3	Integrals, sums, products, etc. Producing Mathematical Graphics.	
3.0		**Latex Class and formatting**	**5L+10P**
	3.1	Document classes for paper writing, thesis, books, etc.	
	3.2	Table of contents, index, hypertext, pdf pages, geometry, fancy header and footer, Verbatim, itemize, and enumerate, boxes, equation number.	
	3.3	Creating Tables, Inserting figures, enumeration list, itemized list, font effects, and inserting equations.	
4.0		**Presentation in Latex**	**5L+10P**
	4.1	Beamer class, beamer theme, frames, slides, pause,	
	4.2	Overlay transparent, handouts and presentation mode.	
	4.3	Inserting references, Manual reference,	
	4.4	Reference using BibTex, citing reference.	
		Total	**60**

Reference Books:

1. LATEX Tutorials A Primer, Indian TEX Users Group, Trivandrum, India, 2003 September.
2. Learning LATEX by Doing, Andre Heck, 2002.
3. Latex beginners guide, Stefan Kottiwitz.
4. The Latex companion, M. Carter, B.vanBrunt, second edition, Addison wisely, Pearson Education.
5. Learning Latex, D.F.Griffits, D.J.Higham, Siam, Philadelpha, 1997

M. Sc. First Year Semester-II *(Level 6.0)*

SMATC451: Linear Algebra

Course objectives:

This course is aimed to provide an introduction to the theories, concepts and to develop working knowledge of vector spaces, linear transformations, canonical forms and Inner product space.

Course outcomes:

After completing this course, the student will be able to:

- Identify the concepts of Liner Independence, bases and Dual spaces.
- Discuss Algebra of Linear Transformations and Characteristics roots.
- Explain canonical forms and Cayley-Hamilton Theorem.
- Analyze rational canonical forms and Determinants.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Introduction, Vector spaces, subspaces,	
	1.2	Quotient Spaces, Linear combinations and system of linear equations,	
	1.3	linear dependence and independence, Bases and dimension,	
	1.4	Maximal Linear Independent Subsets.	
2.0			**15**
	2.1	Linear Transformations, Null spaces, Ranges, The matrix representation of a linear transformation,	
	2.2	Composition of linear transformations, Invertibility and Isomorphism,	
	2.3	The change of Co-ordinate matrix, Dual spaces.	
3.0			**15**
	3.1	Elementary Matrix Operations and elementary matrices, The rank of a matrix,	
	3.2	System of linear equations-Theoretical Aspects, System of linear equations-Computational Aspects,	
	3.3	Eigen values and Eigen vectors, Diagonalizability, Triangulable Operators, Invariant Subspaces, Cayley-	

		Hamilton Theorem.	
4.0			**15**
	4.1	Inner products and Norms, The Gram-Schmidt Orthogonalization process and orthogonal complements,	
	4.2	The adjoint of a linear operator, Bilinear forms, Quadratic forms.	
	4.3	Jordan Canonical form-I, Jordan Canonical form-II,	
	4.4	The Minimal Polynomial, Rational Canonical form.	
		Total	**60**

Text Book:

1. **S.H. Friedberg, A.J. Insel, L.E. Spence**, "Linear Algebra", Prentice-Hall, International, Inc., 3rd Edition.
   Scope: Unit I - Chapter 1- Art 1.1 to 1.7
   Unit II - Chapter 2 - Art 2.1 to2.6.
   Unit III - Chapter 3 - Art 3.1 to 3.4, Chapter 5 - Art 5.1, 5.2, 5.4.
   Unit IV - Chapter 6 - Art 6.1, 6.2, 6.3, 6.4, 6.8. Chapter 7 - Art 7.1 to 7.4.

Reference Books:

1. **Vivek Sahai and Vikas Bist**, "Linear Algebra", Narosa Publishing House, 2nd Edition.
2. **S.Lang**, "Introduction to Linear algebra", Springer International Edition, 2nd Edition.
3. **K.Hoffman, R.Kunze**, "Linear Algebra", Prentice Hall of India.
4. **S.Kumaresan**, "Geometrical approach to Linear Algebra", Prentice Hall India Learning Private Limited; New title edition (2000).

