ST. ALOYSIUS' COLLEGE
JABALPUR (MADHYA PRADESH)

Autonomous, Reaccredited 'A++' Grade by NAAC (CGPA 3.58/4.00)
College with Potential for Excellence (CPE) by UGC
DST-FIST Supported & Star College Scheme by DBT
Affiliated to Rani Durgavati Vishwavidyalaya, Jabalpur (M.P.)

St. Aloysius College (Autonomous), Jabalpur

Reaccredited 'A++' by NAAC (CGPA – 3.58/4.00)

College with Potential for Excellence by UGC

DST FIST Supported

Department of Mathematics

Syllabus

M.Sc. I to IV Semester

To be implemented in 2025-26

CHOICE BASED CREDIT SYSTEM (CBCS)

(For PG Programme in Mathematics from the academic year 2025-2026)

1. Eligibility

(i) Admission: Candidates who have passed the qualifying examination (UG) with Mathematics shall be given in admission to M.Sc. Mathematics Degree Programme.

(ii) Degree : The candidates shall have subsequently undergone the prescribed course of study in the college affiliated to the University for a period of not less than two academic years, passed the examinations prescribed and fulfilled such conditions as have been prescribed.

2. Duration

The course is for a period of two years. Each academic year shall comprise of two Semester, viz. Odd and Even Semester. Odd semesters shall be from July to November and Even Semesters shall be from January to April. There shall be not less than 90 working days which shall comprises of minimum 375 teaching clock hours for each semester. (Exclusive of the days for the conduct of Odd and Even Semester examinations).

3. Programme

M.Sc. Mathematics

4. The CBCS System

The Programme will run on Choice Based Credit System (CBCS). It is an instructional package developed to suit the needs of students to keep pace with the developments in higher education and the quality assurance expected of it in the light of globalization in higher education.

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Syllabus of the Post-Graduate Programme and Distribution of Credits

for

I st-Year of 2-Year PG Programme in Mathematics after 3-Year degree Course

(Semester System)

Scheme B-3 (For Non-Practicum Courses)

1-YEAR (w.e.f. 2025-26)

(English Version)

Course Type						Credits Total
Sem	Core Courses / Dissertation				Internship/ Apprenticeship/Seminar OR VAC (CHM/EESC)	
	Courses Level	Course (5 Credits)	Title of Paper (Theory)	Credits		
I	400	CC-11	Advanced Abstract Algebra-1	(5 Credits)	Internship/ Apprenticeship OR Seminar (2 Credits)	22
	400	CC-12	Topology – I	(5 Credits)		
	400	CC-13	Real Analysis	(5 Credits)		
	400	CC-14	Complex Analysis	(5 Credits)		
II	400	CC-21	Advanced Abstract Algebra-II	(5 Credits)	Foundational Skills for Career Success [VAC (CHM/EESC) (2 Credits)	22
	400	CC-22	Topology – II	(5 Credits)		
	400	CC-23	Lebasque Measure and Integration	(5 Credits)		
	400	CC-24	Differential Geometry	(5 Credits)		

DEPARTMENT OF MATHEMATICS

Part A : Introduction			
Program: 2-Year	Class: Post-Graduate I-Year (Semester-1)	Year: 2025	Session: 2025-2026
Subject: Mathematics			

1	Course Code		
2	Course Title	**Advanced Abstract Algebra - I (Theory)**	
3	Course Type	CC-11	
4	Pre-requisite (if any)	To study this course, a student must have had the subject Mathematics at Degree level (3 Year Degree Course).	
5	Course Learning Outcomes (CLO)	The course will enable the students to: 1. Understand the basic concepts of group operations and their applications. 2. Apply the Sylow's theorem to characterize certain finite groups. 3. Know the fundamental concepts in ring theory such as polynomial rings. Euclidean domain and unique factorization domain. 4. Learn the fundamental properties of extension of a field. 5. Analyse and the characterize algebraic and transcendental extensions.	
6	Credit Value	5 Credits	
7	Total Marks	Max. Marks: 40 + 60	Min. Passing Marks: 40

Part B: Content of the Course		
Total No. of Lectures (in hours per week): 5 hours per week **Total Lectures:75 hours**		
Module	**Topics**	**No. of Lectures**
I	Class equation of a finite group, Centre for Group of prime power order, Cauchy's and Sylow's theorems for finite groups, Isomorphism theorems, Maximal normal groups, Simple groups.	**18**
	Suggested Activities: By analysing conjugacy classes, determine the center of the group and identify normal subgroups. Determining the structure of groups based on Sylow p-subgroups.	
II	Normal and Subnormal Series, Composition series of a group, Jordan-Holder theorem, Commutator subgroup of a group, Solvable groups, Nilpotent groups.	**15**
	Suggested Activities: Used in the classification of finite simple groups, providing a foundation for understanding group structures. Applying the commutator subgroup to analysing the fundamental group of topological spaces	
III	Euclidean ring, Polynomial ring, Polynomials over a Ring, Division algorithm, Polynomial over the rational field.	**15**
	Suggested Activities: Discuss how Euclidean ring and Division algorithm be used in cryptography.	
IV	**Indian Knowledge System:** Contribution and biography of following Indian Mathematicians in Advanced Abstract, Algebra: Dr. Harish-Chandra, Dr. V. V. Narlikar, Dr. S. S. Abhyankar, Euclidean ring, Polynomial ring, Polynomials over a Ring, Division algorithm, Polynomial over the rational field.	**12**
	Suggested Activities: Discuss how Euclidean ring and Division algorithm be used in cryptography.	

