Enclosure -8

ACADEMIC REGULATIONS & SYLLABUS

Faculty of Applied Sciences

Master of Science Programme
(Mathematics)

Education Campus – Changa, (ECC), hitherto a conglomerate of institutes of professional education in Engineering, Pharmacy, Computer Applications, Management, Applied Sciences, Physiotherapy and Nursing, is one of the choicest destinations by students. It has been transformed into **Charotar University of Science and Technology (CHARUSAT)** through an Act by Government of Gujarat. CHARUSAT is permitted to grant degrees under Section-22 of UGC- Govt. of India.

The journey of CHARUSAT started in the year 2000, with only 240 Students, 4 Programmes, one Institute and an investment of about Rs. 3 Crores (INR 30 million). At present there are seven different institutes falling under ambit of six different faculties. The programmes offered by these faculties range from undergraduate (UG) to Ph.D degrees including M.Phil. These faculties, in all offer 32 different programmes. A quick glimpse in as under:

Faculty	Institute	Programmes Offered
Faculty of Technology & Engineering	Chandubhai S. Patel Institute of Technology	B. Tech M. Tech Ph.D
Faculty of Pharmacy	Ramanbhai Patel College of Pharmacy	B. Pharm M. Pharm Ph. D
Faculty of Management Studies	Indukaka Ipcowala Institute of Management	M.B.A PGDM Ph. D
Faculty of Computer Science & Applications	Smt. Chandaben Mohanbhai Patel Institute of Computer Applications	M.C.A. M.Sc.(IT) Ph. D
Faculty of Applied Sciences	P. D. Patel Institute of Applied Sciences	M. Sc M. Phil Ph. D
Faculty of Medical Sciences	Charotar Institute of Physiotherapy Charotar Institute of Nursing	B.PT B. Sc (Nursing) G.N.M.

The development and growth of the institutes have already led to an investment of over Rs.80 crores (INR 800 Million). The future outlay is planned with an estimate of Rs. 250 Crores (INR 2500 Million).

The University is characterized by state-of-the-art infrastructural facilities, innovative teaching methods and highly learned faculty members. The University Campus sprawls over 105 acres of land and is Wi-Fi enabled. It is also recognized as the Greenest Campus of Gujarat.

CHARUSAT is privileged to have 350 core faculty members, educated and trained in IITs, IIMs and leading Indian Universities, and with long exposure to industry. It is also proud of its past students who are employed in prestigious national and multinational corporations.

From one college to the level of a forward-looking University, **CHARUSAT** has the vision of entering the club of premier Universities initially in the country and then globally. **High Moral Values like Honesty, Integrity and Transparency** which have been the foundation of ECC continue to anchor the functioning of **CHARUSAT**. Banking on the world class infrastructure and highly qualified and competent faculty, the University is expected to be catapulted into top 20 Universities in the coming five years. In order to align with the global requirements, the University has collaborated with internationally reputed organizations like Pennsylvania State University – USA, University at Alabama at Birmingham – USA, Northwick Park Institute –UK, ISRO, BARC, etc.

CHARUSAT has designed curricula for all its programmes in line with the current international practices and emerging requirements. Industrial Visits, Study Tours, Expert Lectures and Interactive IT enabled Teaching Practice form an integral part of the unique **CHARUSAT** pedagogy.

The programmes are credit-based and have continuous evaluation as an important feature. The pedagogy is student-centred, augurs well for self-learning and motivation for enquiry and research, and contains innumerable unique features like:

- Participatory and interactive discussion-based classes.
- Sessions by visiting faculty members drawn from leading academic institutions and industry.
- Regular weekly seminars.
- Distinguished lecture series.
- Practical, field-based projects and assignments.
- Summer training in leading organizations under faculty supervision in relevant programmes.
- Industrial tours and visits.
- Extensive use of technology for learning.
- Final Placement through campus interviews.

Exploration in the field of knowledge through research and development and comprehensive industrial linkages will be a hallmark of the University, which will mould the students for global assignments through technology-based knowledge and critical skills.

The evaluation of the student is based on grading system. A student has to pursue his/her programme with diligence for scoring a good Cumulative Grade Point Average (CGPA) and for succeeding in the chosen profession and life.

CHARUSAT welcomes you for a Bright Future

CHAROTARUNIVERSITY OF SCIENCE AND TECHNOLOGY

Faculty of Applied Sciences

ACADEMIC REGULATIONS

M.Sc. (Mathematics)

Charotar University of Science and Technology (CHARUSAT)
CHARUSAT Campus, At Post: Changa – 388421, Taluka: Petlad, District: Anand
Phone: 02697-247500, Fax : 02697-247100, Email: info@charusat.ac.in
www.charusat.ac.in

Year – 2019

CHARUSAT

FACULTY OF APPLIED SCIENCES
ACADEMIC REGULATIONS

Faculty of Applied Sciences

To ensure uniform system of education, duration of post graduate programmes, eligibility criteria for and mode of admission, credit load requirement and its distribution between course and system of examination and other related aspects, following are the academic rules and regulations.

1. System of Education

The Semester system of education shall be followed across The Charotar University of Science and Technology (CHARUSAT) at Master's levels. Each semester will be at least 90 working day duration. Every enrolled student will be required to do a specified course work in the chosen subject of specialization and also complete a project/dissertation if any. Medium of instruction will be English

2. Duration of Programme

Postgraduate programme	(M.Sc.)
Minimum	4semesters (2 academic years)
Maximum	6 semesters (3 academic years)

The maximum limit can be extended by 1 or 2 semester subject to the approval of university on case to case basis.

3. Eligibility for admissions

For the admission to M.Sc., programs in the subject of Biological/Physical/Mathematical/Chemical Sciences a candidate must have obtained a Degree of Bachelor of Science from any recognized University or a Degree recognized as equivalent thereto, with minimum Second Class.

4. Mode of admissions

Admission to M.Sc. programme will purely on combined merit of admission test and performance at graduation.

5. Programme structure and Credits

A student admitted to a program should study the course and earn credits specified in the course structure. (Please refer Annexure-A)

6. Attendance

6.1 All activities prescribed under these regulations and listed by the course faculty members in their respective course outlines are compulsory for all students pursuing the courses. No exemption will be given to any student from attendance except on account of serious personal illness or accident or family calamity that may genuinely prevent a student from attending a particular session or a few sessions. However, such unexpected absence from classes and other activities will be required to be condoned by the Dean/Principal.

6.2 Student attendance in a course should be 80%.

7. Course Evaluation

7.1 The performance of every student in each course will be evaluated as follows:

7.1.1 Internal evaluation by the course faculty member(s) based on continuous assessment, for 30% of the marks for the course; and

7.1.2 Final examination will be conducted by the University for 70% of the marks for the course.

7.2 *Internal Evaluation*

7.2.1 Internal evaluation will be based on internal tests and several other tools of assessment like, quiz, viva, seminar etc., as prescribed by concerned teacher and decided by the faculty.

7.3 Internal Institutional evaluation for practical

7.3.1 One internal practical test/viva will be conducted per semester totaling to 30 % internal marks for practical

7.3.2 In "Continuous evaluation" Students shall be evaluated in a continuous manner for their involvement in the practical, aptitude for learning, completion of practical related assignments, regularity in the practical and record keeping

7.4 University Examination

7.4.1 The final examination by the University for 70% of the evaluation for the course will be through written paper or practical test or oral test or presentation by the student or a combination of any two or more of these.

7.4.2 In order to earn the credit in a course a student has to obtain grade other than FF.

7.5 Performance at Internal & University Examination

7.5.1 Minimum performance with respect to internal marks as well as university examination will be an important consideration for passing a course.
Details of minimum percentage of marks to be obtained in the examinations areas follows

Minimum marks in University Exam per subject	Minimum marks Overall per subject
40%	50%

7.5.2 If a candidate obtains minimum required marks per subject but fails to obtain minimum required overall marks, he/she has to repeat the university examination till the minimum required overall marks are obtained.(As per the clause 8.2(iv)

8 Grading

8.1 The internal evaluation marks and final University examination marks in each course will be converted to a letter grade on a ten-point scale as per the following scheme:

Grading Scheme:

Range of Marks (%)	≥80	≥75 <80	≥70 <75	≥65 <70	≥60 <65	≥55 <60	≥50 <55	<50
Letter Grade	AA	AB	BB	BC	CC	CD	DD	FF
Grade Point	10	9	8	7	6	5	4	0

8.2 The student's performance in any semester will be assessed by the Semester Grade Point Average (SGPA). Similarly, his performance at the end of two or more consecutive semesters will be denoted by the Cumulative Grade Point Average (CGPA). The SGPA and CGPA are calculated as follows:

(i) SGPA = $\sum C_i G_i / \sum C_i$ where C_i is the number of credits of course i
G_i is the Grade Point for the course i
and i = 1 to n, n = number of courses in the semester

(ii) CGPA = $\sum C_i G_i / \sum C_i$ where C_i is the number of credits of course i
G_i is the Grade Point for the course i
and i = 1 to n, n = number of courses of all semesters up to which CGPA is computed.

(iii) No student will be allowed to move further if CGPA is less than 3 at the end of every academic year.

9. Awards of Degree

9.1 Every student of the programme who fulfils the following criteria will be eligible for the award of the degree:

9.1.1 He/ She should have earned at least minimum required credits as prescribed in course structure; and

9.1.2 He/ She should have cleared all internal and external evaluation components in every course; and

9.1.3 He/ She should have secured a minimum CGPA of 5.0 at the end of the programme;

9.1.4 In addition to above, the student has to complete the required formalities as per the regulatory bodies.

9.2 The student who fails to satisfy minimum requirement of CGPA will be allowed to improve the grades so as to secure a minimum CGPA for award of degree. Only latest grade will be considered.

10 Award of Class:

The class awarded to a student in the programme is decided by the final CGPA as per the following scheme:

Distinction:	CGPA $\geq$ 7.5
First class:	CGPA$\geq$ 6.0
Second Class:	CGPA$\geq$ 5.0

11 Transcript:

The transcript issued to the student at the time of leaving the University will contain a consolidated record of all the courses taken, credits earned, grades obtained, SGPA,CGPA, class obtained, etc.

Charotar University of Science & Technology
Faculty of Applied Sciences
P. D. Patel Institute of Applied Sciences
MASTER OF SCIENCE

VISION
To become an eminent national institute imparting science education integrated with research.
MISSION
To engage in education, research, and spread of science for the benefit of society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The Postgraduate would be able to

PEO-1: Apply the acquired knowledge in various fields of sciences to plan and execute tasks. (POs 1, 2, 3, 8)
PEO-2: Have scientific aptitude and competency in solving local and global problems. (POs 4, 6, 9, 10)
PEO-3 Possess an ethical approach, while executing research projects and scientific writing. (POs 7, 9, 10)
PEO-4 Ability to follow life-long learning. (POs 11)
PEO-5 Understand the importance of team work and possess leadership and entrepreneurship traits. (POs 5, 6, 8)
N.B. POs are mapped with PEOs.

