SHRI GURU RAM RAI UNIVERSITY

[ESTD. BYGOVT.OF UTTARAKHAND,VIDE SHRIGURURAMRAI UNIVERSITY ACTNO.03OF 2017&RECOGNIZEDBYUGCU/S(2F) OF UGCACT1956]

MINUTES OF MEETING

FOURTH BOARD OF STUDIES MEETING IN MATHEMATICS AS PER NEP 2020

A meeting of all the members of the Board of Studies in Mathematics was held on10th Jan 2022 from 11:00 am onwards at School of Basic & Applied Sciences, Shri Guru Ram Rai University, Patel Nagar, Dehradun. The following members were present:

PROF. (DR.) ARUN KUMAR, DEAN, SBAS, SGRR UNIVERSITY, DEHRADUN
CHAIRPERSON

DR. A S PARMAR (ASSISTANT PROFESSOR, DEPT. OF MATHEMATICS)
CONVENER

PROF. (DR.) R C DIMRI, PROFESSOR, DEPARTMENT OF MATHEMATICS, H.N.B. GARHWAL CENTRAL UNIVERSITY
EXTERNAL EXPERT-1

DR. U. S. RANA, ASSOCIATE PROFESSOR & HEAD, DEPT. OF MATHEMATICS D.A.V P.G COLLEGE, DEHRADUN
EXTERNAL EXPERT-2

DR. RASHI BHARGAVA, ASSISTANT PROFESSOR, DEPT. OF MATHEMATICS, SBAS, SGRR UNIVERSITY, DEHRADUN
MEMBER

PROCEEDINGS AND RESOLUTIONS:

The members of the BOS discussed the agenda item wise and resolutions were made accordingly

Agenda No. 1: To confirm the minutes of third Board of Studies in Mathematics held on 19th June 2021.

Resolution: The board confirmed and approved the last Board of Studies meeting held on **19th June 2021.**

Agenda No. 2: Implementation of NEP-2020 from the Academic Session 2022-23 &Inclusion and finalization of Program outcomes (POs), Program specific outcomes (PSOs), Course outcomes (COs) of B.Sc. (Mathematics as per NEP 2020 and CBCS)

Resolution: It was recommended by the members of the board that from the academic session 2022-23 implementing NEP in the UG course and course outcomes should be included in the curriculum. The Program outcomes (POs), Program specific outcomes (PSOs), Course outcomes (COs) for B.Sc. Mathematics were discussed in detail with the honorable members and all the members resolved to approve the same from the honorable external expert.

Agenda No. 3: To consider distribution of courses for all semesters in B.Sc. (Mathematics as per CBCS/NEP guidelines) as per CBCS/NEP for the Academic Session 2022-23

Resolution: The distribution of courses for all semesters in the UG program as per CBCS/NEP 2020 was discussed in detail with the honorable members and it was resolved to approve and implement the same for the academic session 2022-23 with the following suggestions & recommendation:

(i) External BOS members suggested that the course/course contents may be reshuffled in the next BOS.

(ii) External BOS members also recommended that the credits for open/minor electives should be of 2 credits (applicable only if state guidelines revised)

Agenda No. 4: Allotment and description of course code and credits to different courses in the UG programme for all semesters.

Resolution:

The course codes in the UG programme were allotted as per **Uttarakhand State Govt. Guidelines** and University norms and all the members resolved to approve the same. The credit system in the UG were approved as per UGC norms/NEP guidelines. The theory lectures were of 4 credits each. Each lab course was of 2 credits for UG course programme in 1^{st} to 3^{rd} year and 6 credit for lab course in 4^{th} year where the teaching hours of lab course of each credit was of 2 hours.

Agenda No. 5: Medium of instruction, question paper pattern, medium of examination, and duration of examination, allotment of marks in internal and external exams.

Resolution:

- The members were of the view and recommended that the medium of instruction would be English medium/Hindi medium for UG Course program as per SGRR University norms.
- It was resolved by all the members that the duration of the End term examination would be as per the guidelines issued by the Board of Examination SGRR University from time to time including the duration of Lab Course examinations.
- Each paper would be of 100 marks. The distribution of mid-term and end term examination marks will be as per guidelines issued by the Board of Examination SGRR University from time to time.

Agenda No. 6: Evaluation pattern and distribution of marks.

10/1/2023

Resolutions: All the members of BOS were of the view that the evaluation pattern and distribution of marks should be at par with other subjects and should follow university norms to bring uniformity.

The meeting ended with the vote of thanks.

PROF. (DR.) R C DIMRI,
(EXTERNAL EXPERT)

DR. U. S. RANA

(EXTERNAL EXPERT)

10/01/2023

PROF. (DR.) ARUN KUMAR
(CHAIRPERSON)

DR. A S PARMAR

(CONVENER)

DR RASHI BHARGAVA.

(MEMBER)

SHRI GURU RAM RAI UNIVERSITY

[ESTD. BYGOVT.OF UTTARAKHAND, VIDE SHRIGURURAMRAI UNIVERSITY ACTNO.03OF 2017&RECOGNIZEDBYUGCU/S(2F)OF UGCACT1956]

DEPARTMENT OF MATHEMATICS,
SCHOOL OF BASIC AND APPLIED SCIENCES,
S.G.R.R UNIVERSITY, DEHRADUN-248001, UTTARAKHAND

Proposed Syllabus based on NEP - 2020
for

B.Sc. in Mathematics/

B.Sc. (with Research) in Mathematics

FIRST THREE YEARS OF UNDER-GRADUATE (UG) PROGRAMME IN MATHEMATICS

AS PER GUIDELINES OF COMMON MINIMUM SYLLABUS BY UTTARAKHAND GOVERNMENT ACCORDING TO NATIONAL EDUCATION POLICY-2020
(W.E.F. ACADEMIC SESSION 2022-23)

MEMBER OF BOARD OF STUDIES

DEPT OF MATHEMATICS
SCHOOL OF BASIC AND SCIENCE
SHRI GURU RAM RAI UNIVERSITY
PATEL NAGAR, DEHRADUN, UTTARAKHAND

S. no.	Name & Designation	Signature
1	PROF. (DR.) ARUN KUMAR CHAIRPERSON	
2	DR. A S PARMAR CONVENER	
3	PROF. (DR.) R C DIMRI EXTERNAL EXPERT-1	
4	DR. U. S. RANA EXTERNAL EXPERT-2	
5	DR. RASHI BHARGAVA MEMBER	

SEMESTER-WISE TITLES OF THE PAPERS IN B.SC
(MATHEMATICS AS ONE OF THE MAJOR SUBJECT)

Year	Sem.	Course Code	Paper Title	Theory/Practical	Contact Hours	CREDIT
CERTIFICATE IN SCIENCE (MATHEMATICS AS ONE OF THE MAJOR SUBJECT)						
FIRST YEAR	I	MATMC101/ MATME101	Differential Calculus	THEORY	6	6
	II	MATMC201/ MATME201	Integral and Vector Calculus	THEORY	6	6
DIPLOMA IN SCIENCE (MATHEMATICS AS ONE OF THE MAJOR SUBJECT)						
SECOND YEAR	III	MATMC301/ MATME301	ODE & PDE-I	THEORY	6	6
	IV	MATMC401/ MATME401	Real Analysis-I	THEORY	6	6
BACHELOR OF SCIENCE (MATHEMATICS AS ONE OF THE MAJOR SUBJECT)						
THIRD YEAR	V	MATMC501/ MATME501	Abstract Algebra-I	THEORY	4	4
		MATMC502/ MATME502	Integral Transform	THEORY	4	4
		MATMC503/ MATME503	Project-I		0	2
	VI	MATMC601/ MATME601	Complex Analysis-I	THEORY	4	4
		MATMC602/ MATME602	Analytical Geometry	THEORY	4	4
		MATMC603/ MATME603	Project-II		0	2
BACHELOR OF SCIENCE (WITH RESEARCH) IN MATHEMATICS						
FOURTH YEAR	VII	MATMC701	ODE & PDE -II	THEORY	4	4
		MATMC702	Abstract Algebra –II	THEORY	4	4
		MATMC703	Real Analysis –II	THEORY	4	4
		MATMC704	Complex Analysis-II	THEORY	4	4
		MATMP705	Lab course in Latex	Practical	4	4