V	Extension of a fields, Roots of polynomials, Algebraic and transcendental extensions, Primitive elements, Algebraically closed field.	**15**
	Suggested Activities: Discuss the applications of field extension and primitive elements in real world problems.	

Keywords/ Tags: Cauchy's and Sylow's theorems, Jordan-Holder theorem, Solvable groups, Nilpotent groups Euclidean rings, Polynomial rings, Euclidean domain, Principal ideal domain, Unique factorization domain, Quotient field, Extension Field.

Part C - Learning Resources

Text Books, Reference Books, Other Resources

Suggested Readings:

Text Books:

1.P. B. Bhattacharya, S. K. Jain & S. R. Nagpaul: Basic Abstract Algebra, 2nd edition, Cambridge University Press, 2003.

2. I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd. New Delhi. 1977.

3. मध्यप्रदेश हिन्दी ग्रंथ अकादमी की पुस्तकें।

Reference Books:

1. I. S. Luther and I. B. S. Passi: Algebra. Vol. I and II, Narosa Publishing House, 1997.

2. Shanti Narayan: A text Book of Modern Abstract Algebra, S. Chand and Company. New Delhi, 1967.

3. Surjeet Singh and Qazi Zameeruddin: Modern Algebra, Vikas Publishing House Pvt Ltd; Delhi, Eighth edition, 2006.

Suggested Digital Platforms Web links:

https://www.eshiksha.mp.gov.in/mpdhe
https://epgp.inflibnet.ac.in

Suggested Equivalent online courses:

https://ugcmoocs.inflibnet.ac.in/index.php/courses/view ug/335

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods: Maximum Marks: 100 Continuous Comprehensive Evaluation (CCE): 40 Marks University Exam (UE): 60 Marks	
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	**Total Marks: 40**
External Assessment: University Exam (UE)	**Total Marks: 60**

Part A : Introduction			
Program: 2-Year	Class: Post-Graduate I-Year (Semester-1)	Year: 2025	Session: 2025-2026
Subject: Mathematics			

1	Course Code		
2	Course Title	**Topology 1 (Theory)**	
3	Course Type	CC-12	
4	Pre-requisite (if any)	To study this course, a student must have had the subject Mathematics at Degree level (3 Year Degree Course).	
5	Course Learning Outcomes (CLO)	The course will enable the students to: 1. Determine interior, closure, boundary and limit points of metric space. 2. Determine interior, closure, boundary, limit points, basis and sub-basis of topological spaces. 3. Check whether a collection of subsets is a basis for a given topological spaces or not and determine the topology generated by a given basis. 4. Identify the continuous maps between two spaces and maps from a space into product space. 5. Determine common topological properties of given two spaces.	
6	Credit Value	5 Credits	
7	Total Marks	Max. Marks: 40 + 60	Min. Passing Marks: 40

Part B: Content of the Course		
Total No. of Lectures (in hours per week): 5 hours per week **Total Lectures:75 hours**		
Module	**Topics**	**No. of Lectures**
I	Metric Space: Definition, examples and types of Metric spaces. Neighbourhoods, Limit points, Interior points and Boundary points. Open and closed sets. Closure and interior of a set. Subspace of a Metric space. Sequences in a Metric space: Convergent sequence, Cauchy sequences. Completeness of a Metric space. Cantor's intersection theorem. Contraction principle. Dense subsets, Baire Category theorem. Continuous functions.	**18**
	Suggested Activities: Discuss about the applications of Closure of a set, Interior points, Boundary points and Baire Category theorem.	
II	Topological Spaces: Definition and examples of topological spaces. Neighbourhood of a point, limit point and derived set. Closed set and closure of a set. Dense set and nowhere dense set. Interior, exterior and boundary points of a set.	**15**
	Suggested Activities: Discuss about the applications of Closure of a set, Interior, exterior and boundary points of a set in topological space.	
III	**Indian Knowledge System:** Contribution and biography of following Indian Mathematicians in Topology: Dr. M. S. Narasimhan, Dr. V. S. Varadarajan, Topological subspace and relative topology. Basis and subbasis. First and second countable spaces and separable spaces.	**12**
	Suggested Activities: Discuss how Topological Subspaces he used in Computer graphics, GIS, robotics.	

IV	Continuity and Homeomorphism: Continuity in topological spaces, Sequential Continuity at a point, Open and closed functions, Homeomorphism of topological spaces, Topological property.	**15**
	Suggested Activities: (i) Discuss application of Homeomorphism in Robotics. (ii) Discuss how Sequential Continuity be used in Machine Learning.	
V	Connectedness: Separated sets, Connected and Disconnected Sets, Continuity and Connectedness, Component of a space. Totally disconnected spaces, Locally connected spaces.	**15**
	Suggested Activities: Discuss the applications of Separated Sets, Connected and Disconnected Sets to solve the real-world problems.	
Keywords/ Tags: Metric Space, Topological Spaces, Continuity and Homeomorphism in topological spaces, Separable spaces in topological space.		