SMATC452: Measure & Integration Theory

Course objectives:

This course introduce the concepts of Lebesgue outer measure, measurable set, integration of non-negative functions, Fatou's Lemma, Riemann and Lebesgue Integrals, function of bounded variations, four derivative, Abstract measure spaces, Jordan and Hahn decomposition theorem, Raydon–Nikodym theorem.

Course outcomes:

After completing this course, the student will be able to:

- Comprehend the measurable sets, Lebesgue measure, Fatou's Lemma, Lebesgue's Dominated Convergence and Integration of series.
- Discuss the four derivatives, Functions of bounded variations.
- Define the Hereditary class and Measure spaces.
- Explain signed measure and their derivatives.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Lebesgue outer measure, Measurable sets, Regularity, Measurable functions, Borel and Lebesgue measurability,	
	1.2	Integration of non-negative functions, Fatou's Lemma, Lebesgue's Monotone Convergence Theorem,	
	1.3	The general integral, Lebesgue's Dominated Convergence, Integration of series,	
	1.4	Riemann and Lebesgue Integrals.	
2.0			**15**
	2.1	Differentiation: The four derivatives, Continuous non-differentiable functions,	
	2.2	Functions of bounded variations, Lebesgue Differentiation Theorem (Statement only),	
	2.3	Differentiation and integration, The Lebesgue Set.	
3.0			**15**
	3.1	Abstract measure spaces: Measure and outer measure, Hereditary,	
	3.2	Complete Measure, Extension of measure, Uniqueness of the extension,	
	3.3	Completion of measure, Measure spaces, Integration with respect to measure.	

4.0			
	4.1	Signed measure and their derivatives: Signed measure	**15**
	4.2	The Hahn-Decomposition,	
	4.3	The Jordan decomposition,	
	4.4	The Raydon–Nikodym theorem (Statement only).	
		Total	**60**

Text Book:

1. **G.de Barra**, "Measure theory and integration", New Age International (P) Ltd. Publishers.
   Scope: Unit I- Chapter-2 (2.1-2.5), Chapter-3.
   Unit II- Chapter-4.
   Unit III- Chapter-5.
   Unit IV- Chapter-8 (8.1 to 8.3).

Reference Books:

1. **P.K. Jain and V.P. Gupta**, "Lebesgue measure and Integration" New Age International (P) Ltd. Publishers.
2. **P.R. Halmos**, "Measure theory", Van Mostranel Princeton, 1950.
3. **Inder K. Rana**, "An introduction to measure and Integration", Narosa Publishing House, Delhi, 1997.

SMATC453: Topology

Course objectives:

The goal of the course is to provide in depth knowledge of this fundamental core course in mathematics to show various techniques from analysis, set theory, logic that are used in topological spaces to obtain their properties, to demonstrate application in physics.

Course outcomes:

After completing this course, the student will be able to:

- Understand basics of Topological Spaces and their properties.
- Study Continuous functions, Metric Topology, Connected Spaces, Limit Point, Compactness, Local Compactness, Limit point Compactness.
- Achieve the zenith in treating Countable Axioms, Separable, Regular and Normal spaces.
- Understand the Urysohn's Lemma, Urysohn's Metrization Theorem and their applications.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Topological Spaces: Basis for a topology,	
	1.2	Order topology, Subspace Topology,	
	1.3	Product topology,	
	1.4	closed sets and limit points.	
2.0			**15**
	2.1	Continuous functions, Metric Topology,	
	2.2	Connected spaces, Connected Subspaces of Real Line,	
	2.3	Components and Local Connectedness.	
3.0			**15**
	3.1	Compact spaces,	
	3.2	Compact Subspaces of the Real Line,	
	3.3	Limit point compactness, Local Compactness.	
4.0			**15**
	4.1	Countability Axioms,	
	4.2	Separation axioms,	
	4.3	Normal Spaces,	
	4.4	Urysohn's Lemma (without proof), The Urysohn's Metrization Theorem (without proof), Tietze Extension Theorem (Without Proof), Tychonoff's Theorem.	
		Total	**60**

Text Book:

1. J**.R. Munkres, "Topology"** Prentice Hall of India, Second Edition.

Scope: Unit I - Chapter 2 Art 12 to 17.

Unit II - Chapter 2 - Art 18 to 20. Chapter 3- Art 23 to 25.