PROGRAM OUTCOMES (POs)

The Programme Outcome are as under:

The Post Graduates would be able to

PO1. Knowledge in sciences: Possess knowledge and comprehend the various core and allied courses offered under the opted stream of sciences.

PO2. Planning Abilities: Demonstrate effective planning abilities, including time management, resource management, delegation skills, organizational skills, teamwork, and interpersonal skills.

PO3. Problem analysis: Utilize the principles of scientific enquiry and think analytically, critically with clarity of thought, while solving problems.

PO4. Modern tool usage: **A**pply appropriate methodologies, methods and procedures, resources to conceptualize the matters.

PO5. Leadership skills: Realize the importance of teamwork and take initiatives to plan and implement a workflow to fulfill tasks with a compassionate attitude.

PO6. Professional Identity: Establish as a professional in the chosen area of the profession with social responsibility**.**

PO7. Ethics in Science: To understand the value of being ethical and implement its principles while carrying out research and publication, tasks at workplace and in life. To respect and adhere to the rules/regulations/treaties/directives/notifications/laws related to scientific research and business.

PO8. Communication: Communicate effectively and responsibly with the scientific community and with society at large, such as being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions.

PO9. Modern Science and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and help society whenever situations arise.

PO10. Environment and sustainability: Understand the causes of environmental pollution and how it can be reduced and remedied using green technology in industries and environment.

PO11. Life-long learning: Vigilant about changes in the worldwide professional scenario arising out of technological, political, and economic factors. Recognize the need for and undertake steps necessary to fill the gaps recognized to keep oneself professionally competent. Self- assess and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

DEPARTMENT OF MATHEMATICAL SCIENCES

Syllabus

M. Sc. Mathematics (Semester I- IV)

Effective from July 2019

M. Sc. (Mathematics)

Aim: To motivate and nurture young talent in the field of science through concept-based and inquiry-driven education, so that they can take up challenging research and teaching assignments in universities, R & D institutions and various industries.

Background:

Increasingly, in today's times, there is a growing emphasis on the interdisciplinary nature of science, and recognition of the importance of research experience. This is only possible if one can make the learning of basic sciences exciting through a creative and integrated approach to teaching.

The Charotar University of Science & Technology, a university for future thinkers, will be starting a M.Sc. degree course in Mathematics from the year 2017-18. The Programme focuses on the unified nature of science and aims to train some of the brightest young minds of our country, mentored by some of the best practitioners of science in India

The hall mark of the Programme:

- A comprehensive programme that will enable the students to understand the basic laws of nature and develop necessary skills to apply them to any desired area or discipline.
- Small student-to-teacher ratio.
- Modern research and scientific environment will help every student excel in the field of Mathematics.
- It integrates the conventional bachelors and masters' programmes into a more holistic science education experience.

Outline

- The courses offered during the semesters, I to IV are comprehensive courses in all areas of Mathematics. It would help them make an informed judgment to determine their real interest and their aptitude for a given subject.
- These courses are meant to give a flavor of the various approaches and analyses as well as to prepare them for advanced courses in later years for research.
- In the semesters III and IV, students can choose advanced courses based on their interest.

Intake: 20-30 Students

ANTEXURE-A

CHAROTARUNIVERSITY OF SCIENCE & TECHNOLOGY

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY (CHARUSAT)													
Proposed subjects for M.Sc. Mathematics Programme Semester - I													
	Subject Code	Subjects	Teaching scheme				Theory Evaluation			Practical Evaluation			Total I +II
			L+S#	P	Total hrs.	Total Credits	Institute	University	Total-I	Institute	University	Total-II	
Sem I	MA711	Complex Analysis	4+1		5	4	30	70	100				100
	MA712	Functions of Several Real Variables	3+1		4	3	30	70	100				100
	MA713	Numerical Analysis	3+1	1	6	4	30	70	100				100
	MA714	Ordinary Differential Equations	3+1		4	3	30	70	100				100
	MA715	Topology -1	2+1		3	2	30	70	100				100
	MA716	Problems and Exercises in Mathematics - 1	5+2		7	5	30	70	100				100
	HS701	Advance Critical Thinking and Logic			2	2							100
		University Elective			2	2							100
		Total			**33**	**25**							**800**

 # S = Seminar hours. These hours are not to be counted for credit hours

	Subject Code	Subjects	Teaching scheme				Theory Evaluation		Total
			L+S#	P	Contact hrs.	Total Credits	Institute	University	
Sem II	MA721	Algebra - 1	3+1		4	3	30	70	100
	MA722	Differential Geometry	3+1		4	3	30	70	100
	MA723	Linear Algebra	4+1		5	4	30	70	100
	MA724	Partial Differential Equations	3+1		4	3	30	70	100
	MA725	Real Analysis	3+1		4	3	30	70	100
	MA726	Problems and Exercises -2	5+1		6	5	30	70	100
	HS702	Academic Writing and Communication Skills			2	2			100
		University Elective			2	2			100
					31	25			800

 # S = Seminar hours. These hours are not to be counted for credit hours

M. Sc. (Mathematics) Semester – I & II

Internal Evaluation: Internal evaluation will be done as under:

Name of examination	Number		Examination duration	Distribution of internal of 30 marks
Internal Test	Two		90 minutes	20
Quiz	At least two		5 to 10 minutes	05
Seminar	At least one		About 15 to 20 minutes	05

The evaluation will be done by the faculty members.

University examination:

There will be university examination at the end of the semester.

Remark:

Special interactive problem solving sessions will be conducted by respective faculty members on weekly bases. The courses are aimed to train the student to acquire the knowledge in higher mathematics which helps the student preparing for career in Higher Mathematics. More emphasize will be given to problem solving in each course.

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

P. D. PATEL INSTITUTE OF APPLIED SCIENCES

DEPARTMENT OF MATHEMATICAL SCIENCES

MA711: COMPLEX ANALYSIS

M. Sc. SEMESTER-I

Credits and Hours:

Teaching Scheme	Theory	Practical/Seminar	Total	Credit
Hours/week	4	1	5	4
Marks	100	-	100	

A. Objective of the Course:

1. This course is for the introduction of complex number and study complex analysis in detail.

B. Outline of the course:

Sr No.	Title of the unit	Minimum number of hours
1.	Basic Concept of Complex Analysis	04
2.	Analytic Functions	11
3.	Complex Integration	20
4.	Series Representation	25

Total hours: 60

C. Detailed Syllabus:

1	**Basic Concept of Complex Analysis**	**04 Hours**	**5%**
1.1	Algebraic properties of Complex numbers (sum, product, conjugate, exponential form, arguments of products and quotients, roots of complex number)		**1**
1.2	Representations of complex numbers. Regions in the complex plain		**1**
1.3	Functions and mappings, limits, continuity and derivatives		**2**
2	**Analytic Functions**	**11 Hours**	**25%**
2.1	Cauchy- Riemann equations (in Cartesian and polar form).		**2**
2.2	Analytic functions		**2**
2.3	Harmonic functions		**2**
2.4	Power series and analytic functions		**2**
2.5	Exponential and Logarithmic functions. Branches and derivatives of Logarithmic function, identities involving Logarithms		**2**
2.6	The power function. The trigonometric functions sine and cosine. Hyperbolic functions. Inverse trigonometric and hyperbolic functions.		**1**
3	**Complex Integration**	**20 Hours**	**33%**
3.1	Contour, contour integrals, anti-derivative		**4**
3.2	Cauchy-Goursat Theorem, simply and multiply connected domains		**4**
3.3	Cauchy's Integral Formula, Extension of the Cauchy's Integral Formula.		**4**
3.4	Morera's theorem, Cauchy's inequality. Liouville's theorem,		**4**
3.5	Fundamental theorem of Algebra. Maximum modulus principle.		**4**
4.	**Series Expansion**	**25 Hours**	**37%**
4.1	Taylor's theorem, Laurent series		**4**
4.2	Absolute and uniform convergence of power series		**3**
4.3	Residue. Residues theorem		**4**
4.4	Types of Isolated singularities, residues at poles, zeros of analytic function		**3**
4.5	Evaluation of improper real integrals		**4**
4.6	Improper integrals from Fourier Analysis		**2**
4.7	Mobius transformations, Conformal Mappings		**5**

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures/laboratory which carries a 5% component of the overall evaluation.
- Minimum two internal exams will be conducted and average of two will be considered as a part of 15% overall evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval. It carries a weighting of 5%.
- Two Quizzes (surprise test) will be conducted which carries 5% component of the overall evaluation.

E. Course Outcomes (COs):

At the end of the course, the students will be able to

CO1	describe and dissect many core concepts of Complex Analysis and solve many complex integration
CO2	apply the concepts of this course to learn some other courses of Mathematics like Functional Analysis, Banach Algebras, Harmonic Analysis etc.
CO3	apply the concepts developed in this course in several branches of engineering.
CO4	develop their communication skills and an academic practice through self-prepared seminars of complex analysis.
CO5	develop their academic leadership through problem solving sessions of complex analysis
CO6	develop and enhance their ability of critical and clear thinking and their planning ability through the proof of the results of complex analysis.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	-	-	-	3	3	3
CO2	3	-	3	3	-	-	-	-	3	-	3
CO3	3	-	3	3	3	-	-	-	3	-	3
CO4	3	-	-	-	-	-	-	3	-	-	3
CO5	3	-	-	-	-	3	-	-	-	-	3
CO6	3	3	3	3	-	-	-	-	-	-	3

F. Recommended Study Material:

Text Books:

1. J. W. Brown and R. V. Churchill; Complex Variables and Applications, McGraw-Hill Education (2009) ninth edition.

Reference Books:

1. S. Ponnusamy; Foundation of Complex Analysis, Narosa Publ. House, New Delhi (1995).
2. J. B. Conway; Functions of One Complex Variables, Narosa Publ. House, New Delhi (1995) (Second Edition).
3. B. Chaudhary; The Elements of Complex Analysis, Wiley Eastern Ltd. New Delhi (1992) Second Edition.

URL Links:

https://en.wikipedia.org/wiki/Complex_analysis

http://mathworld.wolfram.com/ComplexAnalysis.html

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF MATHEMATICAL SCIENCES

MA712: FUNCTIONS OF SEVERAL REAL VARIABLES

M. Sc. SEMESTER - I

Credits and Hours:

Teaching Scheme	Theory	Seminar	Total	Credit
Hours/week	3	1	4	3
Marks	100	-	100	

A. Objective of the Course:

This course is aimed to study the properties of the functions on the Euclidean space R^n.