		MATMR706	Research Project -I/ Dissertation		6	6
	VIII	MATMC801	Abstract Algebra –III	THEORY	4	4
		MATMC802	Operations Research	THEORY	4	4
		MATMC803	Metric Spaces	THEORY	4	4
		MATMC804	Discrete Structures	THEORY	4	4
		MATMP805	Lab course in MATLAB	Practical	4	4
		MATMR806	Research Project -II/ Dissertation		6	6

	Minor Elective (ME) Courses/Open Elective Courses (4 Credits each)				Contact Hours			Credit
S. No	**YEAR**	**Semester**	**Course Code**	**Name of The Course**	**L**	**T**	**P**	**C**
1.	I	I /II	MAT-OE-001	Fundamental Mathematics-I	4	0	0	4
2.	II	III/IV	MAT-OE-002	Fundamental Mathematics -II	4	0	0	4

	Vocational Course/ Skill Enhancement Courses (3 Credits each)				Contact Hours			cred
S. No	**YEAR**	**Semester**	**Course Code**	**Name of The Course**	**L**	**T**	**P**	C
1.	I	I	MATVC102	Mathematical Finance	3	0	0	3
2.		II	MATVC202	Bio Mathematics	3	0	0	3
3.	II	III	MATVC302	Internship-1	0	0	0	3
4		IV	MATVC402	Vedic Mathematics	3	0	0	3

	Vocational Course/ Skill Enhancement Courses (3 Credits each)				Contact Hours			cred
S. No	**YEAR**	**Semester**	**Course Code**	**Name of The Course**	**L**	**T**	**P**	
1.	I	I	COCCR103	Communication Skills	4	0	0	0
2.		II	COCCR203	Environment Studies and Value Education	4	0	0	0
3.	II	III	COCCR305	Management Paradigms From Bhagavat Gita	4	0	0	0
4		IV	COCCR405	Meditation	4	0	0	0
5	III	V	COCCR506	Vedic Science	4	0	0	0
6		VI	COCCR606	Essence of Indian Traditional Knowledge	4	0	0	0

1. **Subject prerequisites:**

1. For Semester I: 12th pass with subjects Physics, Chemistry & Mathematics
2. For Semester II: Passed Semester I with Mathematics
3. For Semester III: Passed Semester II with Certificate Course in Science
4. For Semester IV: Passed Semester III
5. For Semester V: Passed Semester IV with Diploma in Science
6. For Semester VI: Passed Semester V

2. **Programme Objectives:**

The undergraduate degree course in Mathematics aims to provide:

1) In-depth knowledge in Mathematics through understanding of key mathematical concepts, principles, theories and their applications.
2) inculcate strong interest in learning mathematics,
3) evolve broad and balanced knowledge and understanding of definitions, key concepts, principles and theorems in Mathematics,
4) enable learners/students to apply the knowledge and skills acquired by them during the programme to solve specific theoretical and applied problems in mathematics,
5) develop in students the ability to apply relevant tools developed in mathematical theory to handle issues and problems in social and natural sciences,
6) provide students with sufficient knowledge and skills that enable them to undertake further studies in mathematics and related disciplines,

3. **PROGRAMME OUTCOMES:**

The learning outcomes of the undergraduate degree course in Mathematics are as follows:

PO1) Communicate mathematics effectively by written, computational and graphic means.
PO2) Create mathematical ideas from basic axioms
PO3) Gauge the hypothesis, theories, techniques and proofs provisionally.
PO4) Utilize mathematics to solve theoretical and applied problems by critical understanding, analysis and synthesis.
PO5) Identify applications of mathematics in other disciplines and in the real-world, leading to enhancement of career prospects in plethora of fields and research.
PO6): It is to give foundation knowledge for the students to understand basics of mathematics including applied aspect for the same
PO7): It is to develop enhanced quantitative skills and pursuing higher mathematics and research as well.
PO8): Students will be able to develop solution-oriented approach towards various issues related to their environment.
PO9): Students will become employable in various govt. and private sectors
PO10): Scientific temper in general and mathematical temper in particular will be developed in students.
PO11): Enhance the ability to develop solution-oriented approach towards various real world problems.
PO12): Evolve in-depth knowledge of various branches of pure and applied mathematics.

4. **PROGRAM SPECIFIC OUTCOMES (PSOS)**

1. Certificate in Science will give students a basic knowledge of mathematics. Two other major subjects needed for the study o other courses in forthcoming years. It will enable students to join the diploma course (semester III and IV) in any University o College of Higher Education in Uttarakhand
2. Diploma will enable students to join the Bachelor of Science course(semester V and VI) in Any University or College of Higher education in Uttarakhand
3. Upon completion of a degree, students will be eligible for Masters Degree in any of the major subject in any of the highe

institutions of India. It will gives students an ability of critical thinking and scientific study of any discipline. Students afte getting Bachelorsdegreewillbeeligibleforallthecompetitiveexaminationswheregraduationisanessential qualification.

4. A very nice and major outcomes NEP term is that, It gives the opportunity end of the every year to get the job and change the University or programme. Hence After successful completion of every year of this programme, students will be able to get the job in various field

4.1 Programme Specific Outcome OF UG I Year / Certificate course in Science

After completing this certificate course, the student should have:

PSO1): Student should be able to possess recall basic idea about mathematics which can be displayed by them.
PSO2): Student should have adequate exposure to many aspects of mathematical sciences.
PSO3): Student is equipped with problem-solving skills .
PSO4): Student should be able to apply their skills and knowledge in various fields of studies including, science, engineering, commerc and management etc.

4.2 Programme Specific Outcome OF UG II Year / Diploma course in Science

After completing this course, the student will have:

PSO1): understand the Advanced Mathematics and its applications
PSO2): compete in various national and international competitive examinations.

PSO3): Students are able to formulate and develop mathematical arguments in a logical manner.
PSO4): Students will become employable in various govt. and private sectors

4.3 Programme Specific Outcome OF UG III Year / Bachelor of Science

After completing this course, the student will have:

PSO1): Basic knowledge in the field of Modern Pure and Applied Mathematics, which is most important at both post graduate and Research level.
PSO2): sufficient subject matter competence and enable students to prepare for various competitive examinations such as IIT-JAM, GATE, GRE, UGC-CSIR, NET/JRF and Civil Services Examinations etc.
PSO3): Students are motivate and prepare for research studies in mathematics and related fields.
PSO4): Student is equipped with mathematical modeling ability, critical mathematical thinking, and problem-solving skills etc.

4.4 Programme Specific Outcome OF UG IV Year / Bachelor of Science (with Research) in Mathematics

After completing this course, the student will have:

PSO1): Have a strong foundation in core areas of Mathematics, both pure and applied.
PSO2): Student should be able to think in a critical manner and develop problem solving skills.
PSO3): Communicate mathematical ideas effectively, in writing as well as orally.
PSO4): Able to formulate and develop mathematical arguments in a logical manner.