Unit III - Chapter 3- Art 26 to 29.

Unit IV - Chapter 4 - Art 30 to 35. Chapter 5- Art 37.

Reference Books:

1. **Stephen Willard,** "General Topology", Addison-Wesley Publishing Company, 1970.
2. **J. Dugundji, "**Topology", Allya and Bacon. (1966) reprinted: Printice Hall of India.
3. **W. J. Pervin,** "Foundations of general topology", academic press Inc. N.Y. H
4. **S. T.Hu**, "Elements of general topology". Holden day Inc. 1965.

SMATE451 (A): Partial Differential Equations

Course objectives:

To study partial differential equations of the first order, partial differential equations of the second order, classification of second order partial differential equations, Dirichlet problem, Neumann problem, Harnack's theorem, heat conduction problem, Duhamel's principle.

Course outcomes:

After completing this course, the student will be able to:

- Analyze the origin of first order partial differential equations and solving them using Charpit's method.
- Justify non-linear first order partial differential equation.
- Classify second order partial differential equations.
- Discuss boundary value problems and classification in the case of *n*-variables.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Curves and surfaces, Genesis of first order PDE,	
	1.2	classification of integrals,	
	1.3	linear equations of first order,	
	1.4	Pfaffian differential equations, Compatible systems.	
2.0			**15**
	2.1	Charpits method, Jacobi's method,	
	2.2	Integral surface through a given curve, Quasilinear equations,	
	2.3	Non-linear first order partial differential equation.	
3.0			**15**
	3.1	Genesis of second order partial differential equation, classification of second order partial differential equation,	
	3.2	vibrations of an infinite string, vibrations of semi-infinite string,	
	3.3	Vibrations of a string of finite length, method of separation of variables.	
4.0			**15**
	4.1	Boundary value problems, Maximum and Minimum principles,	
	4.2	The Cauchy problem, the Dirichlet problem, Neumann	

		problem,	
	4.3	Harnacks theorem, heat conduction problem, Duhamels principle,	
	4.4	Classification in the case of n-variables.	
		Total	**60**

Text Book:

1. **T. Amarnath**, "An Elementary course in Partial Differential Equations" (2nd edition), Narosa Publishing House, New Delhi.

Scope: Unit I: Chapter 1.1-1.6.
Unit II: Chapter1.7-1.11.
Unit III: Chapter 2.1 to 2.3.
Unit IV: Chapter 2.4 to 2.7.

Reference Books:

1. **I .N. Sneddon**, Elements of partial differential equations, Mc-Graw Hill Book Company.
2. **E.T. Copson**, Partial differential equations, Cambridge university press.
3. **K. Sankara Rao**, Introduction to partial differential equations, Prentice-Hall Of India Pvt. Limited.

SMATE451 (B): Combinatorics

Course objectives:

This course introduce the basic concepts of counting principles, arrangements and selections, Permutations and Combinations, Generating Functions, Recurrence Relations, Inclusion-exclusion principle and Rook polynomials.

Course outcomes:

After completing this course, the student will be able to:

- Comprehend the rules of Sum and Product of Permutations and Combinations.
- Identify Solutions by the technique of Generating Functions.
- Discuss the Recurrence relations, Divide and conquer relations.
- Analyze the Inclusion-exclusion principle and Rook polynomials.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Basic counting principles, Simple arrangements and selections,	
	1.2	Arrangements and selection with repetition,	
	1.3	Distributions,	
	1.4	Binomial Identities.	
2.0			**15**
	2.1	Generating function models,	
	2.2	Calculation of generating functions, Partitions,	
	2.3	Exponential generating functions, a summation method.	
3.0			**15**
	3.1	Recurrence relations: Recurrence relation model, Divide and conquer relations,	
	3.2	Solution of linear recurrence relations, Solution of inhomogeneous recurrence relations,	
	3.3	Solution with generating functions.	
4.0			**15**
	4.1	Counting with Venn diagrams,	
	4.2	Inclusion-exclusion formula,	
	4.3	Restricted positions,	
	4.4	Rook polynomials.	
		Total	**60**

Text Book:

1. **Alan Tucker**, "Applied Combinatorics", (3rd edition), John Wiley & sons, New York (1995)

Scope: Unit I: Chapter 5: Complete, **Unit II:** Chapter 6: Complete
Unit III: Chapter 7: Complete, **Unit IV:** Chapter 8: Complete

Reference Books:

1. **V. Krishnamurthy**, "Combinatorial, Theory and Applications", East West Press, New Delhi (1989) Scientific, (1996).
2. **V.K. Balakrishnan**, "Theory and Problems of Combinatories", Schaum outline series, Mcgraw Hill, New York.