B. Outline of the course:

Sr No.	Title of the unit	Minimum number of hours
1.	Geometry of the Euclidean Space R^n.	09
2.	Differentiations.	20
3.	Integrations.	16
	Total hours:	45

C. Detailed Syllabus:

1	**Geometry of the Euclidean Space R^n: 09 Hours**	**20%**
1.1	R^n as a vector space.	
1.2	Inner product and Euclidian norm on the Euclidian space R^n.	
1.3	Limit, continuity of functions from R^m to R^n.	
2	**Differentiation : 20 Hours**	**45%**
2.1	Differentiation of functions from R^m to R^n.	
2.2	Basic properties of differentiation of functions from R^m to R^n. Chain Rule.	
2.3	Jacobian matrix. Partial derivatives.	

2.4	Directional derivatives and their relationship with differentiability of a function from R^m to R^n.	
2.5	Continuously differentiability of functions from R^m to R^n.	
2.6	Implicit function Theorem.	
2.7	Inverse function theorem.	
3	**Integration** **16 Hours**	**35%**
3.1	Tensor products.	
3.2	Fields and forms.	
3.3	Exterior derivatives, closed and exact forms.	
3.4	Poincare Lemma.	
3.5	Singular chain.	
3.6	Stokes' theorem.	

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in last lecture.
- At the end of the lecture, teacher will say the topic he/she planned to cover in the next lecture.

E. Course Learning Outcomes:

At the end of the course, the students will be able to

CO1	analyze and use fundamental concepts to solve core problems of several variable calculus in modern science
CO2	recognize patterns and determine appropriate techniques for solving a variety of complex problems of multivariable functions
CO3	classify and determine lifelong problems in various branches of engineering
CO4	create and enhance their ability of the critical and clear thinking and ability of planning through the proof of the theorems, lemmas etc. covered in this course.
CO5	develop their academic leadership through discussion in a group to solve exercises and quires of the course. Students will be able to develop their communication skills and academic practices through self- prepared seminars.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	3	-	-	-	-	3	-	-
CO2	3	3	-	3	-	-	-	-	-	-	-
CO3	3	-	3	3	-	-	-	-	-	-	3
CO4	3	3	-	3	-	-	-	-	-	-	-
CO5	3	-	-	-	3	3	-	3	-	-	-

Correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

F. Recommended Study Material:

Text Books:

1. G. Spivak; Calculus on Manifolds, W. E. Benjamin (1965).

Reference Books:

1. S. R. Ghorpade and B. V. Limaye; A Course in Multivariable Calculus and Analysis.
2. W. Rudin; Principle of Mathematical Analysis, Tata McGrow Hill Publ. (1983) third edition.
3. S. Kantorovitz; Several Real Variables, Springer Undergraduate Mathematics Series (2016).
4. M. Moskowitz; Functions of Several Real Variables, World Scientific (2011)

URL Links:

https://www.maths.tcd.ie/~ignateva/23212Proofs.pdf

https://en.wikipedia.org/wiki/Function_of_several_real_variables

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (MATHEMATICS) SEMESTER – I

MA713: NUMERICAL ANALYSIS

Credits and Hours

Teaching Scheme	Theory	Practical	Seminar	Total	Credit
Hours/week	3	2	**1**	6	4
Marks	100	-		100	

A. Objective of the Course:

This course is divided in two parts: In the first part various numerical methods will be discussed in the class room and in the second part computer programs for these methods will be performed by the students on computers.

B. Outline of the course:

Sr No.	Title of the unit	Minimum number of hours
1.	Approximate solutions of nonlinear equations and system of linear equations	12
2.	Interpolation	12
3.	Numerical Integration and Differentiation	09
4.	Numerical solutions of differential equations	12
5.	Practical	15
	Total hours	**60**

C. Detailed Syllabus:

1	**Approximate solutions of nonlinear equations and system of linear equation:**	**12 Hours(26%)**
1.1	Method of iteration, Bisection method, Regula - Falsi methods	
1.2	Secant method, Newton-Raphson method, Rate of convergence of these methods	
1.3	Gauss elimination method and its applications	
1.4	Gauss-Seidal method.	
2	**Interpolation:**	**12 Hours(27%)**
2.1	Finite differences	
2.2	Lagrange, Hermite, Newton interpolations	
2.3	Spline interpolation	
2.4	Uniqueness of interpolation polynomial	
2.5	Applications of interpolation.	
3.	**Numerical Integration and Differentiation:**	**09 Hours(20%)**
3.1	Newton–Cotes Quadrature	
3.2	Romberg Integration and Gaussian Quadrature	
3.3	Numerical Differentiation	
4.	**Numerical solutions of differential equations:**	**12 Hours(27%)**
4.1	Euler's method, Picard's method	
4.2	Modified Euler's method, Runge – Kutta's methods (of order 2 and 4)	
4.3	Multistep methods : Milne's method	
4.4	Adams-Bashfourth'smethod , Adams-Moulton's method.	

D. Instructional Method and Pedagogy:

- At the starting of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, the teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, the teacher will say the topic he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	construct algorithms and write programs for numerical methods and analyze errors in the computed results.
CO2	evaluate out the approximate solution of single-variable equations and systems of linear equations using numerical methods.
CO3	determine the solution of interpolation theory and applications in numerical calculus to analyze real-world problems.
CO4	solve numerically the initial valued problem of ordinary differential equation for the scientific problems.
CO5	develop their academic leadership through discussion in a group and self-prepare seminar.
CO6	solve the problems of competitive examinations like UGC-NET, GATE, NBHM related to Numerical methods.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	-	3	3	3	-	-	-	-	-	3
CO3	3	-	3	3	3	-	-	-	-	3	3
CO4	3	-	3	3	3	-	-	-	-	3	3
CO5	3	-	-	-	-	3	3	-	-	-	3
CO6	3	-	3	3	3	-	-	-	-	-	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Text Books:

1. S. D. Conte and C. de Boor; Elementary Numerical Analysis, McGrow Hill (1980) Third Edition.

Reference Books:

i. Sastry S. S., "Introductory Methods of Numerical Analysis", Prentice Hall of India.

ii. A. Iserles; A First Course in the Numerical Analysis of Differential Equations, Cambridge University Press (1996)

iii. S. A. Mollah; Numerical Analysis and Computational Procedures, Books and Allieds (P) Ltd. (1996)

iv. K. Atkinson and W. Han; Elementary Numerical Analysis, Third Edition (2004).

URL Links:

http://mathworld.wolfram.com/NumericalAnalysis.html

https://en.wikipedia.org/wiki/Numerical_analysis

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

DEPARTMENT OF MATHEMATICAL SCIENCES

M714: ORDINARY DIFFERENTIAL EQUATIONS

M. Sc. SEMESTER - I

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	1	4	3
Marks	100	-	100	

A. Objective of the Course:

Advanced theory of ordinary differential equations will be discussed in this course. The topics to be discussed in this course are useful to subjects like Physical Sciences as well as various branches of Engineering.

B. Outline of the Course:

Sr. No.	Title of the unit	Minimum number of hours
1.	Second order linear differential equations	13
2.	Series solutions of first and second order equations	16
3.	Systems of first order differential equations & existence and uniqueness of solution of differential equations	10
4.	Existence and uniqueness of solution of differential equations:	06
	Total hours:	**45**

C. Detailed Syllabus:

1.	**Second order linear differential equations**	**13 Hours**	**28%**
1.1	Introduction of second order linear differential equations		
1.2	General solution of homogeneous equation		
1.3	Other solution by using known solutions		

1.4	Homogeneous equations with constant coefficients		
1.5	Method of undetermined coefficients		
1.6	Method of variation of parameters		
2.	**Series solutions of first and second order equations:**	**16 Hours**	**36%**
2.1	Ordinary points		
2.2	Singular points		
2.3	Regular singular points		
2.4	Gauss's hypergeometric equation		
2.5	The point at infinity		
3.	**Systems of first order differential equations:**	**10 Hours**	**22%**
3.1	Linear systems		
3.2	Homogeneous linear systems with constant coefficients		
3.3	Nonlinear systems		
4.	**Existence and uniqueness of solution of differential equations:**	**06 Hours**	**14%**
4.1	The method of successive approximations		
4.2	Picard's theorem		

D. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	solve ordinary differential equations aries in physical and engineering sciences
CO2	keen the practical importance of solving differential equations
CO3	solve systems of linear first-order differential equations
CO4	use series methods to solve Bessel, hypergeometric and Legendre equations

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	---	3	3	3	3	3	3
CO3	3	---	3	3	---	3	3	3	3	3	3
CO4	3	---	3	3	---	3	---	3	---	3	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

E. Instructional Method and Pedagogy:

- At the starting of course, the course delivery pattern, prerequisite of the subject will be discussed
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, the teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, the teacher will say the topic he/she planned to cover in the next lecture.

F. Recommended Study Material:

Text Books:

1. G. F. Simmons; Differential Equations and Applications with Historical notes, Taylor& Francis Group, CRC Press (2017) Third Edition.

Reference book:

1. E. A. Coddington; Introduction to Ordinary Differential Equations, Dover Publishing, INC, New York (1961).
2. A. L. Rabenstein; Introduction to Ordinary Differential Equations, Academic Press (1966).
3. D. Somasundaram; Differential Equations, Narosa Publ. New Delhi (2002).
4. M. D. Raisinghania; Advanced Differential Equations, Khanna Publ. New Delhi (2002).
5. S. G. Deo and V. Raghavendra; Ordinary Differential Equations and Stability Theory, Tata McGrow Hill Publ. Co. Ltd. (1980).

Web site: http://mathworld.wolfram.com/topics/OrdinaryDifferentialEquations

https://en.wikipedia.org/wiki/Ordinary_differential_equation

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (MATHEMATICS) SEMESTER – I

MA715: TOPOLOGY - 1

Credits and Hours

Teaching Scheme	**Theory**	**Seminar**	**Total**	**Credit**
Hours/week	2	1	3	2
Marks	100	-	100	

A. Objective of the Course:

In this course the general theory of metric space will be discussed. The topics covered in this course are necessary for some other subjects of Mathematics.

B. Outline of the course:

Sr. No.	**Title of the unit**	**Minimum number of hours**
1.	Some concepts of Set Theory	6
2.	Metric Space	10
3.	Completeness	6
4.	Compactness	8
	Total hours:	**30**

C. Detailed Syllabus:

1.	**Some concepts of Set Theory**	**6 Hours (20%)**
1.1	Elementary set theory, finite, countable and uncountable sets	
1.2	Partially ordered sets, Zorn's lemma.	
2.	**Metric Space**	**10 Hours (33%)**
2.1	The Inequalities of Young, Holderand Minkowski	
2.2	Metric spaces and examples. Equivalent metrics	
2.3	Interior point, limit point and boundary point of a subset of a metric space	
2.4	Open sets and closed sets in a metric space	
2.5	Cauchy and convergent sequences in a metric space	
2.6	Continuous and uniformly continuous functions	
2.7	Spaces of continuous functions.	
3.	**Completeness**	**6 Hours (20%)**
3.1	Completeness of a metric space	
3.2	Baire's theorem.	
3.	**Compactness**	**8 Hours (27%)**
4.1	Compactness for metric spaces	
4.2	Ascoli's theorem.	