Part C - Learning Resources
Text Books, Reference Books, Other Resources
Suggested Readings: **Text Books:** **1**. G. F. Simmons: Introduction to Topology and Modern Analysis, McGraw Hill Education, 2017. 2. J. R. Munkres: Topology, Pearson; 2nd edition, 2015. 3. मध्यप्रदेश हिन्दी ग्रंथ अकादमी की पुस्तकें।
Reference Books: **1.** K. D. Joshi: Introduction to General Topology, New Age International Private Limited, 2017. 2. T. B. Singh, Elements of Topology, CRC Press, Taylor & Francis, 2013. 3. K. Chandrasekhara Rao: Topology, Narosa Públishing House, 2009.

Suggested Digital Platforms Web links:
https://www.eshiksha.mp.gov.in/mpdhe https://epgp.inflibnet.ac.in
Suggested Equivalent online courses:
https://ugcmoocs.inflibnet.ac.in/index.php/courses/view ug/335

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods: Maximum Marks: 100 Continuous Comprehensive Evaluation (CCE): 40 Marks University Exam (UE): 60 Marks	
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	**Total Marks: 40**
External Assessment: University Exam (UE)	**Total Marks: 60**

Part A : Introduction			
Program: 2-Year	Class: Post-Graduate I-Year (Semester-1)	Year: 2025	Session: 2025-2026
Subject: Mathematics			

1	Course Code		
2	Course Title	**Real Analysis (Theory)**	
3	Course Type	CC-13	
4	Pre-requisite (if any)	To study this course, a student must have had the subject Mathematics at Degree level (3 Year Degree Course).	
5	Course Learning Outcomes (CLO)	The course will enable the students to: 1. Learn the properties of Riemann and Riemann-Stieltjes integrable functions and applications of the fundamental theorems of integration. 2. Understand the concepts of convergence and term by term integration and differentiation of a power series. 3. Understanding and evaluating uniform convergence of series of real valued functions. 4. Analysing the relation between uniform convergence and continuity, uniform continuity and differentiation and integration of sequences of real valued functions.	
6	Credit Value	5 Credits	
7	Total Marks	Max. Marks: 40 + 60	Min. Passing Marks: 40

Part B: Content of the Course		
Total No. of Lectures (in hours per week): 5 hours per week **Total Lectures:75 hours**		
Module	**Topics**	**No. of Lectures**
I	**Indian Knowledge System:** Contribution and biography of following Indian Mathematicians in Real Analysis: Dr. K. Chandrasekharan, Dr. D. S. Kothari, **Real Number System:** Introduction, Denseness property, Neighbourhood, Limit Points of a set, Open and Closed Set, Interior and Closure of a Set, Bolzano-Weierstrass Theorem.	**07**
	Suggested Activities: Discuss Limit Points of a set, Open and Closed Set, Interior and Closure of a Set.	
II	**Riemann Integral, Integration and Differentiation:** Riemann Integral: Properties of Riemann sums, Riemann integrability, Properties of Riemann integrable functions, Riemann integration and continuity, Integral as a limit of sums. Integration and Differentiation. Fundamental theorem of calculus, Mean value theorems of integral calculus, Integration by parts, Change of variables.	**15**
	Suggested Activities: Understanding the properties of Riemann integrable functions and their applications.	
III	**Riemann-Stieltjes Integral:** Definition, existence and properties of Riemann-Stieltjes integral, Relation Between Riemann and Riemann-Stieltjes integral, Mean value theorem. Integration and differentiation, Fundamental theorem of calculus for Riemann-Stieltjes integral, Integration of vector valued functions, Rectifiable curves.	**15**
	Suggested Activities: Gives the applications of Riemann-Stieltjes Integral in various fields.	
IV	**Improper Integral and Fourier Series:**	**18**

	Improper integrals and their convergence: Comparison tests and u-test, Abel's and Dirichlet's tests. Absolute and Conditional convergence of improper integrals, Frullani's integral as a function of a parameter, Differentiability & integrability of an integral of a function of a parameter, Fourier series for half and full intervals.	
	Suggested Activities: Discuss the application of Fourier Series in Signal Processing and Communications.	
V	**Uniform Convergence and Power Series:** Pointwise and uniform convergence of sequences of functions: Cauchy's general principle of uniform convergence, Weierstrass Mn-Test, Uniform convergence of series of functions: Weierstrass M-test, Uniform convergence, continuity, differentiability and Riemann integrability. Algebra of power series: Uniform convergence of power Series, Uniqueness of power series, Abel's theorem, Properties of power series, Tauber's theorem.	**20**
	Suggested Activities: Analysing the relation between uniform convergence and Continuity	
Keywords/ Tags: Real Numbers, Riemann Integral, Riemann-Stieltjes Integral, Improper Integral, Fourier Series, Uniform Convergence, Power Series.		

Part C - Learning Resources
Text Books, Reference Books, Other Resources
Suggested Readings: **Text Books:** 1. Walter Rudin: Principles of Mathematical Analysis, McGraw Hill Education, Third edition, 2017. 2. S. C. Malik and Savita Arora: Mathematical analysis, New Age Publication. Delhi, 2017. 3. G. F. Simmons: Introduction to Topology and Modern Analysis, McGraw Hill Education, 2017. 4. Goldberg R R: Methods of Real Analysis, Oxford & IBH Publishing, 2020.