SMATE451 (C): Dynamics and Continuum Mechanics-II

Course objectives:

This course introduce the concept of indices, tensor, scalar and vector fields, gradient, description of motion of continumm, deformation, compatibility conditions of infinitesimal strain components, Newtonian fluid.

Course outcomes:

After completing this course, the student will be able to:

- Define the basic concept of indices, tensor, scalar and vector fields.
- Discuss the description of motion of a Continuum, rate of deformation.
- Analyze strain component, stress tensor, components of symmetry of stress Tensor.
- Explain the Newtonian fluids, mathematical principles.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Indicial Notation, Summation convention, Dumy indices, Free indices, Kronecker delta, Permutation symbol,	
	1.2	Tensor as a linear transformation, Components, Sum, Dyadic product, Product of tensors,	
	1.3	Identity, Transpose, Orthogonal tensors, Symmetric and antisymmetric tensors, Eigen values and Eigenvectors of a tensor,	
	1.4	The dual vector of an antisymmetric tensor, Principal values and principal directions of real symmetric tensors.	
2.0			**15**
	2.1	Tensor Valued function of a scalar, Scalar field and Gradient of a scalar function,	
	2.2	Vector field and Gradient of vector Function, Divergence of a vector field and divergence of a tensor field,	
	2.3	Curl of Vector filed, Laplacian of Scalar field, Laplacian of Vector field.	
3.0			**15**
	3.1	Description of motion of a continumm, Material and spatial description, Material derivatives, Infinitesimal Deformation,	
	3.2	Principle strain, Dilatation, Rate of deformation, Equation of conservation of mass,	

	3.3	Compatibility conditions of infinitesimal strain components.	
4.0			**15**
	4.1	Stress vector, Stress tensor, Components of symmetry of stress tensor,	
	4.2	Principle of moment of momentum, Principal stresses, Maximum shearing stress, Equations of motion,	
	4.3	Principle of linear momentum, Fluids, Compressible and incompressible fluid, Equations of hydrostatics,	
	4.4	Newtonian Fluid, Interpretation of Incompressible Newtonian fluid.	
		Total	**60**

Text Book:

1. **Lai W. M. Rubin D and Kremple E**, ''Introduction to continuum Mechanics'',
   Scope: **Unit I:** Chapter 2: 2.1-2.4, 2.6-2.15, 2.20-2.23.
   Unit II: Chapter 2:.2.6-2.32.
   Unit III: Chapter 3: 3.1-3.3, 3.7, 3.9, 3.10, 3.13, 3.15, 3.16.
   Unit IV: Chapter 4:4.1-4.4, 8, Chapter6: 6.1-6.6.

Reference Books:

1. **Lang R.R.**, "Mechanics of Solids and fluids", Prentice hall.

SMATE451 (D): Operation Research

Course objectives:

In this course we introduce the basic concepts of Operations Research such as Linear Programming Problem, Duality in Linear Programming, Transportation Problem, Assignment Problem and Game Theory.

Course outcomes:

After completing this course, the student will be able to:

- Explain Graphical Method, Simplex Method, Big-M method, Two Phase method.
- Apply Duality to solve problems in Linear Programming.
- Analyze the test of optimality for Degeneracy by using Transportation Algorithms.
- Discuss the Assignment Problem and its Applications, game theory.