D. Instructional Method and Pedagogy:

- At the starting of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, the teacher will recall what he/she covered in last lecture.
- At the end of the lecture, the teacher will say the topic he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	understand and visualize the concept of Metrics (distance) in real world
CO2	understand many core concepts of Metric Spaces.
CO3	apply the concepts of this course to Functional Analysis, Real Analysis and Complex Analysis.
CO4	develop their academic leadership through discussion in a group to solve exercises and queries of this course
CO5	find the solutions of the exercises and problems, the students have to analyse it first to solve. Student will be able to develop their communication skill and academic practices through self-prepared seminars.
CO6	through the proof of the theorems, lemmas etc. covered in this course, students will be able to develop and enhance their ability of critical and clear thinking and ability of planning

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	3	-	-	-	-	-	-	3
CO2	3	-	-	3	-	-	-	-	-	-	3
CO3	3	-	3	-	-	-	-	-	-	-	3
CO4	3	-	3	3	-	3	-	3	-	-	3
CO5	3	3	3	3	-	-	3	3	-	-	3
CO6	3	3	3	3	-	-	-	3	-	-	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Text Books:

1. G. F. Simmons; Introduction to Topology and Modern Analysis, Tata McGrow Hill Publ. Co. Ltd.

Reference Books:

1. J. Munkers; Topology: A First course, Prentice Hall of India Pvt. Ltd. New Delhi.
2. R. R. Goldberg; Methods of Real Analysis, Oxford & IBH Publ. Ltd. ; Several Real Variables, Springer Undergraduate Mathematics Series (2016).

3. M. O'Searcoid; Metric Spaces, Springer Undergraduate Mathematics Series(2001)
4. J. Heinonen; Lectures on Analysis on Metric Spaces, Springer (2001)
5. MícheálO'Searcoid ; Metric Spaces , springer (2007)
6. S. Shirali, H. L. Vasudeva; Metric Spaces, Springer (2006)

URL Links:

Web site: http://www.topologywithouttears.net/topbook.pdf

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (MATHEMATICS) SEMESTER – I

MA716: Problems and Exercises in Mathematics – 1

Credits and Hours

Teaching Scheme	Theory	Seminar	Total	Credit
Hours/week	5	1	6	5
Marks	100	-	100	

A. Objective of the Course:

Problem related to above subjects as well as other branches of Mathematics will be discussed in this course. It is very helpful to develop the problem solving skill of the student which is a very important aspect of Mathematics and it will be helpful the students who want to make carrier in higher mathematics.

B. Outline of the course:

Sr No	Title of the unit	Minimum number of hours
1.	Complex Analysis	15
2.	Functions of Several Real Variables	15
3.	Numerical Analysis	15
4.	Ordinary Differential Equations	15
5.	Real Analysis and Topology	15
	Total	**75**

C. Detailed Syllabus:

1.	Problems and Exercises in Complex Analysis	**15 Hours (20%)**
2.	Problems and Exercises in Functions of Several Real Variables	**15 Hours (20%)**
3.	Problems and Exercises in Numerical Analysis	**15 Hours (20%)**
4.	Problems and Exercises in Ordinary Differential Equations	**15 Hours (20%)**
5.	Problems and Exercises in Real Analysis and Topology -1	**15 Hours (20%)**

D. Instructional Method and Pedagogy:

- At the start of course, teacher will say to the students the importance of this course.
- In this course, emphasizes will be given to problem solving.
- At the starting of the lecture, teacher will recall which problems was discussed in last session.
- At the end of the lecture, teacher will give some problems to discuss in the next session.
- The teacher will solve some problems in the class.
- Students will solve problems in the class with the help of the faculty members.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	understand the theory part of courses they have studied
CO2	enhance his/her thinking which would be helpful to them who are preparing for competitive examinations.
CO3	encouraged/ inspired to go for research in Mathematics
CO4	develop their academic leadership through discussion in a group to solve exercises and queries of this course
CO5	find the solutions of the exercises and problems, the students have to analyse it first to solve. Student will be able to develop their communication skill and academic practices through self-prepared seminars.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	3	3	-	-	-	-	-	-	3
CO2	3	-	3	3	-	-	-	-	-	-	3
CO3	3	-	3	3	-	-	-	-	-	-	3
CO4	3	-	3	3	-	3	-	-	-	-	3
CO5	3	-	3	3	-	3	3	3	-	-	3
CO6	3	-	3	3	-	3	-	-	-	-	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Text Books:

All books mentioned in above syllabus of Semester I as text books.

Reference Books:

All books mentioned in above syllabus Semester I as reference books.

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (MATHEMATICS) SEMESTER – II

MA721: ALGEBRA - 1

Credits and Hours

Teaching Scheme	Theory	Practical/Seminar	Total	Credit
Hours/week	3	1	4	3
Marks	100	-	100	

A. Objective of the Course:

Some topics of Number Theory will be covered in this course. Also in this course Group Theory which is a basic course of Abstract Algebra will be discussed in detail.This course is for the introduction of complex number and study complex analysis in detail.

B. Outline of the course:

Sr No.	Title of the unit	Minimum number of hours
1.	Concepts of Number Theory	6
2.	Groups and subgroups	6
3.	Homomorphism	6
4.	Automorphisms	4
5.	Permutations	6
6.	Conjugation	5
7.	Sylow's theorem	5
8.	Some special types of groups	7
	Total hours	**45**

C. Detailed Syllabus:

1	**Concepts of Number Theory:**	**06 Hours(13%)**
1.1	Euclid's Algorithm.	
1.2	Divisibility of integers and fundamental theorem of arithmetic	
1.3	Congruence	
1.4	Chinese remainder theorem	

1.5	Euler's function φ.	
2	**Groups and subgroups:**	**6 Hours (14%)**
21	Groups and subgroups and examples	
2.2	Finite groups	
2.3	Lagrange's Theorem and its applications	
2.4	Normal subgroups and quotient groups.	
3	**Homomorphism:**	**6 Hours (13%)**
3.1	Homomorphism and Homomorphism theorems	
3.2	Cauchy's theorem for abelian groups	
3.3	Sylow's theorem for abelian groups	
4	Automorphisms:	**4 Hours (09%)**
4.1	Automorphisms	
4.2	Cayley's theorem.	
5	**Permutations:**	**6 Hours (14%)**
5.1	Product of permutations	
5.2	Cycles, Transpositions, Even Odd permutations	
5.3	permutation groups.	
6	**Conjugation:**	**5 Hours (11%)**
6.1	Conjugate classes	
6.2	class equation and applications.	
7	**Sylow's theorem**	**5 Hours (11%)**
7.1	Sylow's theorem	
7.2	Applications of Sylow's theorem.	
8	**Some special types of groups:**	**7 Hours (15%)**
8.1	Simple groups	
8.2	Solvable groups.	

D. Instructional Method and Pedagogy:

- At the starting of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing boardor multi-media projector or OHP etc.
- At the starting of the lecture, the teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, the teacher will say the topic he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	understand many core concepts of Elementary Number Theory and Group Theory.
CO2	apply concepts this course to Cryptology. They can apply their skill to Artificial (informal) Languages as well as Artificial Intelligence

CO3	develop their academic leadership through discussion in a group to solve exercises and queries of this course
CO4	find the solutions of the exercises and problems, the students have to analyse it first to solve. Student will be able to develop their communication skill and academic practices through self-prepared seminars.
CO5	Enhance the concepts of this course to Linear Algebra, Ring and Field theory
CO6	through the proof of the theorems, lemmas etc. covered in this course, students will be able to develop and enhance their ability of critical and clear thinking and ability of planning

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	3	-	-	-	-	-	-	3
CO2	3	3	-	3	3	-	-	-	-	-	3
CO3	3	-	3	3	-	3	-	-	-	-	3
CO4	3	-	3	3	-	3	3	3	-	-	3
CO5	3	-	-	3	-	-	-	-	-	-	3
CO6	3	3	3	3	-	-	-	-	-	-	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Text Books:

I.N. Herstein;- Topics in Algebra (2nd Edition, 1975).

Reference Books:

1. I.N. Herstein; Abstract Algebra, Prentice Hall (1996), Third Edition
2. J.B. Fraleigh; A first course in abstract algebra (Narosa, 3rd Edition, 1983).
3. D. M. Burton; Elementarynumber theory, Universal Book Stall, New Delhi (Second Edition) .
4. D. J. S. Robinson; A Course in the Theory of Groups, Springer (1995)
5. J. F. Humphreys; A Course in Group Theory, Oxford University Press, (2001)

URL Links:

http://www.math.mtu.edu/~kreher/ABOUTME/syllabus/GTN
http://www.jmilne.org/math/CourseNotes/GT.pdf

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) SEMESTER - II

MA722: DIFFERENTIAL GEOMETRY

Credits and Hours

Teaching Scheme	Theory	Seminar	Total	Credit
Hours/week	3	1	4	3
Marks	100	-	100	

A. Objective of the Course:

This course is the study of the geometry of curves and surfaces in three-dimensional space using calculus techniques.

B. Outline of the course:

Sr No.	Title of the unit	Minimum number of hours
1.	Curves in the plane and space:	11
2.	Three dimensional Geometry	10
3.	Curvature and Geodesic	18
4.	Gauss' Theorema Egregium	6
	Total hours	**45**

C. Detailed Syllabus:

1	**Curves in the plane and space:**	**11 Hours (24%)**
1.1	Curves in the plane and space	
1.2	Parameterization	
1.3	Curvature, torsion and signed curvature	
1.4	Frenet-Serret equations	
1.5	Isoperimetric Inequality.	
2	**Three dimensional Geometry**	**10 Hours (22%)**
2.1	Surfaces in three dimensions:	
2.2	Smooth surfaces, smooth maps, tangent and normal	
2.3	Lengths of curves on surfaces	
2.4	Isometries of surfaces	
2.5	Conformal mappings of surfaces	
3	**Curvature and Geodesic**	**18 Hours (40%)**
3.1	Second fundamental form	
3.2	Normal and geodesic curvature	
3.3	Gaussian and mean curvatures	
3.4	Principal curvatures of a surface	
3.5	Geodesic and its properties	

3.6	Geodesic equation.	
4	**Gauss' Theorema Egregium**	**6 Hours (14%)**
4.1	The Gauss and Codazzi - Mainardi equations,	
4.2	Gauss's theorem.	

D. Instructional Method and Pedagogy:

- At the starting of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- The teacher will show some of computer generated three dimensional figures and concepts.
- At the starting of the lecture, the teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, the teacher will say the topic he/she planned to cover in the next lecture.