5. Eligibility for admission:

Any candidate who has passed the Plus Two of the Higher Secondary Board of Examinations in any state recognized as equivalent to the Plus Two of the Higher Secondary Board in with not less than 45 % marks in aggregate is eligible for admission, However, SC/ST, OBC and other eligible communities shall be given relaxation as per University rules.

SEMESTER - I

COURSE NAME: DIFFERENTIAL CALCULUS

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	15	15	70

Course code : MATMC101/ MATME101					
Course Name : Differential Calculus					
Semester /Year : **SEMESTER - I**					
	L	T	P	C	
	6	0	0	6	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

Student will be able to understand differentiation and fundamental theorem in differentiation and various rules. Verify the value of th limit of a function at a point using the definition of the limit. Learn to check function is continuous understand the consequences of th intermediate value theorem for continuous functions.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Identify the notions of limit of a sequence and convergence of a series of real numbers.
CO2	Interpret tracing of curves, different theorem based questions.
CO3	Examine successive differentiation by Leibnitz theorem, Indeterminate forms.
CO4	Evaluate Limit and Continuity, Tangents and normal, Indeterminate forms.
CO5	Distinguish Curvature, Asymptotes, Singular points, Tracing of curves.
CO6	Solve limit, normal, singular points, maxima minima.

Course Syllabus

Unit	Content of Unit	No. o Hour
I	Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions. Cauchy's definition, Uniform continuity, boundedness theorem, Intermediate value theorem, extreme value theorem, Darboux's intermediate value theorem for derivatives and Chain rule.	15
II	Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions, Tangents and normals.	15
III	Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.	15
IV	Rolle' s theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, ex, log(l+x), (1+x)m, Maxima and Minima, Indeterminate forms.	15

SUGGESTED READINGS:

Text Books:

TB1. Ganesh Prasad, *A textbook for differential calculus*, London Green & co.

TB2. Shanti Narayan , Differential Calculus, S.Chand& co.

Reference Books:

RB1. RaiSinghania, M. D. Advanced Differential Equations. S. Chand &Company Ltd., New Delhi, 2001.

RB2. Simmons, G. F. Differential Equations with Applications and Historical Notes. 2nd edition, Tata McGraw Hill, New Delhi, 2016.

COURSE NAME: INTEGRAL AND VECTOR CALCULUS

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	15	15	70

Course code	:	MATMC201/ MATME201			
Course Name	:	Integral and Vector Calculus			
Semester /Year	:	**SEMESTER - II**			
		L	T	P	C
		6	0	0	6

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Describe various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.
CO2	Understand the genesis of ordinary differential equations.
CO3	Apply the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.
CO4	Classify mathematical models in the form of ordinary differential equations to suggest possible solutions of the day to day problems arising in physical, chemical and biological disciplines.
CO5	Evaluate differential equation of first order, Linear homogenous equations.
CO6	Solve Charpit's method based questions, Simultaneous differential equations.

Course Syllabus

Unit	Content of Unit	No. o Hour
I	Integral as a limit of sum, Properties of Definite integrals, Fundamental theorem of integral calculus, Summation of series by integration, Infinite integrals, Differentiation and integration under the integral sign. Beta function, Properties and various forms, Gamma function, Recurrence formula and other relations, Relation between Beta and Gamma function, Evaluation of integrals using Beta and Gamma functions	15
II	Double integrals, Repeated integrals, Evaluation of Double integrals, Double integral in polar coordinates, Change of variables, Change of order of integration in Double integrals, Triple integrals, Evaluation of Triple integrals, Drichlet's theorem and its Liovelle's extension. Area bounded by curves (quadrature), Rectification (length of curves), Volumes and Surfaces of Solids of revolution	15
III	Scalar and vector product of three vectors, product of four vectors. Reciprocal vectors. Vector differentiation. Scalar Valued point functions, vector valued point functions, derivative along a curve, directional derivatives.	15

	Gradient of a scalar point function, geometrical interpretation of grad Φ, character of gradient as a point function. Divergence and curl of vector point function, characters of Div $\bar{f}$ and Curl $\bar{f}$ as point function, examples. Gradient, divergence and curl of sums and product and their related vector identities. Laplacian operator.	
IV	Vector Integration, Line integral, Surface integral, Volume integral, Theorems of Gauss, Green & Stokes and problems and Applications based on these theorems for evaluation of double and triple integrals.	15

SUGGESTED READINGS:

Text Books:

TB1. Shanti Narayan & P.K. Mittal, Integral Calculus, S Chand, 2005

TB2. Shanti Narayna : A Text Book of Vector Calculus. S. Chand & Co., New Delhi.

Reference Books:

RB1. Murrary R. Spiegal : Theory and Problems of Advanced Calculus, Schaum Publishing Company, New York.

RB2. Murrary R. Spiegal : Vector Analysis, Schaum Publisghing Company, New York.

RB3. N. Saran and S.N. Nlgam. Introduction to Vector Analysis, Pothishala Pvt. Ltd., Allahabad.

RB4. T.M. Apostol, Calculus Vol. II, John Wiley Publication, 1974

RB5. G.B. Thomas and R.L. Finney, *Calculus,* 9th Ed., Pearson Education, Delhi, 2005.

RB6. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus,* 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.

RB7. H. Anton, I. Bivens and S. Davis, *Calculus,* 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.

RB8. Suggestive digital platforms web links: NPTEL/SWAYAM/MOOCS

COURSE NAME: ODE & PDE -I

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	15	15	70

Course code	:	MATMC301/ MATME301			
Course Name	:	ODE & PDE -I			
Semester /Year	:	**SEMESTER - III**			
		L	T	P	C
		6	0	0	6

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

Student will be able to solve first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous. Student will be able to find the complete solution of a non-homogeneous differential equation as a linear combination of the complementary function and a particular solution. Student will have a working knowledge of basic application problems described by second order linear differential equations with constant coefficients.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Describe various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.
CO2	Understand the genesis of ordinary differential equations.
CO3	Apply the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.
CO4	Classify mathematical models in the form of ordinary differential equations to suggest possible solutions of the day to day problems arising in physical, chemical and biological disciplines.
CO5	Evaluate differential equation of first order, Linear homogenous equations.
CO6	Solve Charpit's method based questions, Simultaneous differential equations.

Course Syllabus

Unit	Content of Unit	No. o Hour
I	First order exact differential equations. Integrating factors, rules to find an integrating factor.	15
II	First order higher degree equations solvable for x, y, p. Methods for solving higher-order differential equations,Basic theory of linear differential equations, Wronskian, and its properties. Solving a differential equation by reducing its order.	15
III	Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters, The Cauchy-Euler equation, Simultaneous differential equations, Total differential	15

	equations.	
IV	Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.	15

SUGGESTED READINGS:

Text Books:

TB1. M.D. Raisinghania: Ordinary and Partial Differential Equations S. Chand & Company Ltd., New Delhi, 2001.

TB2. M. D. Raisinghania, Advanced Differential Equations. S. Chand & Company Ltd., New Delhi, 2001.

Reference Books:

RB1. Schaum's, Outlines of Differential Equations, McGraw-Hill, International Education Pvt Ltd.

RB2. B. Rai, D.P. Choudhary & H. J. Freedman, A Course in Differential Equations, Narosa, 2002

RB3. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.

RB4. I. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition, 1967.