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Definitions, Graphical method,	
	1.2	Simplex Method (Technique or Algorithm),	
	1.3	Duel Simplex Method, Big-M method,	
	1.4	Two Phase method.	
2.0			**15**
	2.1	Introduction to the model, Definition of the Transportation Model, Matrix Terminology,	
	2.2	Formulation and solution of transportation models, Variance in transportation problems, Least time transportation Problems,	
	2.3	Post Optimality analysis in Transportation, Trans-Shipment Problems.	
3.0			**15**
	3.1	Definition of Assignment Model, Mathematical representation of the assignment model,	
	3.2	Comparison with the Transportation model, Solution of the Assignment problem,	
	3.3	Hungerian method for solution of the assignment problems, Formulation and solution of assignment Models.	
4.0			**15**
	4.1	Variations of the Assignment problem, Sensitivity	

		analysis in Assignment problems,	
	4.2	Travelling Salesman problem(Shortest Cyclic Route Models), The theory of games,	
	4.3	Characteristics of games, Game Models, Saddle Points,	
	4.4	Two by Two and three by three Game Theory, Optimization.	
		Total	**60**

Text Book:

1. **Premkumar Gupta**, **D. S. Hira**, "Operation Research", S. Chand and Co. Ltd.

Scope:Unit 1:- Art.2, 2.9, 2.16, 2.17, 2.17.1, 2.17.2.

Unit 2:- Art.3.1 to 3.10.

Unit 3:- Art.4.1, 4.6.

Unit 4:- Art. 4.7, 4.10, 9.10 to 9.18.

Reference Books:

1. **H.A. Taha** , "Operation Research", Prentice Hall.
2. **Kanti Swarup**, "Operation Research", S. Chand Co.

SMATP451: Introduction to Scilab

Course objectives:

Scilab, an alternate to MATLAB, is a scientific software package providing a powerful open computing environment for engineering and scientific applications. In this course, different tool boxes like related to plotting, matrices, polynomials, system of equations, etc. will be discussed.

Course outcomes:

After completing this course, the student will be able to:

- Install Scilab and execute looping and branching commands.
- Able to understand the basic concepts of programming.
- Handle matrices and their operations in scilab; Plot and visualize 2D and 3D graphs of various functions.
- Understand the main features of the SCILAB program development environment to enable it's usage in the higher learning.
- Interpret and visualize simple mathematical functions and operations by using plots.

Curriculum Details:

oduleNo.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0		**Introduction to Scilab**	**5L+10P**
	1.1	Introduction to Scilab, Installation of Scilab,	
	1.2	Basic elements of the language, Looping and Branching:	
	1.3	If, select, for, break, continue, Functions, return,	
	1.4	Contour plots, tiles, axes, legends.	
2.0		**Linear Algebra using Scilab**	**5L+10P**
	2.1	Creating matrices, sum, product of matrices, inverse, rank determinant,	
	2.2	Comparing matrices, system of equations, High level linear algebra features, working with polynomials,	
	2.3	Matrix inversions, Solving system of equations.	
3.0		Scilab Demonstrations:	**5L+10P**
	3.1	Polynomials, discrete and continuous Random variables,	
	3.2	Basic functions, animation, Bezier curves and surfaces, matplot,	
	3.3	complex elementary functions. Scilab	
4.0		**Calculus Using Scilab**	**5L+10P**
	4.1	Plotting 2D and 3D graphs, defining a function and output arguments.	
	4.2	Parametric plots, Polar plots	
	4.3	Evaluation of definite integrals, Generating prime numbers	
	4.4	Illustration of Rolle's and Mean value theorems.	
		Total	**60**

Reference Books:

1. Introduction to scilab, Michael Baudin, Scilab Consortium, digiteo, Nov 2010.
2. An introduction to scilab, SatishAnnigeri, free online version.
3. Introduction to Scilab, Graeme Chandler, Stephen Roberts, free online version, 2002.
4. Introduction to Scilab, Gilberto E. Urroz, distributed by infoclearinghouse.com

Guidelines for Course Assessment:

A. Continuous Assessment (CA) (20% of the Maximum Marks):

This will form 20% 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. End Semester Assessment (80% of the Maximum Marks):

(For illustration we have considered a paper of 04 credits, 100 marks and need to be modified depending upon credits of an individual paper)

1. **ESA Question paper will consists of 6 questions, each of 20 marks.**
2. **Students are required to solve a total of 4 Questions.**
3. **Question No.1 will be compulsory and shall be based on entire syllabus.**
4. Students need to solve **ANY THREE** of the remaining Five Questions (Q.2 to Q.6) and shall be based on entire syllabus.

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