E. Course Outcomes (COs):

At the end of the course, the students will be able to

CO1	analyze the geometrical primarily by focusing on the theory of curves and surface theory in modern science
CO2	apply classical lifelong problem-solving techniques of differential geometry in physics, engineering or other mathematical contexts
CO3	classify and apply concepts of differential geometry in various research fields using modern tools
CO4	find the solutions of the exercises and problems, the students have to analyze it first to solve. Students will be able to develop their communication skills and academic practices through self-prepared seminars.
CO5	develop their academic leadership through discussion in a group to solve exercises and quires of the course.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	3	-	-
CO2	3	-	3	3	-	-	-	-	-	-	3
CO3	3	-	3	-	-	-	-	-	-	-	-
CO4	-	3	3	3	-	3	-	3	-	-	-
CO5	-	-	-	3	3	-	-	-	-	-	-

Correlation levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

F. Recommended Study Material:

Text Books:

Andrew Pressly; Elementary Differential Geometry, SUMSeries, (2004).

Reference Books:

1. Goetz ; Introduction to Differential Geometry, Addison Wesley, Publ. Co., (1970).
2. C. E. Weatherburn; Differential Geometry in Three Dimensions, Cambridge University Press, (1964).
3. C. C. Hsiung; A First Course in Differential Geometry, John Wiley and Sons (1981)
4. E. D. Bloch; A First Course in Geometric Topology and Differential Geometry, Birkhauser (1997)
5. M. Spivak; A Comprehensive Introduction to Differential Geometry, Publish or Perish, INC (1999)

URL Links:

https://en.wikipedia.org/wiki/Differential_geometry
http://people.math.gatech.edu/~ghomi/LectureNotes/

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY
FACULTY OF APPLIED SCIENCES

M. SC. (MATHEMATICS) SEMESTER – II

MA723: LINEAR ALGEBRA

Credits and Hours

Teaching Scheme	**Theory**	**Practical/Seminar**	**Total**	**Credit**
Hours/week	4	1	5	4
Marks	100	-	100	

A. Objective of the Course:

This is a basic course in linear algebra which covers vectors spaces and matrices. It is useful in many branches of Mathematics especially Functional Analysis.

B. Outline of the course:

Sr No.	Title of the unit	Minimum number of hours
1.	Vector spaces	14
2.	linear transformations and Matrices	16
3.	Canonical forms of linear transformations:	16
4.	Trace and Determinants:	9
5.	Quadratic forms:	5
	Total Hours	**60**

C. Detailed Syllabus:

1	**Vector spaces**	**14 Hours (24%)**
1.1	Vector spaces and examples	
1.2	Subspaces	
1.3	Linear dependence, basis and dimension.	
1.4	Dual space.	
2	**linear transformations and Matrices**	**16 Hours (27%)**
2.1	The algebra of linear transformations	
2.2	Characteristic roots	
2.3	Matrix representation of linear transformations, and change of basis.	
3	**Canonical forms of linear transformations:**	**16 Hours (26%)**
3.1	Canonical triangular forms	
3.2	Canonical forms of a Nilpotent linear transformation.	
3.3	Decomposition of a finite dimensional vector space: Jordan forms	
4	**Trace and Determinants:**	**9 Hours (15%)**
4.1	Trace and transpose	
4.2	Determinants.	
5	**Quadratic forms:**	**5 Hours (08%)**
5.1	Reduction and classification of quadratic forms.	

D. Instructional Method and Pedagogy:

- At the starting of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing boardor multi-media projector or OHP etc.
- At the starting of the lecture, the teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, the teacher will say the topic he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	apply the concepts of this course to Computer Engineering / Information Technology, Physics
CO3	apply the concepts of this course in the study of Functional Analysis, Banach Algebras and Field Theory.
CO4	find the solutions of the exercises and problems, the students have to analyse it first to solve. Student will be able to develop their communication skill and academic practices through self-prepared seminars.
CO5	develop their academic leadership through discussion in a group to solve exercises and queries of this course

CO6	through the proof of the theorems, lemmas etc. covered in this course, students will be able to develop and enhance their ability of critical and clear thinking and ability of planning

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	3	3	3	-	-	-	-	-	3
CO2	3	-	3	3	-	-	-	-	-	-	3
CO3	3	-	3	3	-	-	-	-	-	-	3
CO4	3	3	3	3	-	-	3	3	-	-	3
CO5	3	3	3	3	-	3	-	-	-	-	3
CO6	3	3	3	3	-	-	-	-	-	-	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Text Books:

I.N. Herstein;- Topics in Algebra (2nd Edition, 1975).

Reference Books:

1. S. Kumaresan; Linear Algebra: A Geometric Approach, Prentice Hall Of India, (2000).
2. Helson; Linear Algebra, Hindustan Book Agency, Trim-4, (Second Edition) (1994).
3. J. H. Kwak And S. Hong; Linear Algebra, Birkhauser (Second Edition)
4. P. R. Halmos; Finite Dimensional Vector Spaces, Van Nostrand East-West Press
5. R. R. Stoll; Linear Algebra And Matrix Theory, Dover Publications, Inc., New York (1952)

URL Links:

https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/index
https://betterexplained.com/articles/linear-algebra-guide/

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

P. D. PATEL INSTITUTE OF APPLIED SCIENCES

DEPARTMENT OF MATHEMATICAL SCIENCES

MA724: PARTIAL DIFFERNTIAL EQUATIONS

M. Sc. SEMESTER - II

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	1	4	3
Marks	100	-	100	

A. Objective of the Course:

This course is to discuss some topics of the theory of partial differential equations and main focus in course will be given in finding solutions of particular equations.

B. Outline of the Course:

Sr. No.	Title of the unit	Minimum number of hours
1.	First Order Partial Differential Equations	15
2.	Second Order Partial Differential Equations	15
3.	Wave, Laplace and Heat equations	15
	Total hours:	**45**

C. Detailed Syllabus:

1	**First Order Partial Differential Equations:**	**15 Hours**	**33%**
1.1	Origins of First order Partial Differential Equations		
1.2	Cauchy's Problem for First order Equations		
1.3	Linear Equations of the First Order		
1.4	Pfaffian Differential equations		
1.5	Nonlinear Partial Differential Equations of the First Order		
1.6	Compatible Systems of First order Equations		
1.7	Charpit's Method		
1.8	Jacobi's Method.		
2	**Second Order Partial Differential Equations:**	**15 Hours**	**33%**
2.1	The Origin of Second order Equations		
2.2	Linear Partial Differential Equations with Constant Coefficients,		
2.3	Equations with Variable Coefficients,		

2.4	Classification of second order Partial Differential Equations and canonical form.		
2.5	The Solution of Linear Hyperbolic Equations,		
2.6	Separation of Variables.		
2.7	Nonlinear equation of second order.		
3	**Wave, Laplace and Heat equations:**	**15 Hours**	**34%**
3.1	Wave Equation, vibration of different type of strings		
3.2	Laplace equation: Boundary Value Problems		
3.3	Separation of Variables		
3.4	Dirichlet and Neumann problems		
3.5	Solutions of Heat equations.		

D. Instructional Method and Pedagogy:

a. At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
b. Lectures will be conducted with the aid of classical writing boardor multi-media projector or OHP etc.
c. Teacher will show some of computer generated three dimensional figures and concepts.
d. At the starting of the lecture, teacher will recall what he/she covered in last lecture.
e. At the end of the lecture, teacher will say the topic he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	solve partial differential equations arise in physical and engineering sciences
CO2	solve linear Partial Differential with different methods
CO3	classify partial differential equations and transform into canonical form
CO4	identify real phenomena as models of partial derivative equations.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	__	3	3	---	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Text Books:

1. N. Sneddon; Elements of Partial Differential Equations, McGraw- Hill Publ. Co., (1957).
2. T. Amarnath; Elementary Course in Partial Differential Equations, Narosa Publ. House, New Delhi, (1997).

Reference Books:

2. Phoolan Prasad and R. Ravindran; Partial Differential Equations, Wiley Eastern
2. Qing Han; A basic course in partial differential equations , The American Mathematical Society (2011).
3. Z. Rubinstein; A Course in Ordinary, Academic Press (1969)
4. H. F. Weinberger; Partial Differential Equations with complex variables and Transform Method, Dover Publications, INC (1965)

URL Links:

http://tutorial.math.lamar.edu/Classes/DE/IntroPDE.aspx
http://nptel.ac.in/courses/111103021/5
http://www.math.uni-leipzig.de/~miersemann/pdebook.pdf

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

P. D. PATEL INSTITUTE OF APPLIED SCIENCES

DEPARTMENT OF MATHEMATICAL SCIENCES

MA 725: REAL ANALYSIS - 1

M. Sc. SEMESTER - II

Credits and Hours:

Teaching Scheme	**Theory**	**Practical/Seminar**	**Total**	**Credit**
Hours/week	3	1	4	3
Marks	100	-	100	

A. Objective of the Course:

In this course focus will be given to Lebesgue measure and Lebesgue integration theory. It also covers theory functions of real variable.

B. Out line of the course:

Sr No.	Title of the unit	Minimum number of hours
1.	Measurable sets and Functions	**15**
2.	Lebesgue Integration	**15**
3.	Some classes of functions	**15**
	Total Hours	45

C. Detailed Syllabus:

1	**Measurable sets and Functions:**	**15 Hours (33%)**
1.1	Algebra and σ-algebra of sets, Borel sets in R	
1.2	Lebesgue outer measure in R	
1.3	Measurable sets and Lebesgue measure on R	
1.4	Non-measurable set	
1.5	Measurable functions	
1.6	Sums, Products, and Compositions of Measurable functions	
1.7	Littlewood's Three Principles	
1.8	Egoroff's Theorem and Lusin's Theorem	
2	**Lebesgue Integration:**	**15 Hours (34%)**
2.1	The Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure.	
2.2	Comparison of Riemann and Lebesgue integrations.	