3. मध्यप्रदेश हिन्दी ग्रंथ अकादमी की पुस्तकें।
Reference Books: 1. Santi Narayan and M. D. Raisighania: Elements of Real Analysis, S Chand, 2003. 2. J. R. Munkres: Topology, Pearson; 2nd edition, 2015. 3. D. Somasundaram and B. Choudhary: A First Course in Mathematical Analysis, Narosa Publishing House, 1996.
Suggested Digital Platforms Web links: https://www.eshiksha.mp.gov.in/mpdho https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25 **Suggested Equivalent online courses:** **https://nptel.ac.in/courses/111106142/** **https://nptel.ac.in/courses/111106153/** **https://nptel.ac.in/courses/111106141/**

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods: Maximum Marks: 100 Continuous Comprehensive Evaluation (CCE): 40 Marks University Exam (UE): 60 Marks	
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	**Total Marks: 40**
External Assessment: University Exam (UE)	**Total Marks: 60**

Part A : Introduction			
Program: 2-Year	Class: Post-Graduate I-Year (Semester-1)	Year: 2025	Session: 2025-2026
Subject: Mathematics			

1	Course Code		
2	Course Title	Complex Analysis (Theory)	
3	Course Type	CC-14	
4	Pre-requisite (if any)	To study this course, a student must have had the subject Mathematics at Degree level (3 Year Degree Course).	
5	Course Learning Outcomes (CLO)	The course will enable the students to: 1. Visualize complex numbers as points of R2 and stereographic projection of complex plane on the Riemann sphere. 2. Recognize the significance of differentiability and analyticity of complex functions. 3. Use Cauchy-Goursat theorem and Cauchy integral formula in evaluation of contour integrals. 4. Apply Liouville's theorem in fundamental theorem of Algebra. 5. Learn Taylor and Laurent series expansions of analytic functions. 6. Classify the nature of singularity, poles and residues and apply Cauchy residue theorem.	
6	Credit Value	5 Credits	
7	Total Marks	Max. Marks: 40 + 60	Min. Passing Marks: 40

Part B: Content of the Course		
Total No. of Lectures (in hours per week): 5 hours per week **Total Lectures:75 hours**		
Module	**Topics**	**No. of Lectures**
I	**Complex Number and Functions:** Introduction of complex numbers and their geometrical representation: Extended complex plane, Stereographic projection of complex numbers. Continuity and differentiability of complex functions, Analytic functions, Cauchy-Riemann equations, Harmonic functions, Polar form of Cauchy-Riemann equations.	**15**
	Suggested Activities: Discuss the applications of Cauchy-Riemann equations and Harmonic functions.	
II	**Complex Integration:** Definition and examples of complex integration, Absolute value of a complex integral, Cauchy's Theorem, Cauchy's-Goursat theorem, Cauchy's integral formula, Higher order derivatives, Morera's theorem, Cauchy's inequality, 'Liouville's theorem, Taylor's theorem, Laurent theorem.	**18**
	Suggested Activities: Using Cauchy-Goursat theorem and Cauchy integral formula in evaluation of contour integrals.	
III	**Poles, Zeros and Singularities:** Introduction of poles, zeros and singularities, Meromorphic function, Argument principle, Rouche's theorem, Fundamental theorem of algebra, Maximum modulus principle, Schwarz lemma.	**15**
	Suggested Activities: Discuss the applications of Argument principle and Rouche's theorem.	
IV	**Calculus of Residues:** Residue, Cauchy's Residue theorem, Evaluation of integrals: $\int_0^{2\pi} f(cos\theta, sin\theta)d\theta$, $\int_{-\infty}^{\infty} f(x)dx$, $cosmx$ and $sinmx$ as a factor in the integrand, Integration of many valued functions.	**15**
	Suggested Activities: Discuss the applications of Calculus of Residues to solve various problems.	

V	**Indian Knowledge System:** Contribution and biography of following Indian Mathematicians in Complex Analysis: Dr. C. T. Rajagopal, Dr. S. Minakshisundaram, **Mobius Transformation and Conformal Mapping:** Mobius Transformation, their properties and classification. Conformal Mapping and their properties.	**12**
	Suggested Activities: Real world applications of Mobus Transformation and Conformal Mapping	
Keywords/ Tags: Complex Numbers, Complex Function, Complex Integration, Poles, Zeros, Singularities, Calculus of Residues, Mobius Transformation, Conformal Mapping		

Part C - Learning Resources

Text Books, Reference Books, Other Resources

Suggested Readings:

Text Books:

1. L. V. Alhfors: Complex Analysis, McGraw Hill Education; Third edition, 2017.
2. T. Pati: Functions of a Complex Variables, Pothishala Pvt. Ltd, 1986.
3. मध्यप्रदेश हिन्दी ग्रंथ अकादमी की पुस्तकें।

Reference Books:

1. Ponnuswamy S: Foundations of Complex Analysis, Alpha Science International Ltd, 2nd edition, 2005.
2. V. Karunakaran: Complex Analysis, Narosa Publication, 2005.
3. Kayalal Pachaiyappa: Complex Analysis, S. Chand and Company Ltd., 2014.