RB5. G.F. Simmons, Differential Equations with Application and Historical Notes, Tata –McGraw Hill 2002

RB6. Suggested digital platform: NPTEL/SWAYAM/MOOCs

COURSE NAME: REAL ANALYSIS-I

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	15	15	70

Course code	:	MATMC401/ MATME401			
Course Name	:	**Real Analysis** -I			
Semester /Year	:	**SEMESTER - IV**			
		L	T	P	C
		6	0	0	6

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

Describe fundamental properties of the real numbers that lead to the formal development of real analysis. Comprehend rigorous arguments developing the theory underpinning real analysis. Demonstrate an understanding of limits and how they are used in sequences, series, Construct rigorous mathematical proofs of basic results in real analysis

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Select the limit superior, limit inferior, and the limit of a bounded sequence.
CO2	Understand many properties of the real line $\mathbb{R}$ and learn to define sequence in terms of functions from $\mathbb{R}$ to a subs of $\mathbb{R}$.
CO3	Apply the ratio, root and alternating series and limit comparison tests for convergence and absolute convergence c an infinite series of real numbers.
CO4	Classify some of the properties of Riemann integral functions and the applications of the fundamental theorems of integration.
CO5	Test the convergence of the infinite series by Ratio test, P test, Root test etc
CO6	Solve the questions based on M, Mn test and Leibnitz test etc.

Course Syllabus

Unit	Content of Unit	No. o Hour
I	Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano-Weierstrass theorem.	15
II	Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence (monotone convergence theorem without proof).	15
III	Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series,	15

IV	Leibnitz's test (Tests of Convergence without proof). Definition and examples of absolute and conditional convergence. Sequences and series of functions, Point-wise and uniform convergence. Mn-test, M-test.	15

SUGGESTED READINGS:

Text Books:

TB1. S.C. Malik & Savita Arora, Mathematical Analysis, New age international publisher.

TB2. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis, John Wiley and Sons (Asia) P. Ltd., 2000.

Reference Books:

RB1. K.A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003.

RB2. T. M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.

COURSE NAME: ABSTRACT ALGEBRA-I

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	15	15	70

Course code	:	MATMC501/ MATME501			
Course Name	:	Abstract Algebra -I			
Semester /Year	:	**SEMESTER - V**			
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

Student will be able to solve the problems of abelian and non abelian groups. The definition of Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups etc.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Definition of groups, subgroups, cyclic subgroups and rings.
CO2	Understand the theorems and problems regarding groups and rings etc.
CO3	Apply the properties of groups and rings to solve the problems.
CO4	Distinguish various problems regarding fields, integral domain, ideals.
CO5	Evaluate Cyclic groups from number systems, complex roots of unity, circle group, Subrings and ideals, Integral domains and fields, examples of fields: Zp, Q, R, and Cetc.
CO6	Solve the commutator subgroup of group, examples of center of a group etc.

Course Syllabus

Unit	Content of Unit	No. o Hour
I	Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers under addition modulo n and the group U(n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group.	15
II	The general linear group GLn (n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle,(iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions, Subgroups, cyclic subgroups.	15
III	The concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group.Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.	15
IV	Definition and examples of rings, examples of commutative and non-commutative rings: rings from number systems,	15

	Zn the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Zp, Q, R, and C.	

SUGGESTED READINGS:

Text Books:

TB1. V. K. Khanna and S. K. Bhambri, A course in Abstract Algebra, Vikas Publishing House Pvt (Ltd), 2014.

TB2. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.

Reference Books:

RB1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.

RB2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.

RB2. Suggested digital platform: NPTEL/SWAYAM/MOOCs

COURSE NAME: INTEGRAL TRANSFORM

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	15	15	70

Course code : MATMC502/ MATME502					
Course Name : **Integral Transform**					
Semester /Year : **SEMESTER - V**					
	L	T	P	C	
	4	0	0	4	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

Student will be able to .

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Knowledge of
CO2	Understand and Describe the ideas of Fourier and Laplace Transforms and indicate their applications.
CO3	find the integral transform, Laplace transform, inverse Laplace transform and Fourier transform. This course basically develops a problem solving skill in the students.
CO4	Use Fourier and Laplace transform for solving boundary value problems.
CO5	Evaluate the questions based on etc.
CO6	Develop the related results etc.

Course Syllabus

Unit	Content of Unit	No. o Hour
I	Integral Transforms: Definition, Kernel. Laplace Transforms: Definition, Existence theorem, Linearity property, Laplace transforms of elementary functions, Heaviside Step and Dirac Delta Functions, First Shifting Theorem, Second Shifting Theorem, Initial-Value Theorem, Final-Value Theorem, The Laplace Transform of derivatives, integrals and Periodic functions.	15
II	Inverse Laplace transforms: Inverse Laplace transforms of simple functions, Inverse Laplace transforms using partial fractions, Convolution, Solutions of differential and integro-differential equations using Laplace transforms. Dirichlet's condition,	15
III	Fourier series: Fourier series, Trigonometric Fourier Series and its convergence, Fourier series of even and odd functions, Gibbs phenomenon, Fourier half-range series, Parseval's identity, Complex form of Fourier series. Fourier expansion of piecewise monotonic functions, Half and full range expansions,	15
IV	Fourier Transforms: Fourier transforms (finite and infinite), Fourier Complex Transforms, Fourier sine and cosine transforms, Properties of Fourier Transforms, Inverse Fourier transforms. Application of Fourier transforms to Boundary Value Problems.	15

SUGGESTED READINGS:

Text Books:

TB1. M. D. Raisinghania, Advanced Differential Equations. S. Chand & Company Ltd., New Delhi, 2001.

Reference Books:

RB1. R.K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, Narosa Publishing House, 2009.
RB2. L. Debanth and D. Bhatta, Integral Transforms and their Applications. 2 nd Ed. Taylor and Francis Group, 2007.
RB2. Murry R. Spiegal: Laplace Transform (SCHAUM Outline Series), McGraw-Hill.
RB2. Ronald N. Bracewell: The Fourier transforms and its applications, Mcgraw Hill.
RB2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons. 2011
RB2. Suggested digital platform: NPTEL/SWAYAM/MOOCs

COURSE NAME: PROJECT –I

Examination Scheme:

Components	I[st] internal	II[nd] Internal	External (ESE)	
			Report	Presentation
Weightage (%)	15	15	50	20

Note: Examination Scheme of this course may vary as per University/NEP Rules

Course code	:	MATMC503/ MATME503			
Course Name	:	**PROJECT –I**			
Semester /Year	:	**SEMESTER - V**			
			L	T	P	C
			2	0	0	2

L - Lecture T – Tutorial P – Practical C – Credit

COURSE NAME: COMPLEX ANALYSIS-I

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	15	15	70

Course code	:	MATMC601/ MATME601			
Course Name	:	**COMPLEX ANALYSIS-I**			
Semester /Year	:	**SEMESTER - VI**			
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

Compute sums, products, quotients, conjugate, modulus, and argument of complex numbers · Define and analyse limits and continuity for complex functions as well as consequences of continuity. Conceive the concepts of analytic functions and will be familiar with the elementary complex functions and their properties ·

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Gain knowledge of sketching different surfaces like parabola, ellipse etc. Identify the isolated singularities of a function and determine whether they are removable, poles, or essential.
CO2	Understand the significance of differentiability for complex functions and be familiar with the Cauchy-Riemann equations.
CO3	Apply the concept and consequences of analyticity and the Cauchy-Riemann equations and Illustrate the related problems .
CO4	Distinguish the properties of various terms. Analyze functions as Taylor, power and Laurent series, find residues and Evaluating complex integrals using the residue theorem.
CO5	Discriminate Analytic functions, exponential function, limits, Liouville's theorem and mappings etc, Evaluate the problems.
CO6	Write the techniques for Limits, continuity, derivatives of functions ,upper bounds ,Taylor and Laurent series and construct the related solutions.