2.3	The Lebesgue Integral of a Nonnegative Measurable Functions,	
2.4	The General Lebesgue Integral,	
2.5	Countable Additivity and Continuity of Integration.	
2.6	Fatou's lemma and monotone convergence theorem	
2.7	General Lebesgue integral,	
2.8	Dominated convergence theorem.	
2.9	Convergence in measure.	
3	**Some classes of functions:**	**15 Hours (33%)**
3.1	Continuity and Differentiability of Monotone Functions,	
3.2	Functions of Bounded Variation.	
3.3	Absolutely Continuous Functions.	
3.4	Integrating Derivatives: Differentiating Indefinite Integrals.	
3.5	Convex Functions	

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in last lecture.
- At the end of the lecture, teacher will say the topic he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	describe and dissect many core concepts of Complex Analysis and solve many complex integration
CO2	apply the concepts of this course to learn some other courses of Mathematics like Functional Analysis, Banach Algebras, Harmonic Analysis etc.
CO3	apply the concepts developed in this course in several branches of engineering.
CO4	develop their academic leadership through problem solving sessions of real analysis
CO5	develop their communication skills and an academic practice through self-prepared seminars of real analysis.
CO6	develop and enhance their ability of critical and clear thinking and their planning ability through the proof of the results of real analysis.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	-	-	-	3	3	3
CO2	3	-	3	3	-	-	--	-	3	-	3
CO3	3	-	3	3	3	-	-	-	3	-	3
CO4	3	3	3	3	-	-	-	-	3	-	3
CO5	3	-	-	-	-	3	-	3	-	-	3
CO6	3	3	3	3	-	-	-		-	-	3

F. Recommended Study Material:

Text Books:

H.L.Royden, Real Analysis (3rd Edition) Mc. Millan, 1998

Reference Books:

1. Rana, I. K., An introduction to measure and integration, Narosa Publ. House, New Delhi, 1997.
2. De Barra G. Introduction to measure theory, Van Nostrand Reinhold Co., 1974.
3. J. N. McDonald and N. A. Weiss; A Course on Real Analysis, Academic Press (2004)
4. Kolmogorov And S. V. Fomin ;Elements Of The Theory Of Functions And Functional Analysis Volume 2 Measure. The Lebesgue Integral. Hilbert Space, GRAYLOCK PRESS ALBANY, N. Y. (1961)
5. S. Hartman And J. Mikuslnski; The Theory of Lebesgue Easure And Integration, PERGAMON PRESS

URL Links:

http://home.iitk.ac.in/~tmk/courses/mth404/main.

https://ocw.mit.edu/courses/mathematics/18-125-measure-and-integration-fall-2003/lecture-notes/

https://www.uio.no/studier/emner/matnat/math/MAT2400/v11/RealAnalCh4.pdf

http://www.math.utoronto.ca/almut/MAT1000/LL-1.pdf

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. SC. (MATHEMATICS) SEMESTER – II

MA726: PROBLEMS AND EXERCISES IN MATHEMATICS - 2

Credits and Hours

Teaching Scheme	Theory	Seminar	Total	Credit
Hours/week	5	1	6	5
Marks	100	-	100	

A. Objective of the Course:

Problem related to above subjects as well as other branches of Mathematics will be discussed in this course. It is very helpful to develop the problem solving skill of the student which is a very important aspect of Mathematics and it will be helpful the students who want to make carrier in higher mathematics.

B. Outline of the course:

Sr. No.	Title of the unit	Minimum number of hours
1.	Algebra	15
2.	Differential Geometry	15
3.	Linear Algebra	15
4.	Partial Differential Equations	15
5.	Real Analysis	15
	Total	**75**

C. Detailed Syllabus:

1.	Problems and Exercises in Algebra	**15 Hours (20%)**
2.	Problems and Exercises in Differential Geometry	**15 Hours (20%)**
3.	Problems and Exercises in Linear Algebra	**15 Hours (20%)**
4.	Problems and Exercises in Partial Differential Equations	**15 Hours (20%)**
5.	Problems and Exercises in Real Analysis	**15 Hours (20%)**

D. Instructional Method and Pedagogy:

- At the starting of course, the teacher will say to the students the importance of this course.
- In this course, emphasizes will be given to problem solving.
- At the starting of the lecture, the teacher will recall problems discussed in the last session.

- At the end of the lecture, the teacher will give some problems to be discussed in the next session.
- Teacher will solve some problems in the class.
- Students will solved problems in the class with the help of the faculty members.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	understand the theory part of courses they have studied
CO2	enhance his/her thinking which would be helpful to them who are preparing for competitive examinations.
CO3	encourage/ inspire to go for research in Mathematics
CO4	develop their academic leadership through discussion in a group to solve exercises and queries of this course
CO5	find the solutions of the exercises and problems, the students have to analyse it first to solve. Student will be able to develop their communication skill and academic practices through self-prepared seminars.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	-	-	-	-	-	-	3
CO2	3	3	3	3	-	-	-	-	-	-	3
CO3	3	3	3	3	-	-	-	-	-	-	3
CO4	3	3	3	3	-	3	-	-	-	-	3
CO5	3	3	3	3	-	3	3	3	-	-	3
CO6	3	3	3	3	-	3	-	-	-	-	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Text Books:

All books mentioned in above syllabus of semester II as text books.

Reference Books:

All books mentioned in above syllabus semester II as reference books.

Enclosure - 2

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

Faculty of Applied Sciences

MATHEMATICAL SCIENCES

Syllabus

M. Sc. (Mathematics) (Semester-III & IV)

Effective from Academic Year 2019 - 20

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY
FACULTY OF APPLIED SCIENCES
Syllabus details
Effective from Academic year 2019 - 20

Degree : M. Sc. (Mathematics) **Semester :III**
Total Subjects : 7
Total Regular subjects : 6
Total Elective subjects : 1

Group name: Regular

Course Code	Course Title	Teaching scheme (hours)				Theory Evaluation		Total
		L	P	Total hrs.	Total Credits	Internal	External	
MA811	Mathematical Methods - 1	4	0	4	4	30	70	100
MA812	Algebra - 2	4	0	4	4	30	70	100
MA813	Topology -2	4	0	4	4	30	70	100
MA814	Functional Analysis	4	0	4	4	30	70	100
MA815	Problems and Exercises in Mathematics - 3	4	0	4	4	30	70	100
MA816	Comprehensive Viva	0	0	0	1	0	50	50
	Total			**20**	**21**			**550**

Group name: Elective

Course Code	Course Title	Teaching scheme (hours)				Theory Evaluation		Total
		L	P	Total hrs.	Total Credits	Internal	External	
MA817	Mathematical Foundation of Mechanics	4	0	4	4	30	70	100
MA818	Graph Theory	4	0	4	4	30	70	100
MA819	Operations Research	4	0	4	4	30	70	100

Total Credit for Regular Subjects	:	21
Total Credit for Elective Subjects	:	4
Total Credit	:	25

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY
FACULTY OF APPLIED SCIENCES
Syllabus details
Effective from Academic year 2019 - 20

Degree : M. Sc. (Mathematics) **Semester :IV**
Total Subjects : 7
Total Regular subjects : 6
Total Elective subjects : 1

Group name: Regular

Course Code	Course Title	Teaching scheme (hours)				Theory Evaluation		Total
		L	P	Total hrs.	Total Credits	Internal	External	
MA821	Mathematical Methods - 2	4	0	4	4	30	70	100
MA822	Advanced Complex Analysis	4	0	4	4	30	70	100
MA823	Banach Spaces and Banach Algebras	4	0	4	4	30	70	100
MA824	Special Functions	4	0	4	4	30	70	100
MA825	Problems and Exercises In Mathematics - 4	4	0	4	4	30	70	100
MA826	Comprehensive Viva	0	0	0	1	0	25/50	50
				20	**21**			

Group name: Elective

Course Code	Course Title	Teaching scheme (hours)				Theory Evaluation		Practical Evaluation		Total
		L	PR	Total hrs.	Total Credits	Internal	External	Internal	External	
MA827	Statistical Methods and Probability Theory	4	0	5	4	30	70	0	0	100
MA828	Tribology	4	0	5	4	30	70	0	0	100
MA829	Computer Programming and Mathematical Algorithms	2	4	6	4	15	35	15	35	100

Total Credit for Regular Subjects	:	21
Total Credit for Elective Subjects	:	4
Total Credit	:	25

M. Sc. (Mathematics) Semester – III & IV

Internal Evaluation: Internal evaluation will be done as under:

Name of examination	Number		Examination duration	Distribution of internal of 30 marks
Internal Test	Two		60 minutes each	20
Quiz/ Oral /Viva examination	At least two		5 to 10 minutes each	05
Seminar	At least one		About 15 to 20 minutes each	05

The evaluation will be done by the faculty members.

University examination:

There will be university examination at the end of each semester.

Remark:

Special interactive problem solving sessions will be conducted by respective faculty members on weekly bases. The courses are aimed to train the student to acquire the knowledge in higher mathematics which helps the student preparing for career in Higher Mathematics. More emphasize will be given to problem solving in each course.

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) SEMESTER - III

MA811: MATHEMATICAL METHODS – 1

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	4	1	5	4
Marks	100	-	100	

A. Objective of the Course:

In this course different type of mathematical techniques will be discussed. The topics covered in this course are applicable to Physical Sciences and different branches of Engineering.

B. Outline of the Course:

Sr No.	Title of the unit	Number of hours
1.	Fourier series and applications	15
2.	Fourier transforms and applications	15
3.	Laplace transforms and applications	15
4.	Orthonormalizations and other topics	15
	Total hours:	**60**

C. Detailed Syllabus:

			Hours
1.	**Fourier series and applications:**		**15 (25%)**
	1.1	Fourier series and Fourier coefficients. Parseval's identity	3
	1.2	Computation of Fourier series of some functions	4
	1.3	Fourier series and applications to boundary value problems Dirichlet and Neumann problems	8
2	**Fourier transforms and applications:**		**15 (25%)**
	2.1	Fourier integral representation and its applications	3
	2.2	Fourier transforms and its properties	3
	2.3	Computations of Fourier transforms of functions	3
	2.4	Convolution and Fourier transform	2
	2.5	Applications to the boundary value problems involving Heat equation, Wave equation and Laplace equations	4

3	**Laplace transforms and applications:**		**15 (25%)**
	3.1	Laplace transform and its properties	3
	3.2	Laplace transforms of some functions	2
	3.3	Inverse Laplace transform	4
	3.4	Convolution theorem	2
	3.5	Applications to solutions of ordinary differential equations, applications to the solutions of diffusion equation and wave equation	4
4.	**Orthonormalizations and other topics:**		**15 (25%)**
	4.1	Gram-Schmidt orthonormalization	3
	4.2	Legendre polynomials	2
	4.3	Hermite polynomials	2
	4.4	Jacobi polynomials	2
	4.5	Z-transform	3
	4.6	Green's function and its applications	3
		Total hours	60

D. **Instructional Method and Pedagogy:**

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	derive a Fourier series of a given periodic function by evaluating Fourier coefficients
CO2	recognize the different methods of finding Laplace transforms and Fourier transforms of different functions
CO3	apply the knowledge of Laplace transform, Fourier transform and Finite Fourier transforms in finding the solutions of differential equations, initial value problems and boundary value problems.
CO4	solve boundary value problems using Green function

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	3	3	3	3	3	3

CO2	3	__	3	3	---	3	3	3	3	3	3
CO3	3	__	3	3	3	3	3	3	3	3	3
CO4	3	__	3	3	---	3	3	3	3	3	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Reference Books:

1. Courant and Hilbert, Methods of Mathematical Physics Vol 1, Wiley International Publ . 1989
2. Lokenath Debnath And Dambarubhatta, Integral Transforms and Their Applications, Crc Press, Taylor & Francis Group (2015) Third Edition
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2004.
4. B. V. Limaye, Functional analysis, New Age International Publ. Ltd., New Delhi, 1996
5. L.A. Pipes, Applied Mathematics for Engineers and Physicists
6. M. D. Raisinghania, Advanced Differential Equations
7. Shankar Rao, Introduction to Partial Differential Equations
8. I. N. Sneddon; Special Functions of Mathematical Physics and Chemistry, Dover Publ. INC.