Suggested Digital Platforms Web links:

https://www.eshiksha.mp.gov.in/mpdhe
https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25

Suggested Equivalent online courses:

https://nptel.ac.in/courses/111106142/
https://nptel.ac.in/courses/111106153/
https://mplel.ac.in/courses/111106141/

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods: Maximum Marks: 100 Continuous Comprehensive Evaluation (CCE): 40 Marks University Exam (UE): 60 Marks	
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	**Total Marks: 40**
External Assessment: University Exam (UE)	**Total Marks: 60**

Part A : Introduction			
Program: 2-Year	Class: Post-Graduate I-Year (Semester-2)	Year: 2025	Session: 2025-2026
Subject: Mathematics			

1	Course Code		
2	Course Title	**Foundational Skills for Career Success (Theory)**	
3	Course Type	VAC (CHM/EESC)	
4	Pre-requisite (if any)	To study this course, a student must have had the subject Mathematics at Degree level (3 Year Degree Course).	
5	Course Learning Outcomes (CLO)	The course will enable the students to: 1. Use appropriate tone, pitch, and language based on audience and purpose. 2. Interpret body language, facial expressions, and gestures accurately. 3. Analyse sentence components to improve grammar and clarity. 4. Conduct a personal SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis. 5. Develop strategies to stay motivated and maintain a positive mindset. 6. Understand the functions and features of common presentation software (e.g., PowerPoint, Google Slides). 7. Insert and format text using headings, bullet points, and styles. 8. Integrate animations, transitions, and multimedia (audio, video) into presentations. M	
6	Credit Value	5 Credits	
7	Total Marks	Max. Marks: 40 + 60	Min. Passing Marks: 40

Part B: Content of the Course		
Total No. of Lectures (in hours per week): 5 hours per week **Total Lectures:75 hours**		
Module	**Topics**	**No. of Lectures**
I	Indian Knowledge System: Gurukul Discipline & Time Management, Natyashastra Critical Thinking, Panini's Ashtadhyayi - Communication.	**02**
II	Communication Skills: Verbal Communication, Communication, active Listening, Writing Skills: Parts of Speech, Sentences. Self-management Skills: Strength and Weakness Analysis, Motivation and Positive Attitude, Result Orientation, Self-awareness. Non-Verbal	**14**
	Suggested Activities: Practice mock interviews, Peer Editing, SWOT Activity, Case Study Analysis, "Who Am I?" Exercise.	
III	Information and Communication Technology Skills: Presentation Software, Opening, Closing, Saving and Printing a Presentation, Working with Slides and Text in a Presentation, Advanced Features used in Presentation.	**14**
	Suggested Activities: Presentation Basics Relay, Slide Design Challenge, Create a Tutorial Presentation.	
Keywords/ Tags: Communication Skills, Self-management Skills, ICT Skills.		

Part C - Learning Resources
Text Books, Reference Books, Other Resources
Suggested Readings: **Text Books:** 1. Employability Skills, Textbook for Class IX, NCERT Publication, 2018. 2. Employability Skills, Textbook for Class XII, NCERT Publication, 2020. 3. मध्यप्रदेश हिन्दी ग्रंथ अकादमी की पुस्तकें।
Suggested Digital Platforms Web links: **https://www.eshiksha.mp.gov.in/mpdhe** **https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001610/P001800/M025909/ET/I513941412MODULE9SkillsforEmployment,LifeSkillsandEntrepreneurship Final20.9.2017-Edited.pdf** **https://epgp.inflibnet.ac.in/cpgpdata/uploads/epgp_content/S001610/P001800/M025902/ET/1 513941219MODULE2Personality Development-Edited.pdf** **Suggested Equivalent online courses:** **https://nptel.ac.in/courses/109104115** **https://nptel.ac.in/courses/109104107**

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods: Maximum Marks: 100 Continuous Comprehensive Evaluation (CCE): 40 Marks University Exam (UE): 60 Marks	
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	**Total Marks: 40**
External Assessment: University Exam (UE)	**Total Marks: 60**

Part A: Introduction			
Program: 2-Year	Class: Post-Graduate I-Year (Semester-2)	Year: 2025	Session: 2025-2026
Subject: Mathematics			

1	Course Code		
2	Course Title	**Advanced Abstract Algebra - II (Theory)**	
3	Course Type	CC-21	
4	Pre-requisite (if any)	To study this course, a student must have had the subject Mathematics at Degree level (3 Year Degree Course).	
5	Course Learning Outcomes (CLO)	The course will enable the students to: 1. Learn the fundamental properties of finite field extensions and classification of finite fields. 2. Analysing the characterize perfect fields using separable extensions. 3. Construct examples of automorphism group of a field and Galois extensions. 4. Understand Modules, Identify and construct example of modules and apply homeomorphism theorems on the same. 5. Distinguish between free, simple and semi-simple modules.	
6	Credit Value	5 Credits	
7	Total Marks	Max. Marks: 40 + 60	Min. Passing Marks: 40

Part B: Content of the Course		
Total No. of Lectures (in hours per week): 5 hours per week **Total Lectures:75 hours**		
Module	**Topics**	**No. of Lectures**