Course Syllabus

Unit	Content of Unit	No. o Hours
I	Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas,	15
II	Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of	15

	functions.	
III	Definite integrals of functions.Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals.Cauchy- Goursat theorem, Cauchy integral formula.	15
IV	Liouville's theorem and Taylor and Laurent series, and its examples.	15

SUGGESTED READINGS:

Text Books:

TB1. S Ponnusamy, Functions of Complex Analysis, Narosa, 2005
TB2. Shanti Narain , Function of Complex Variable, S Chand, 2005

Reference Books:

RB1. J.W. Brown and R.V. Churchill, Complex Variables and Applications, McGraw Hill International Edition, 2009.
RB2. J.B. Conway, Function of One Complex Variable, Narosa, Delhi.
RB3. Suggested digital platform: NPTEL/SWAYAM/MOOCS

COURSE NAME: ANALYTICAL GEOMETRY

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	15	15	70

Course code	:	MATMC602/ MATME602			
Course Name	:	**Analytical Geometry**			
Semester /Year	:	**SEMESTER - VI**			
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

Introduction to analytical geometry of 2 dimensional. Study of lines in 2 and 3 dimension. Finding equation in various form of line, circle, ellipse, sphere, cones etc. Give the knowledge of geometry using maxima software.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Gain knowledge of sketching different surfaces like parabola, ellipse etc.
CO2	Understand the quadratic equations representing lines etc.
CO3	Illustrate the graphing standard quadric surfaces like cone ellipsoid etc.
CO4	Distinguish the properties of various surfaces.
CO5	Evaluate the General equation of second degree, Central coincides, Tangent plane, Director sphere, Normal etc.
CO6	Write the techniques for sketching parabola, graphing standard quadric surfaces like cone, ellipsoid etc.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Introduction of parabola, techniques for sketching parabola.	15
II	Ellipse and hyperbola, Reflection properties of parabola, ellipse and hyperbola, Classification of quadratic equations representing lines	15
III	Sphere, Cone, Cylindrical Surfaces, Spheres, Cylindrical surfaces. Illustrations of graphing standard quadric surfaces like cone, ellipsoid. Central Conicoids.	15
IV	General equation of second degree, Central conicoids, Tangent plane, Director sphere, Normal, Plane of contact, Polar plane, Conjugate plane and conjugate points.	15

SUGGESTED READINGS:

Text Books:

TB1. Shanti Narayan and P.K. Mittal, Analytical Solid Geometry by Published by S. Chand & Company Ltd. 7th Edition.
TB2. P.K. Jain and Khalil Ahmad : A Textbook of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd. 1999.

Reference Books:

RB1. R.J.T. Bill, Elementary Treatise on Coordinate Geometry of Three Dimensions, McMillan India Ltd., 1994.
RB1. P.R. Vittal, Analytical Geometry 2d & 3D, Pearson, 2013
RB1. S.L. Loney, The Elements of Coordinate Geometry, McMillan and Company, London. 2018
RB1. Suggested digital platform: NPTEL/SWAYAM/MOOCs

COURSE NAME: PROJECT –II

Examination Scheme:

Components	I[st] internal	II[nd] Internal	External (ESE)	
			Report	Presentation
Weightage (%)	15	15	50	20

Note: Examination Scheme of this course may vary as per University/NEP Rules

Course code	:	MATMC603/ MATME603			
Course Name	:	**PROJECT –II**			
Semester /Year	:	**SEMESTER - VI**			
			L	T	P	C
			2	0	0	2

L - Lecture T – Tutorial P – Practical C – Credit

COURSE NAME: ODE & PDE -II

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	: MATMC701				
Course Name	: **ODE & PDE -II**				
Semester /Year	: **SEMESTER - VII**				
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

The aims of this course is to familiarize the learner with elementary terms like as Wronskian, Ordinary points, Regular and singular points of ODE and Classification of PDE after that Picard iteration methods, Uniqueness and existence theorem of ODE, and some standard ODE: Legendre's and Bessel's differential equations, solution of some standard linear and non linear PDE.

Course Outcomes (Cos): After completion of this course the student will be able to the following

CO1.	Remembering elementary terms like as Wronskian, Ordinary points, Regular and singular points of ODE and all other terms related to ODE and PDE etc.
CO2.	Understand the ODE, PDE problems and Frobenius series solution for Legendre's and Bessel's differential equations with generating functions and Uniqueness and existence theorem etc.
CO3.	Classification of PDE of 2nd order and canonical forms, Concept of Method of separation of variables and other problems s related to ODEs and PDEs.
CO4.	Analysis the theory of ordinary differential equations through applications, methods of solution and numerical approximations like as Picard iteration methods.
CO5.	Determine what function or functions satisfy the differential equations.
CO6.	Develop new solutions related to PDE and ODE.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Ordinary differential equations: Qualitative properties of solution, Oscillation, Wronskian, Sturm separation and comparison theorem, Picard iteration methods, Uniqueness and existence theorem.	12
II	Ordinary points, Regular and singular points, Frobenius series solution for Legendre's and Bessel's differential equations with generating functions.	12
III	Classification of PDE of 2nd order and canonical forms, Concept of separation of variable solution.	12
IV	Solution of heat diffusion, Laplace and wave equations, Non-linear partial differential equation of second order.	12

SUGGESTED READINGS:

1. Simmons, G. F.; Differential Equations with Applications and Historical Notes. 2nd edition, Tata McGraw Hill, New Delhi, 2016.

2. Evans, L. C.; Partial Differential Equations, 2nd edition, The Orient Blackswan, 2014.
3. Ross, S. L.; Differential Equations. 3rd edition, Wiley India, 2007.
4. Sneddon, I. N.; Elements of Partial Differential Equations. Dover Publications, 2006.
5. Raisinghania, M. D.; Advanced Differential Equations. S. Chand & Company Ltd., New Delhi, 2001.
6. Reid, W. T.; Ordinary Differential Equations. John Wiley and Sons, New York, 1971.
7. Rai, B., Chaudhary, D.P. & Freedman, H.I.; A Course in ODE : Alpha Sci. Int. Ltd.

COURSE NAME: ABSTRACT ALGEBRA- II

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	MATMC702			
Course Name	:	**ABSTRACT ALGEBRA- II**			
Semester /Year	:	**SEMESTER - VII**			
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Objectives: The aims of this course is to familiarize the learner with Embedding of rings, Ring of residue classes, Euclidean ring, Module, field extension, Roots of polynomials, Splitting field, and Galois group.