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) SEMESTER - III

MA812: ALGEBRA - 2

Credits and Hours

Teaching Scheme	Theory	Total	Credit
Hours/week	4	4	4
Marks	100	100	

A. Objective of the Course:

In this course is of abstract nature. It covers basic ring theory and field theory. The aim of this course to develop Galois Theory.

B. Outline of the course:

Sr No.	Title of the unit	Number of hours
1.	Ring Theory	15
2.	Euclidean Ring and Polynomial Ring	15
3.	Extension Fields	15
4.	Galois Theory	15
	Total hours:	60

C. Detailed Syllabus:

			Hours
1.	**Ring Theory:**		**15 (25%)**
	1.1	Definition and Examples of ring	3
	1.2	Special classes of rings	3
	1.3	Homomorphism	2
	1.4	Ideals and quotient rings	5
	1.5	Field of quotients of integral domain	2
2.	**Euclidean Ring and Polynomial Ring:**		**15 (25%)**
	2.1	Euclidean ring	4
	2.2	Euclidean ring J[i] of complex numbers with integral real and imaginary part	2
	2.3	Polynomial rings over a field	4
	2.4	Polynomial ring over the rational field	2
	2.5	Polynomial ring over a commutative ring	3
3.	**Extension Fields:**		**15 (25%)**
	3.1	Finite extension of a field	2
	3.2	Algebraic elements over a field	2
	3.3	Roots of polynomial over a field	4
	3.4	Construction with Straight-Edge and Compass	3
	3.5	Derivative of a polynomial and its roots	2
	3.6	Simple extension of a field	2
4.	**Galois Theory:**		**15 (25%)**
	4.1	Automorphisms on a field	1
	4.2	Fixed field of Group of automorphisms on a field and examples	2
	4.3	Group of automorphisms of a field K relative to a subfield F (in notation G(K, F))	2
	4.4	Relationship of degree of K over F and G(K,F)	4
	4.5	Normal extension of a field	3
	4.5	Fundamental theorem of Galois Theory	3
		Total hours	60

D. Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	understand the many core concepts of algebra and understand the Galois Theory
CO2	ready to go for higher study in Algebra
CO3	understand Theory of Equations
CO4	through the proof of the theorems, lemmas etc. covered in this course, students will be able to develop and enhance their ability of critical and clear thinking and ability of planning
CO5	develop their academic leadership through discussion in a group to solve exercises and queries of this course
CO6	find the solutions of the exercises and problems, the students have to analyse it first to solve. Student will be able to develop their communication skill and academic practices through self-prepared seminars.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	3
CO4	3	3	3	3	-	3	3	-	-	-	3
CO5	3	3	3	3	-	3	3	-	-	-	3
CO6	3	3	3	3	-	3	3	3	-	-	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Text Books:

1. I. N. Herstein, Topics in Algebra, Wiley Eastern. Ltd., New Delhi, 1975.

Reference Books:

1. M. Artin,, Algebra, Prentice Hall of India, 1991.
2. P.B. Bhattacharya, SK Jain and SR Nagpaul, Basic Abstract Algebra (2/e), Cambridge University Press, South Indian Edition 2002.
3. N. Jacobson, Basic Algebra, Vol. II, Hundastan Publ. Co., Delhi, 1984.
4. I.S. Luthar and I.B.S. Passi, Algebra Vol 3: Modules, Narosa Publishing House, New Delhi, 2004

URL Links:

http://www.math.ucsd.edu/~njw/Teaching/Math271C/Lecture_18.pdf
https://wwwf.imperial.ac.uk/~anskor/notesM2P4.pdf
http://www.math.uchicago.edu/~may/VIGRE/VIGRE2009/REUPapers/Moy.pdf
https://www.math.ku.edu/~mandal/math791/spFteen791/P6Extension.pdf
http://www.math.iitb.ac.in/~srg/Lecnotes/galois.pdf
http://www.math.tifr.res.in/~publ/pamphlets/galoistheory.pdf

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) SEMESTER - III

MA813: TOPOLOGY - 2

Credits and Hours

Teaching Scheme	Theory	Seminar	Total	Credit
Hours/week	4	1	5	4
Marks	100	-	100	

A. Objective of the Course:

In this course is of abstract nature. It covers many concepts of point set topology.

B. Out line of the course:

Sr No.	Title of the unit	Number of hours
1.	Basic concepts of Topology	15
2.	Compact Topological Spaces	15
3.	Separations	15
4.	Connectedness	15
	Total hours:	60

C. Detailed Syllabus:

			Hours
1.	**Basic concepts of Topology:**		**15 (25%)**
	1.1	Topological Spaces: Definition and Examples	3
	1.2	Elementary concepts: Open sets, Closed sets, interior points, limit points, boundary points	4
	1.3	Open bases and open subbases, Weak and strong topologies	5
	1.4	First and second countable spaces. Continuous functions	3
2	**Compact Topological Spaces:**		**15 (25%)**
	2.1	Compact Spaces	5
	2.2	Locally compact spaces	2
	2.3	One Point Compactification	3
	2.4	Product topology and Tychonoff Theorem	5
3	**Separations:**		**15 (25%)**
	3.1	T_0, T_1 spaces, Hausdorff spaces,	3

	3.2	Completely regular spaces, normal spaces	3
	3.3	Urysohn's lemma	3
	3.4	Tietze Extension Theorem	3
	3.5	Stone-Cech Compactification	3
4.	**Connectedness:**		**15 (25%)**
	4.1	Connected and disconnected spaces	3
	4.2	Components	3
	4.3	Totally Disconnected Spaces	2
	4.4	Locally connected Spaces	2
	4.5	Locally compact Housdorff Spaces	4
	4.6	Stone-Weierstrass Theorems (without proof)	1
		Total	60

D. Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	analyze many core concepts of General topology.
CO2	apply the concepts of this course to learn some other courses of Mathematics especially analysis.
CO3	apply these topics in the Physics and Computer engineering, Information & Technology etc.
CO4	summarize the basic concepts of generalized topology to the application point of view in Dynamical system, Homotopy, etc.
CO5	develop and enhance their ability of critical and clear thinking and their planning ability through the proof of the results of real analysis.
CO6	develop their communication skills and an academic practice through self-prepared seminars of real analysis.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	-	3	-	-	-	-	3
CO2	3	-	3	3	-	-	-	-	-	-	3
CO3	3	3	3	3	3	-	-	-	3	-	3

CO4	3	3	3	3	-	-	-	-	-	-	3
CO5	3	3	3	3	-	-	-	-	-	-	-
CO6	3	3	-	-	-	-	-	3	-	-	-

F. Recommended Study Material:

Text Books:

1. Simmons G. F., Introduction to Topology and Modern Analysis, Tata McGraw-Hill Co.
2. Munkres, J., Topology: A First Course, Prentice Hall of India Pvt. Ltd., New Delhi

Reference Books:

1. Joshi, K. D. Introduction to General Topology, Wiley Eastern Ltd. 1984
2. Willards, S., General Topology, Addison-Wesley, Reading, 1970.

URL Links:

http://home.iitk.ac.in/~chavan/topology_mth304.pdf
http://www.cmi.ac.in/~debangshu/TopNotes.pdf
http://www.math.harvard.edu/~ctm/papers/home/text/class/harvard/131/course/course.pdf
https://www3.nd.edu/~stolz/Math60330(F2014)/Notes_Pointset_Topology.pdf

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) SEMESTER - III

MA814: FUNCTIONAL ANALYSIS - 1

Credits and Hours

Teaching Scheme	Theory	Total	Credit
Hours/week	4	4	4
Marks	100	100	

A. Objective of the Course:

In this course the theory of Hilbert spaces and operators will be developed. The topics covered in this course are useful in the study of Mathematical Physics especially Quantum Mechanics.

B. Outline of the course:

Sr No.	Title of the unit	Number of hours
1.	Inner product spaces	15
2.	Approximation, optimization and standard theorems	15
3.	Bounded linear operators	15
4.	Spectrum and Numerical Range. Compact self-adjoint operators	15
	Total hours:	60

C. Detailed Syllabus:

			Hours
1.	**Inner product spaces:**		**15 (25%)**
	1.1	Inner product spaces: Definition and examples. Normed linear space: Definition and examples	3
	1.2	Polarization identity, Schwarz's inequality	2
	1.3	Orthogonal sets, Gram-Schmidt Orthonormalization, Bessel's inequality	2
	1.4	Hilbert spaces. Orthonormal basis. Riesz – Fischer theorem	3
	1.5	Separable Hilbert space	2
	1.6	Weak convergence and weak boundedness	3
2	**Approximation, optimization and standard theorems:**		**15 (25%)**
	2.1	Existence and uniqueness of Best approximation from a certain set to a point	3
	2.2	Gram- matrix and its applications	3
	2.3	Best approximation from a closed subspace to a point	3
	2.4	Projection theorem	2
	2.5	Riesz representation theorem	2
	2.6	Unique Hahn- Banach extension theorem	2
3	**Bounded linear operators:**		**15 (25%)**
	3.1	Continuity / boundedness of a linear operator. Adjoint of a bounded operator	3
	3.2	Matrix representation of a bounded operator	3
	3.3	Adjoint of a bounded operator.	3
	3.4	Normal and unitary operators	3
	35	Self-adjoint operators. Positive operators	3
4.	**Spectrum and Numerical Range. Compact self-adjoint operators.**		**15 (25%)**
	4.1	Definition and Example: the spectrum of a bounded operator	2
	4.2	Parts of the spectrum and its relations. Results on spectrum	2
	4.3	Definition of Numerical range of an operator. Relationship of the spectrum and numerical range of an operator. Results on numerical range	3
	4.4	Compact operators, Hilbert - Schmidt operator	3
	4.5	Compact self-adjoint operators	4
	4.6	Statement of "Spectral theorem for a compact self-adjoint operator"	1
		Total hours	60

D. Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.

- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	understand the Geometry on some vector spaces
CO2	apply the concepts of this course to Physics and Quantum Mechanics
CO3	apply the concepts of this course in the study Banach Algebras
CO4	develop their academic leadership through discussion in a group to solve exercises and queries of this course
CO5	through the proof of the theorems, lemmas etc. covered in this course, students will be able to develop and enhance their ability of critical and clear thinking and ability of planning
CO6	find the solutions of the exercises and problems, the students have to analyse it first to solve. Student will be able to develop their communication skill and academic practices through self-prepared seminars.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	3	-	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	3
CO4	3	3	3	3	-	3	3	3	-	-	3
CO5	3	3	3	3	-	-	3	3	-	-	3
CO6	3	3	3	3	-	-	3	3	-	-	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Text Books:

1. Limaye, B.V., Functional Analysis, New Age International Publ. Ltd., New Delhi, 1996

Reference Books:

1. Royden,H.L., Real Analysis (3rd Edition) Mc. Millan, 1998.
2. Simmons G. F., Introduction to Topology and Modern Analysis, Tata McGraw-Hill Co.