I	**Indian Knowledge System:** Contribution and biography of following Indian Mathematicians in Advanced Abstract Algebra: Dr. C. S. Seshadri, Dr. M.S. Raghunathan, Dr. R. Balasubramanian	**16**
	Splitting fields, Normal extensions, Finite fields, Classification of finite fields, Separable and inseparable extensions.	
	Suggested Activities: Discuss about the applications of Splitting fields and Finite fields in Cryptography.	
II	Perfect field, Simple extension, Automorphism of extensions, Fixed field, Artin theorem.	**14**
	Suggested Activities: Discuss how Perfect field and Fixed field be used in coding theory	
III	Galois extension, Fundamental theorem of Galois theory, Fundamental theorem of Algebra, Roots of unity, Cyclic extensions, Polynomials solvable by radicals.	**15**
	Suggested Activities: Discuss how Fundamental Theorem of Algebra and cyclic extension are useful in computer science.	
IV	Introduction to Modules and their properties, Submodules, Quotient modules, Homomorphism and Isomorphism of modules.	**15**
	Suggested Activities: Discuss how modules be used in coding theory.	
V	Cyclic modules. Simple modules, Semi-simple modules, Free modules, Schur's lemma.	**15**
	Suggested Activities: Discuss the applications of Free modules and Schur's lemma.	
Keywords/ Tags: Splitting fields, Perfect field, Normal and Separable Extension, Galois Theory, Cyclic extensions, Modules, Free modules, Schur's lemma.		

Part C - Learning Resources
Text Books, Reference Books, Other Resources
Suggested Readings:

Text Books:

1. P. B. Bhattacharya, S, K. Jain & S. R. Nagpaul: Basic Abstract Algebra, 2nd edition, Cambridge University Press, 2003.
2. 1. N. Herstein: Topics in Algebra, Wiley Eastern Ltd. New Delhi. 1977.
3. मध्यप्रदेश हिन्दी ग्रंथ अकादमी की पुस्तकें।

Reference Books:

1. 1. S. Luther and I. B. S. Passi: Algebra. Vol. I and II, Narosa Publishing House, 1997.
2. Shanti Narayan: A text Book of Modern Abstract Algebra, S. Chand and Company. New Delhi, 1967.
3. Surjeet Singh and Qazi Zameeruddin: Modern Algebra, Vikas Publishing House Pvt Ltd; Delhi, Eighth edition, 2006.

Suggested Digital Platforms Web links:

https://www.eshiksha.mp.gov.in/mpdhe
https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25

Suggested Equivalent online courses:

https://ugcmoocs.inflibnet.ac.in/index.php/courses/view ug/335

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods: Maximum Marks: 100 Continuous Comprehensive Evaluation (CCE): 40 Marks University Exam (UE): 60 Marks	
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	**Total Marks: 40**
External Assessment: University Exam (UE)	**Total Marks: 60**

Part A : Introduction			
Program: 2-Year	Class: Post-Graduate I-Year (Semester-2)	Year: 2025	Session: 2025-2026
Subject: Mathematics			

1	Course Code		
2	Course Title	**Topology-II (Theory)**	
3	Course Type	CC-22	
4	Pre-requisite (if any)	To study this course, a student must have had the subject Mathematics at Degree level (3 Year Degree Course).	
5	Course Learning Outcomes (CLO)	The course will enable the students to: 1. characterization and basic properties. 2. Recognize the compactness, sequentially and countably compact sets, Stone-Cech compactification. 3. Using the Tychonoff product topology in terms of standard subbase and its characterizations. 4. Able to prove Tychonoff's theorem, Countability and product spaces.	
6	Credit Value	5 Credits	
7	Total Marks	Max. Marks: 40 + 60	Min. Passing Marks: 40

Part B: Content of the Course		
Total No. of Lectures (in hours per week): 5 hours per week **Total Lectures:75 hours**		
Module	**Topics**	**No. of Lectures**
I	**Indian Knowledge System:** Contribution and biography of following Indian Mathematicians in Topology: Dr. Kapil Paranjape, Dr. Sankaran Viswanath	**17**

	Basie properties of compactness, Compactness and Finite Intersection Property, Compactness and Bolzano-Weierstrass Property, Heine Borel Theorem. Local compactness, Lindeloff Spaces and Theorem.	
	Suggested Activities: Discuss the applications of Finite Intersection Property and Bolzano-Weierstrass Property	
II	To-Spaces or Kolmogrov Spaces, Ti-Spaces or Quasi-separated Spaces, T2-Spaces or Hausdorff Spaces, T3-Spaces or Regular Spaces, T4-Spaces or Normal Spaces.	**18**
	Suggested Activities: Discuss how T-Spaces and T-Spaces be used in Machine Learning and Robotics.	
III	Completely Normal Spaces, Completely Regular Spaces, Tychonoff Spaces, One-Point Compactification, Stone-Cech compactification.	**10**
	Suggested Activities: Using One-Point Compactification end Stone-Cech compactification to solve the problems related to Machine Learning, and Robotics	
IV	Tychonoff product topology in terms of standard subbase and its characterizations, Projection Function, Characterization of Tychonoff product.	**15**
	Suggested Tychonoff product." Activities: Discuss the applications of Characterization of Tychonoff product	
V	Separation axioms and product spaces, Connectedness and product spaces, Compactness and product spaces, Tychonoft's theorem, Countability and product spaces.	**15**
	Suggested Activities: Tychonoff's: Discuss the applications of Compactness and product spaces, Tychonoff's theorem in Machine Learning and Robotics.	
Keywords/ Tags: Compactness in and topological product spaces, Local compactness, Separable spaces in topological space, Countability and product spaces.		