Course Outcomes (Cos): After completion of this course the student will be able to the following

CO1.	Define all aspects of Abstract Algebra.
CO2.	Explain Homomorphism, Endomorphism, Automorphism, Inner automorphism, Kernel of a homomorphism, Fundamental theorem on homomorphism of group, Group of automorphisms , Results on group homomorphism. Maximal subgroups, Ideals, Algebra of ideals, Principal ideal ring etc.
CO3.	Use algebraic methods to solve a variety of problems involving exponential, logarithmic, polynomial, and rational functions, systems of equations and inequalities, sequences
CO4.	Analyze a given algebraic structure in detail.
CO5.	Criticize the study of certain structures called groups, rings, fields and some related structures.
CO6.	Investigate Algebraic structure by correctly completing several logical steps before arriving at a final answer.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Simple groups, Conjugacy, Normalization, Centre of a group, Class equation of a group and its consequences, Theorems for finite groups, Cauchy's theorem, Sylow's theorem.	12
II	Homomorphism, Endomorphism, Automorphism, Inner automorphism, Kernel of a homomorphism, Fundamental theorem on homomorphism of group, Group of automorphisms , Results on group homomorphism.	12
III	Maximal subgroups, Composition series, Jordan-Holder theorem, Solvable groups, Commutator subgroups, Direct products.	12
IV	Ideals, Algebra of ideals, Principal ideal ring, Units and associates, Polynomials ring, Division and Euclidean algorithm for polynomials, unique factorization theorem.	12

REFERENCE BOOKS:

1. Khanna, V.K.; and Bhambri, S.K.; Abstract Algebra , Vikash Pub. House P. Ltd.
2. Gallian Josheph A. ; Contemporary Abstract Algebra, NarosaPub.House P. Ltd.

3. Fraleigh John. B.; A First course in Abstract Algebra, Pearson Edu. Inc. , 2003.
4. Herstein I. N. ; Topics in Algebra, John Wiley & Sons, New York.

COURSE NAME: REAL ANALYSIS -II

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	MATMC703			
Course Name	:	**REAL ANALYSIS -II**			
Semester /Year	:	**SEMESTER - VII**			
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Objectives:

The aims of this course is to familiarize the learner with the uniform convergence and pointwise convergence of sequences/series of functions (witl one special case of power series), Riemann- Stieltjes integral, Functions of several variables.

Course Outcome(COs): After completion of this course the student will be able to the following

CO1.	Define and identify the basic of sequences and series of functions, function of several variables.
CO2.	Understand How to check the pointwise/uniform convergence of the sequences/series of functions for the different cases and explain the Riemann-Stieltjes Integral, function of several variables.
CO3.	Explain and describe the results based on sequences and series of functions, power series, function of several variables Weierstrass approximation theorem and how to apply these results in the problems.
CO4.	Analyze the different theoretical problems in real analysis
CO5.	Evaluate and the justify the problems in The Riemann-Stieltjes Integral, sequences and series of functions, function of severa variables.
CO6.	Develop and express the problems related to function of several variables, sequences and series of functions, the inverse function theorem, and implicit function theorem.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	The Riemann-Stieltjes Integral: Definition and existence of Riemann-Stieltjes integral, Properties of integrals, Integration and differentiation, Fundamental theorem of calculus, Integration of vector-valued functions.	12
II	Sequences and series of functions, Pointwise and uniform convergence, Cauchy criterion for uniform convergence, Uniform convergence and continuity, Uniform convergence and Riemann- Stieltjes integral, Uniform convergence and differentiation, Weierstrass approximation theorem.	12
III	Power series, Algebra of power series, Uniqueness theorem for power series, Abel's theorem , Taylor's theorem.	12
IV	Functions of several variables, Concept of functions of two variables, Continuity,Partial derivatives, Differentiability, Change of variables, The inverse function theorem, The implicit function theorem, Chain rule.	12

SUGGESTED READINGS:

1. Malik, S.C. and Arora, Savita; Mathematical Analysis, New Age Int. 1992.
2. Apostol, T.M.; Mathematical Analysis, Pearson Edu. , Taiwan Ltd., 1974.
3. Royden, H.L.; Real analysis, Pearson, 2017.
4. Tao Terence; Real Analysis, Springer.

COURSE NAME: COMPLEX ANALYSIS -II

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	MATMC704			
Course Name	:	**COMPLEX ANALYSIS -II**			
Semester /Year	:	**SEMESTER - VII**			
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The aims of this course is to familiarize the learner with analytic functions, power series (and its properties), Taylor's and Laurent's series, Singularities, Residues (Cauchy residue theorem and its applications), and finally provide a glimpse of maximum principle and Schwarz' lemma, Mittag-Leffler theorem, Rouche's theorem, Conformal mapping, Mobius transformation and related properties.

Course Outcome(COs): After completion of this course the student will be able to the following

CO1.	Recall the basic definitions of analytic function, of Zeros and poles and Singularities.Understand about the kind of singularitie of meromorphic functions which helps in residue theory and contour integrations.
CO2.	Describe conformal mappings between various plane regions.
CO3.	Explain the central ideas in the solution of Taylor and Laurent series.
CO4.	Classify curves and regions in the complex plane defined by simple expressions.
CO5.	Decide when and where a given function is analytic and be able to find it series development.
CO6.	Produce and create the analytic functions and concerned results.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Power series of analytic functions, Convergence of power series, Radius of convergence, Taylor's and Laurent's series, Residue and poles, Singularities, Classification of singularities.	12
II	Residues, Residue at infinity, Cauchy residue theorem, Applications of residue theorem in evaluation of improper real integrals.	12
III	Conformal mapping: properties, Mobius transformation, Elementary examples.	12
IV	Maximum modulus theorem, Mittag-Leffler theorem, Rouche's theorem, Concept of entire functions with simple example, Analytic continuation.	12

SUGGESTED READINGS:

1. Brown, J.W. and Churchill, R.V.; Complex Analysis, McGraw-Hill Ed.Private Ltd.2015.
2. Zill, Dennis G.; Complex Analysis, Jones &Bartlet Learning,2016.
3. Kasana, H. S.; Complex Analysis, PHI Learning.
4. Ponnusamy S.; Foundation of Complex Analysis, Alpha Int. Sci.

COURSE NAME: Lab course in Latex

Examination Scheme:

Components	Internal (PRESENTATION/VIVA VOCE)	External (ESE) (PRESENTATION/VIVA VOCE)
Weightage (%)	40	60

Course code	:	MATMP705			
Course Name	:	**Lab course in Latex**			
Semester /Year	:	**SEMESTER - VII**			
		L	T	P	C
		0	0	4	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Outcome(COs): After completion of this course the student will be able to the following

CO1.	Handle different types of documents.
CO2.	Organize documents into different sections, subsections, etc.
CO3.	Formatting pages (margins, header, footer, orientation)
CO4.	Write complex mathematical formulae.
CO5.	Include tables and images.
CO6.	Cross-referencing, bibliography, and Indexing.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Introduction to LaTeX, its installation. Creates the first document using LaTeX. Introduction to LaTex packages.	10
II	Organizes content into sections using article and book class of LaTeX, different paper sizes, examines packages, formats the page by setting margins, customizing header and footer, changing the page orientation, dividing the document into multiple columns. The topic ends with reading different types of error messages.	12
III	This topic concentrates on formatting text (styles, size, alignment), adding colors to text and entire page, and adding bullets and numbered items. It concludes by explaining the process of writing complex mathematics. Creating basic tables, adding simple and dashed borders, merging rows and columns, and handling situations where a table exceeds the size of a page. The sessions then continue to add an image, explore different properties like rotate, scale, etc..	14
IV	In this topic, the learner learns to add cross-referencing (refer to sections, table, images), add bibliography (references), and create back index. Introduction to creating slides, adding frames, dividing the slide into multiple columns, adding different blocks, etc.	12

SUGGESTED READINGS:

1. Stefan Kottwitz: LaTeX Beginner's Guide: Create visually appealing texts, articles, and books for business and science using LaTeX, 2nd Edition , Packt Publishing, 2021.
2. Firuza Karmali Aibara : A short introduction to LaTeX: A book for beginners, Createspace Independent Publishing Platform, 2019.
3. Dilip Datta: LaTeX in 24 Hours: A Practical Guide for Scientific Writing , 1st ed., Springer, 2017.