Part C - Learning Resources
Text Books, Reference Books, Other Resources
Suggested Readings:

Text Books:
3. मध्यप्रदेश हिन्दी ग्रंथ अकादमी की पुस्तकें।
1. G. 2017. F. Simmons: Introduction to Topology and Modern Analysis, MeGraw Hill Education, **2. J. R. Munkres: Topology,.Pearson; 2nd edition, 2015.** **3. मध्यप्रदेश हिन्दी ग्रंथ अकादमी की पुस्तकें।** **Reference Books:** **1. K. D. Joshi: Introduction to General Topology, New Age International Private Limited, 2017.** **2. T. B. Singh, Elements of Topology, CRC Press, Taylor & Francis, 2013.** **3. K. Chandrasekhara Rao: Topology, Narosa Publishing House, 2009.** **Suggested Digital Platforms Web links:**
Suggested Digital Platforms Web links: **https://www.cshiksha.mp.gov.in/mpdhe** **https://cpgp.inflibnet.ac.in/Home/ViewSubject?catid=25** **Suggested Equivalent online courses:** **https://ugcmoocs.intlibnet.ac.in/index.php/courses/view_ug/335**

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods: Maximum Marks: 100 Continuous Comprehensive Evaluation (CCE): 40 Marks University Exam (UE): 60 Marks	
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	**Total Marks: 40**
External Assessment: University Exam (UE)	**Total Marks: 60**

Part A : Introduction			
Program: 2-Year	Class: Post-Graduate I-Year (Semester-1)	Year: 2025	Session: 2025-2026
Subject: Mathematics			

1	Course Code		
2	Course Title	**Lebesgue Measure and Integration (Theory)**	
3	Course Type	CC-23	
4	Pre-requisite (if any)	To study this course, a student must have had the subject Mathematics at Degree level (3 Year Degree Course).	
5	Course Learning Outcomes (CLO)	The course will enable the students to: 1. Understand and identify Lebesgue outer measure. 2. Using of Integration of non-negative functions and apply Riemann and Lebesgue integrals. 3. Understand the four derivatives, Lebesgue differentiation theorem. 4. Understand the LP-spaces, Hölder and Minkowski inequalities. 5. Recognize the convergence in measure, convergence and almost uniform convergence.	
6	Credit Value	5 Credits	
7	Total Marks	Max. Marks: 40 + 60	Min. Passing Marks: 40

Part B: Content of the Course		
Total No. of Lectures (in hours per week): 5 hours per week **Total Lectures:75 hours**		
Module	**Topics**	**No. of Lectures**
I	**Indian Knowledge System:**	**16**

	Contribution and biography of following Indian Mathematicians in Lebesgue Measure and Integration: Dr. M. G. Nadkarni, Dr. R. Balakrishnan, Dr. K. R. Parthasarathy	
	Lebesgue outer measure, Measurable sets, Regularity of a measure, Measurable function, Borel and Lebesgue measurability of sets, non-measurable sets.	
	Suggested Activities: Discuss on applications of Lebesgue Outer Measure, and Measurable Sets in modern technology	
II	Lebesgue Measurable Function and its Properties, Step Function, Operations on Measurable Functions, Characteristic Function, Simple Function, Borel Measurable Function, Littlewood's three principles.	**14**
	Suggested Activities: Used in defining loss functions over continuous data distributions. Application of Characteristic Function in Machine Learning.	
III	Lebesgue Integral of a Bounded Function Over a Set of Finite Measure, Properties of Lebesgue Integral for Bounded Measurable Functions Integral of Non-Negative Measurable Functions, Integral in Economics, Signal Processing.	**15**
	Suggested Activities: Discuss on applications of Properties of the Lebesgue	
IV	The four derivatives, Functions of bounded variations, Lebesgue differentiation theorem, Differentiation and integration, Integral of Derivative.	**15**
	Suggested Activities: Discuss how Lebesgue Differentiation Theorem be used in Machine Learning. Finance and Thermodynamics.	
V	The LP-spaces, Convex functions, Jensen's inequality, Hölder and Minkowski inequalities for L-spaces, Completeness of LP, Convergence in measure, Almost uniform convergence.	**15**
	Suggested Activities: Analysing how L-spaces and Almost Uniform Convergence can be used in Machine Learning and Signal Processing.	
Keywords/ Tags: Lebesgue outer measure, Littlewood's three principles, Lebesgue Integral, The four derivatives, Hölder and Minkowski inequalities for LP-spaces.		

Part C - Learning Resources
Text Books, Reference Books, Other Resources
Suggested Readings: **Text Books:** 1. G. de Barra, Measure Theory and Integration, Wiley-Eastern Ltd., 1981. 2. मध्यप्रदेश हिन्दी ग्रंथ अकादमी की पुस्तकें।
Reference Books: **1. Walter Rudin, Principles of Mathematical Analysis (3rd Edition). McGraw-Hill, Kogakusha, 1976, International Student Edition.** **2. H. L. Roydcu, Real Analysis. Macmillan Publishing Co. Inc., 4th Edition, New York, 1993.** **3. K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, 1997.** **4. P. K. Jain and V. P. Gupta, Lebesgue Measure and Integration, New-Age International (P) Ltd., New Delhi, 1986.**
Suggested Digital Platforms Web links: https://www.cshiksha.mp.gov.in/mpdhe https://epgp.inflibnet.ac.in/Home/ViewSubject?catid-25 **Suggested Equivalent online courses:** https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/335