COURSE NAME: RESEARCH PROJECT –I/DISSERTATION

Examination Scheme:

Components	I[st] internal	II[nd] Internal	External (ESE)	
			Report	Presentation
Weightage (%)	15	15	50	20

Note: Examination Scheme of this course may vary as per University/NEP Rules

Course code	:	MATMR706			
Course Name	:	**RESEARCH PROJECT –I/DISSERTATION**			
Semester /Year	:	**SEMESTER - VII**			
			L	T	P	C
			0	0	6	6

L - Lecture T – Tutorial P – Practical C – Credit

COURSE NAME: ABSTRACT ALGEBRA- III

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTC801**			
Course Name	:	**ABSTRACT ALGEBRA- III**			
Semester /Year	:	**SEMESTER - VIII**			
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Objectives: The aims of this course is to familiarize the learner with Embedding of rings, Ring of residue classes, Euclidean ring, Module, field extension, Roots of polynomials, Splitting field, and Galois group.

Course Outcome(COs): After completion of this course the student will be able to the following

CO1.	Define all aspects of advanced Abstract Algebra.
CO2.	Explain the different algebraic structures of advanced Abstract Algebra.
CO3.	Solve the related problems embedding ring, field extension and module and Galois group.
CO4.	Analyze a given structure in detail and categorize.
CO5.	Criticize the study of certain structures called Embedding of rings, Euclidean ring, Module, Extension fields Gälois group and some related structures and evaluate the related problems.
CO6.	Develop and design the Algebraic structure by correctly completing several logical steps before arriving at a final answer.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Embedding of rings, Ring of residue classes, Fundamental theorem on homomorphism of ring, Prime ideals, Maximal ideal.	12
II	Euclidean ring, Properties of Euclidean ring, Module, sub-module, Module homomorphism, Linear sum and direct sum of sub-module.	12
III	Extension fields, Simple field extension, Algebraic field extension, Minimal polynomial, Roots of polynomials, Multiple roots, Splitting field.	12
IV	Automorphism of field, Fixed field, Normal extension, Galois group: Examples and characterizations, Construction with straight edge and compass.	12

SUGGESTED READINGS:

1. Gallian, Josheph A. ;Contemporary Abstract Algebra , Narosa Pub. House P. Ltd.
2. Fraleigh, John. B.; A First course in Abstract Algebra, Pearson Edu. Inc. , 2003.
3. Khanna, V.K. and Bhambri, S.K.; Abstract Algebra, Vikash Pub. House P. Ltd.
4. Herstein, I. N.; Topics in Algebra, John Wiley & Sons, New York.

COURSE NAME: OPERATIONS RESEARCH

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTC802**			
Course Name	:	**OPERATIONS RESEARCH**			
Semester /Year	:	**SEMESTER - VIII**			
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Objectives:
To study the Linear programming problems, Linear programming problems in Graphical Method and Simplex Method, Network models, Integer Programming, Decision Theory, Game Theory.

Course Outcome(COs): After completion of this course the student will be able to the following

CO1.	Define and identify the different concept based problems of Operational Research.
CO2.	Explain and show the results based on problems of Operational Research.
CO3.	Solve , Calculate and construct the different problems of Operational Research.
CO4.	Analyze different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.
CO5.	Measure any real life system with limited constraints and depict it in a model form.
CO6.	Express the all theories of OR and solve the related problem .

Course Syllabus

Unit	Content of Unit	No. of Hours
I	An introduction to operations research, Methodology of O.R., Features of O.R. problems, Different models in O.R., Opportunities and shortcomings of O.R. approach.	12
II	Dual simplex method, Revised simplex method, Sensitivity analysis.	12
III	Assignment and Transportation problems.	12
IV	Theory of games, Integer linear programming.	12

SUGGESTED READINGS:

1. KantiSwarup, Gupta, P.K. & Man Mohan ;Operations Research, S. Chand, 1978.
2. Sharma, J.K.; Operations Research: Theory and Applications, Trinity Press, 2016.
3. Taha, H.A.; Operations Research, Prentice Hall of India, 2011.
4. Bronson, R. ;Operations Research, Schaum's Outline Series.McGraw Hill, 1982.

COURSE NAME: METRIC SPACE

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code : **MMTC803**					
Course Name : **METRIC SPACE**					
Semester /Year : **SEMESTER - VIII**					
	L	T	P	C	
	4	0	0	4	

L - Lecture T – Tutorial P – Practical C – Credit

Objectives: The aims of this course is to familiarize the learner with the basic of metric spaces, deep knowledge of Completeness, Connectedness, Compactness, continuous mappings and uniform continuity in metric spaces.

Course Outcome(COs): After completion of this course the student will be able to the following

CO1.	Identify the basic of the different kind of metric spaces and problems.
CO2.	Understand the concept of nbd and its related, Homeomorphism, Connectedness, completeness, Complete metric spaces ar solve the related problems.
CO3.	Solve the problems based on concept of map in between metric spaces like Homeomorphism (1-1, onto, open/closed, continuous), Uniform continuity & Isometry and all others related to metric spaces.
CO4.	Analyze the Bolzano-Weierstrass property, sequentially compact and compact; prove the Lebesgue covering lemma and others problems related to metric spaces.
CO5.	Evaluate the problems on sequences and Cauchy sequences in metric spaces how it will be Complete metric spaces. Cantor's intersection theorem, Baire Category theorem, and Banach's fixed point theorem (based on contraction mapping). Justify th answer related to completeness of metric spaces and prove the completeness of the following: real line, unitary space, Euclidean space and other problems of metric spaces.
CO6.	Make the solution of theoretical numerical problems of Connectedness in metric spaces, and others problems related to metric spaces.

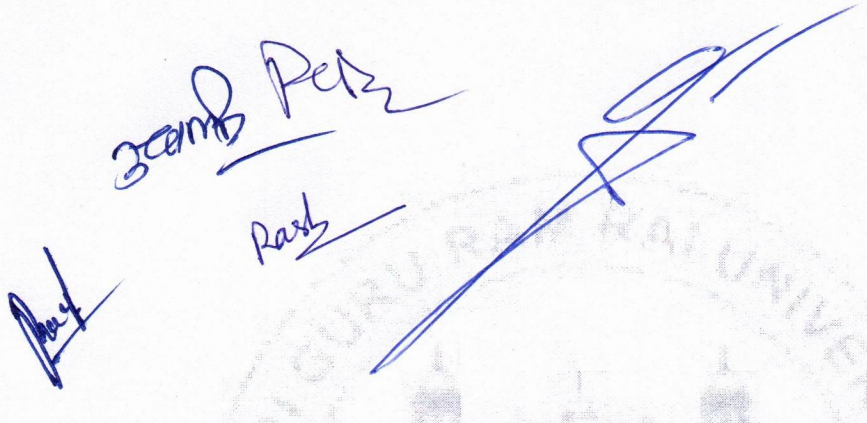
Course Syllabus

Unit	Content of Unit	No. of Hours
I	Metric on a set, Pseudo-metrics, Equivalent metrics, Limit point, Closed sets, Adherent point, Dense subsets, Interior of a set and its properties, Subspaces, Product spaces.	12
II	Convergent sequences, Cauchy sequences, Algebra of convergent sequences, Subsequences, Continuity at a point, Continuity over a apace, Algebra of real valued continuous functions in a metric space, Homeomorphism, Isometrics, Uniform continuity.	12
III	Complete metric spaces, Completeness and continuous mappings, Cantor's intersection theorem, Contraction mapping theorem, Connectedness in metric spaces, Properties of connectedness.	12
IV	Compact spaces, Compact subsets of the real line, Compactness and continuous mappings, Sequential compactness, Countable compactness, B-W property, B-W property and boundedness, B-W property and compactness, Compactness and uniform continuity,	12

	Lebesgue covering Lemma.	

SUGGESTED READINGS:

1. Simmons G.F.; Introduction to Topology and Modern Analysis, Tata McGraw-Hill.
2. Copson, E.T.; Metric Spaces, Cambridge University Press, 1968.
3. Kasriel, Robert H.; Topology , Dover Pub. , 2009.
4. Kumaresan, S.; Topology of Metric Spaces, Alpha Science Int. , 2011.



COURSE NAME: DISCRETE STRUCTURES

Examination Scheme:

Components	I[st] internal Assignment	II[nd] Internal	External (ESE)
Weightage (%)	20	20	60

Course code	:	**MMTC804**			
Course Name	:	**DISCRETE STRUCTURES**			
Semester /Year	:	**SEMESTER - VIII**			
		L	T	P	C
		4	0	0	4

L - Lecture T – Tutorial P – Practical C – Credit

Objectives: This course aims to explore Recurrence relations and their solutions Posets, Lattices, Boolean Lattices, Boolean Algebra, Boolean expressions, Logic gates, Karnaugh maps, Directed Graphs.

Course Outcome(COs): After completion of this course the student will be able to the following

CO1.	Identify the basic definitions in discrete structures and related examples.
CO2.	Explain conceptual based problems of discrete structures and their solutions.
CO3.	Solve the problems of Boolean algebra, Boolean functions, canonical forms of Boolean expressions and solve Karnaugh-Map
CO4.	Analyze the Application of Boolean algebra to switching theory and classify the problems of Graphs.
CO5.	Evaluate Recurrence relations, Directed graphs, Undirected graphs, Eulerian and Hamiltonian graphs, Planner graphs, Connected graphs and related theorems.
CO6.	Design and formulate the problems on discrete structures.

Course Syllabus

Unit	Content of Unit	No. of Hours
I	Recurrence relations, Linear homogeneous recurrence relations, Non-homogeneous recurrence relations, Solutions of recurrence relations.	12
II	Partially ordered sets, Different type of lattices, Sub-lattices, Direct product, Ideal Lattice, Modular and distributive lattices.	12
III	Boolean algebra, Ideals in Boolean algebra, Boolean rings, Boolean functions, Karnaugh maps, Application of Boolean algebra to switching theory.	12
IV	Graphs, Direct graphs, Undirected graphs, Relations and graphs, Path and circuits, Eulerian and Hamiltonian graphs, Planner graphs, Connected graphs.	12

SUGGESTED READINGS:

1. Liu, C. I.; Element of Discrete Mathematics, Mcgraw Higher Edu. ,2012.
2. Rao, H. G. S.; Discrete Mathematical Structures, Galgotia Pub. Pvt. Ltd.
3. Khanna, V. K.; Lattice and Boolean Algebra, Vikash Pub. House.
4. Johnsonbaugh, R.; Discrete Mathematics, Pearson Edu. Ltd., 2014.

COURSE NAME: LAB COURSE IN MATLAB

Examination Scheme:

Components	Internal (PRESENTATION/VIVA VOCE)	External (ESE) (PRESENTATION/VIVA VOCE)
Weightage (%)	40	60

Course code	:	**MMTP805**			
Course Name	:	**LAB COURSE IN MATLAB**			
Semester /Year	:	**SEMESTER - VIII**			
		L	T	P	C
		0	0	4	4

L - Lecture T – Tutorial P – Practical C – Credit

Course Outcome(COs): After completion of this course the student will be able to the following

CO1.	Understand the basics functions of MATLAB.
CO2.	Plot the 2D, 3D figures.
CO3.	Use basic commands of MATLAB.
CO4.	Solve various differential equations using MATLAB.
CO5.	Understand the need for simulation/implementation for the verification of mathematical functions.
CO6.	Understand the main features of the MATLAB program development environment to enable their usage in the higher learning.

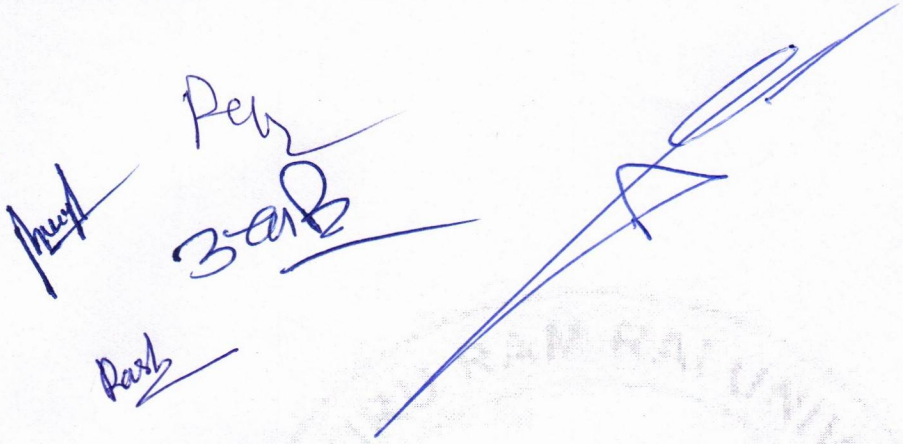
Course Syllabus

Unit	Content of Unit	No. of Hours
I	Introduction to MATLAB: vector and matrix generation, subscripting and the colon notation, matrix and array operations and their manipulations, introduction to some inbuilt functions related to array operations. m-files: scripts and functions, editing, saving m-files, and interaction between them.	12
II	Introduction to builtin functions: related to matrix inversion, eigenvalues, eigenvectors, condition number; for data representation: bar charts, histograms, pie chart, stem plots etc; for solving various type of differential equations; for specialized plotting.	12
III	Relational and logical operators: flow control using various statements and loops including If-End statement, If-Else-End statement, nested If-Else-End statement, For-End and While-End loops with Break commands.	12
IV	Two & three-dimensional graphics: basic plots, change in axes and annotation in a figure, multiple plots in a figure, saving and printing figures, mesh plots, surface plots and their variants e.g., contour plots, sphere, and animations. Symbolic Math and working with polynomials. Some applications: Numerical solution of ODE using solver, Numerical differentiation and integrations etc.	12

SUGGESTED READINGS:

1. Amos Gilat, MATLAB: An Introduction with Applications, 4th edition, Wiley; Fourth edition, 2012.

2. Stephen J. Chapman, MATLAB Programming for Engineers, Cengage learning; 4th edition, 2012.
3. Rudra Pratap ,Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers, Oxford, 2010.
4. V. Dukkipati, Rao, Matlab: An Introduction With Applications, New Age International Private Limited; 1st edition, 2009.
5. Suggestive digital platforms web links: NPTEL/SWAYAM/MOOCS.



COURSE NAME: RESEARCH PROJECT –II/ DISSERTATION

Examination Scheme:

Components	Internal Report	Internal Presentation	External (ESE)	
			Report	Presentation
Weightage (%)	20	10	50	20

Note: Examination Scheme of this course may vary as per University/NEP Rules

Course code	:	MATMR806			
Course Name	:	**RESEARCH PROJECT –II/ DISSERTATION**			
Semester /Year	:	**SEMESTER - VIII**			
		L	T	P	C
		0	0	6	6

L - Lecture T – Tutorial P – Practical C – Credit