Part D: Assessment and Evaluation	
Suggested Continuous Evaluation Methods: Maximum Marks: 100 Continuous Comprehensive Evaluation (CCE): 40 Marks University Exam (UE): 60 Marks	
Internal Assessment: Continuous Comprehensive Evaluation (CCE)	**Total Marks: 40**
External Assessment: University Exam (UE)	**Total Marks: 60**

Part A : Introduction			
Program: 2-Year	Class: Post-Graduate I-Year (Semester-1)	Year: 2025	Session: 2025-2026
Subject: Mathematics			

1	Course Code		
2	Course Title	**Differential Geometry (Theory)**	
3	Course Type	CC-24	
4	Pre-requisite (if any)	To study this course, a student must have had the subject Mathematics at Degree level (3 Year Degree Course).	
5	Course Learning Outcomes (CLO)	The course will enable the students to: 1. Understand parametric representation of a curve and a surface, Osculating Plane. 2. Understand curvature and principal normal, Circle of curvature, Able to prove Frenet-Serret formulae. 3. Understand Locus of centre of curvature, Osculating sphere, Involutes and Evolutes of a curve. 4. Derive tangent plane to a surface, Understand Ruled surfaces. 5. Introduce with curvilinear co-ordinates, Understand Fundamental Magnitude of first order.	
6	Credit Value	5 Credits	
7	Total Marks	Max. Marks: 40 + 60	Min. Passing Marks: 40

Part B: Content of the Course		
Total No. of Lectures (in hours per week): 5 hours per week **Total Lectures:75 hours**		
Module	**Topics**	**No. of Lectures**
I	**Indian Knowledge System:**	**17**

	Contribution and biography of following Indian Mathematicians in Differential Geometry: Dr. K. Varadarajan. Dr. Rajendra Bhatia, Dr. M. S. Narasimhan	
	Curve in Space: Tangent to Curve, Curvature, Torsion, Frenet-Scret Formulae, Contact of a Curve and a Surface.	
	Suggested Activities: Discuss how Tangent to a Curve and Torsion be used in Robotics.	
III	Osculating Plane (Plane of Curvature), Helix, Osculating Circle (Circular Curvature), Locus of Centre of Circular Curvature, Osculating Sphere (Spherical Curvature), Locus of Centre of Spherical Curvature.	**18**
	Suggested Activities: Discuss on applications of Osculating Plane in Aerospace and Osculating Sphere in Aerodynamics.	
IV	Involute and Evolute Curve, Curvature and Torsion of Involute Curve, Curvature and Torsion of Evolute Curve.	**10**
	Suggested Activities: Discuss on applications of Curvature & Torsion of Involute in Biomechanics, Curvature & Torsion of Evolute in Neuroscience.	
V	Surface: First and Second Fundamental Form, Normal Curvature, Principal Curvature, Line of Curvature, Derivative of Unit Normal, Rodrigues Formula.	**15**
	Suggested Activities: Discuss how Normal Curvature he used in Biomechanics and Principal Curvatures can be used in Medical Imaging.	
VI	Jochi-Misthal Theorem, Angle Between Two Directions, Condition for Orthogonal Families of Curves, Euler's Theorem, Umbilics Points and Surface, Meunier's Theorem.	**15**
	Suggested Activities: Discuss on applications of Umbilic Points and Surfaces in Medical Imaging and Angle Between Directions in Robotics	
Keywords/ Tags: Curve in Space, Frenet-Seret Formula, Osculating Plane, Involute and Evolute Curve, Surface, Normal Curvature, Principal Curvature, Umbilics Points and Surface.		

Part C - Learning Resources
Text Books, Reference Books, Other Resources
Suggested Readings: **Text Books:** 1. R. S. Mishra, A course in Tensors with Applications to Riemannian Geometry, Pothishala Pvt. Ltd., Allahabad, 1965. 2. B. B.Sinha, Differential Geometry-An Introduction, Shyam Prakashan Mandir, Allahabad, 1978. 3. मध्यप्रदेश हिन्दी ग्रंथ अकादमी की पुस्तकें।
Reference Books: 1. C. E. Weatherburn, An Introduction to Tensor Calculus and Riemannian Geometry, Cambridge University Press, London, 1942 and Radha Publishing House Calcutta, Indian Edition, 1995. 2. T. J. Willmore, Differential Geometry, Oxford University Press, London, 1959 and Indian XI Edition, New Delhi, 1993 3. I. P. Eisenhart, Differential Geometry with the use of Tensors, Princeton University Press, New Jersey, 1949.
Suggested Digital Platforms Web links: https://www.eshiksha.mp.gov.in/mpdhe https://epgp.inflibnet.ac.in/Home/ViewSubject **Suggested Equivalent online courses:** https://nptel.ac.in/courses/111104095 https://ugcmoocs.inflibnet.ac.in/index.php/courses/view ug/364

Part D: Assessment and Evaluation
Suggested Continuous Evaluation Methods: Maximum Marks: 100 Continuous Comprehensive Evaluation (CCE): 40 Marks University Exam (UE): 60 Marks

Internal Assessment: Continuous Comprehensive Evaluation (CCE)	**Total Marks: 40**
External Assessment: University Exam (UE)	**Total Marks: 60**