URL Links:

http://calvino.polito.it/~terzafac/Corsi/functional_analysis/pdf/chap1.pdf
https://www.math.uni-hamburg.de/home/gunesch/calc1/chapter11.pdf
http://www.pitt.edu/~hajlasz/Notatki/Functional%20Analysis2.pdf
http://web.maths.unsw.edu.au/~potapov/5605_2015/Lecture-Notes.html

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) SEMESTER - III

MA815: PROBLEMS AND EXERCISES IN MATHEMATICS - 3

Credits and Hours

Teaching Scheme	Theory	Total	Credit
Hours/week	4	4	4
Marks	100	100	

A. Objective of the Course:

Problem related to above subjects as well as other branches of Mathematics will be discussed in this course. It is very helpful to develop the problem solving skill of the student which is a very important aspect of Mathematics and it will be helpful the students who want to make carrier in higher mathematics.

B. Outline of the course:

Sr No.	Title of the unit	Number of hours
1.	Mathematical Methods	10
2.	Statistical Methods	10
3.	Functional Analysis	10
4.	Algebra	10
5.	Topology	10
6.	Elective course	10
	Total hours	60

C. Detailed Syllabus:

		Hours
1.	Problems and Exercises in Mathematical Methods	10 (17%)
2.	Problems and Exercises in basic Statistical Methods: Descriptive Statistics, Elementary Probability theory	10 (17%)
3.	Problems and Exercises in Functional Analysis	10 (16%)
4.	Problems and Exercises in Algebra	10 (17%)
5.	Problems and Exercises in Topology	10 (17%)
6.	Problems pertaining to Elective course offered	10 (16%)
	Total	60

D. Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.
- In this course, emphasizes will be given to problem solving.
- Teacher will solve some problems in the class.
- Students will solve problems in the class with the help of the faculty members.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	understand the theory part of courses they have studied
CO2	enhance his/her thinking which would be helpful to them who are preparing for competitive examinations.
CO3	encourage/ inspire to go for research in Mathematics
CO4	develop their academic leadership through discussion in a group to solve exercises and queries of this course
CO5	find the solutions of the exercises and problems, the students have to analyse it first to solve. Student will be able to develop their communication skill and academic practices through self-prepared seminars.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	-	-	-	-	-	-	3
CO2	3	3	3	3	-	-	-	-	-	-	3
CO3	3	3	3	3	-	-	-	-	-	-	3
CO4	3	3	3	3	-	3	-	-	-	-	3
CO5	3	3	3	3	-	3	3	3	-	-	3
CO6	3	3	3	3	-	3	-	-	-	-	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Reference Books:

All books mentioned in above syllabus as text books and reference books.

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) SEMESTER - III

MA817: MATHEMATICAL FOUNDATION OF MECHANICS

Credits and Hours

Teaching Scheme	Theory	Seminar	Total	Credit
Hours/week	4	1	5	4
Marks	100	-	100	

A. Objective of the Course:

This course is a Mathematical foundation of Mechanics.

B. Outline of the course:

Sr No.	Title of the unit	Number of hours
1.	Lagrangian formulation	15
2.	Euler-Lagrange equation, Hamilton's variational principle	15
3.	Hamilton's canonical equation of motion	15
4.	Canonical transformations	15
	Total hours:	60

C. Detailed Syllabus:

			Hours
1.	**Lagrangian formulation**		**15 (25%)**
	1.1	D'almbert's principle. Principle of virtual work	4
	1.2	Classification of constraints	3
	1.3	Lagrange's equation for holonomic systems and illustrations.	4
	1.4	Lagrange's equation in velocity dependent potential and non-commutative forces	4
2	**Euler-Lagrange equation, Hamilton's variational principle**		**15 (25%)**
	2.1	Variational calculus, statement of Euler's equations, Hamilton's variational principle	2
	2.2	Derivation of Lagrange's equation from Hamilton's variational principle	3
	2.3	Generalized momentum-mechanics in configuration space. Illustration on generalized momenta and energy function	5
	2.4	General conservation theorem and illustration	5
3	**Hamilton's canonical equation of motion**		**15 (25%)**
	3.1	Hamilton's canonical equations of motion using Legendre transform	3
	3.2	Relation with Lagrange's equations	3
	3.3	Conservation theorems	3

	3.4	Variational principle approach to Hamilton's equation of motion	3
	3.5	Variational principle and Hamilton's equation and examples	3
4.	**Canonical transformations**		**15 (25%)**
	4.1	Canonical transformations	2
	4.2	Generating functions	2
	4.3	Symplectic condition	2
	4.4	Infintesimal canonical transformations and examples	2
	4.5	Poisson bracket formulation and illustration	3
	4.6	General equation of motion and its formal solution	4
		Total hours	60

D. Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.

E. Course Outcomes:

At the end of the course, the students will be able to

CO1	explain the basic mechanics and solving relevant problems mathematically in modern and classical mechanics.
CO2	justify the lifelong contribution of Lagrangian and Hamiltonian in Mechanics
CO3	analyze critically about various real life activities using modern tools and understand those complex phenomena using the concepts of classical mechanics
CO4	find the solutions of the exercises and problems, the students have to analyze it first to solve. Students will be able to develop their communication skills and academic practices through self- prepared seminars.
CO5	develop their academic leadership through discussion in a group to solve exercises and quires of the course.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	3	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	3
CO3	3	3	3	3	-	-	-	-	-	3	-
CO4	-	3	3	-	-	3	-	3	-	-	-
CO5	-	-	-	-	3	3	-	-	-	-	-

Correlation levels 1, 2 or 3 as defined below:1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

F. Recommended Study Material:

Text Book:

1.Goldstein, H., Poole, C. and Safko, J., Classical Mechanics, (Third Edition), Pearson Education, Inc., Indian Low Price Edition, 2002.

2.Bhatia, B. V., Classical Mechanics with Introduction to Nonlinear Oscillations and Chaos, Narosa Publ. House, 1997.

URL Links:

http://www.fulviofrisone.com/attachments/article/468/Arya%20-%20Classical%20Mechanics%202nd%20ed(T).pdf
http://www.astro.caltech.edu/~golwala/ph106ab/ph106ab_notes.pdf
https://www.youtube.com/watch?v=ApUFtLCrU90
http://www.damtp.cam.ac.uk/user/tong/dynamics/clas.pdf
http://farside.ph.utexas.edu/teaching/301/301.pdf

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) Semester- IV

MA821: MATHEMATICAL METHODS – 2

Credits and Hours:

Teaching Scheme	Theory	Total	Credit
Hours/week	4	4	4
Marks	100	100	

A. Objective of the Course:

In this course different type of mathematical techniques will be discussed. The topics covered in this course are applicable to Physical Sciences and different branches of Engineering.

B. Outline of the Course:

Sr No.	Title of the unit	Number of hours
1.	Euler's equation	15
2.	Integral equations	15
3.	Fredholm integral equations	15
4.	Bessel's, Laguerre's, Hermite, Sturm-Liouville equations	15
	Total hours:	60

C. Detailed Syllabus:

			Hours
1.	**Euler's equation:**		**15 (25%)**
	1.1	Functionals. Euler's equation	3
	1.2	Other forms of Euler's equation	3
	1.3	Some special forms of Euler's equation, geodesics	3
	1.4	Isoperimetric problems, several dependent variables	3
	1.5	Functionals involving higher order derivatives	3
2	**Integral equations:**		**15 (25%)**
	2.1	Integral equations, types of integral equations	3
	2.2	Conversion of differential equation into an integral equation and vice versa	3
	2.3	Solution of integral equation	3

	24	Integral equations of convolution type	3
	2.5	Abel's integral equations, integro-differential equation	3
3	**Fredholm integral equations:**		**15 (25%)**
	3.1	Compact operators and some properties of compact operators	3
	3.2	Compact operators on C[a, b] and L^2[a, b]	3
	3.3	Fredholm integral equations	3
	3.4	Fredholm alternative theorem	3
	3.5	Solutions of Fredholm integral equations for separable kernels	3
4.	**Bessel's, Laguerre's, Hermite, Sturm-Liouville equations:**		**15 (25%)**
	4.1	Legendre equation	3
	4.2	Laguerre equation	3
	4.3	Hermite equation	3
	4.4	Sturm-Liouville equations	3
	4.5	Conversion of various types of differential equations into Sturm-Liouville equation, their solutions	3
		Total hours	60

D. Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	elaborate what functionals are, and their appreciations
CO2	use the Euler-Lagrange equation or its first integral to find differential equations for stationary paths
CO3	solve linear Volterra and Fredholm integral equations using appropriate methods
CO4	solve the Sturm-Liouville problems
CO5	develop their academic leadership through discussion in a group to solve exercises and queries of this course
CO6	find the solutions of the exercises and problems, the students have to analyse it first to solve. Student will be able to develop their communication skill and academic practices through self-prepared seminars

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	__	3	3	__	3	3	3	3	3	3

CO2	3	__	3	3	__	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	__	3	3	__	3	3	3	3	3	3
CO5	3	3	3	3	3	--	--	--	--	--	3
CO6	3	3	3	3	3	--	--	3	--	--	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

H. Recommended Study Material:

Reference Books:

1. Lokenath Debnath And Dambarubhatta, Integral Transforms and Their Applications, Crc Press, Taylor & Francis Group (2015) Third Edition
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publs, 3rd Edition, Delhi.
3. A. S. Gupta, calculus of variations with applications, Prentice-Hall of India, New Delhi, 1999.
4. N. Kumar, An elementary course on variational problems in calculus, Narosa Publishing House, New Delhi, 2005
5. B. V. Limaye, Functional analysis, 2nd Edition, New Delhi, 1996.
6. S. G. Mikhlin, Integral Equations and Applications.

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) Semester- IV

MA822: ADVANCED COMPLEX ANALYSIS

Credits and Hours

Teaching Scheme	Theory	Total	Credit
Hours/week	4	4	4
Marks	100	100	

A. Objective of the Course:

In this course the complex variable function theory will be discussed. The topics covered in this course are necessary for some other subjects of Mathematics.

B. Outline of the course:

Sr No.	Title of the unit	Number of hours
1.	Cauchy's formulas	15
2.	Open Mapping theorem, Maximum modulus principle	15
3.	Compactness and Convergence in the space of Analytic functions	15
4.	Riemann mapping theorem and Factorization theorem	15
	Total hours:	60

C. Detailed Syllabus:

			Hours
1.	**Cauchy's formulas:**		**15 (25%)**
	1.1	Index of a closed curve	3
	1.2	Different versions of Cauchy's theorem and Cauchy's integral formula	12
2.	**Open Mapping theorem, Maximum modulus principle:**		**15 (25%)**
	2.1	Counting zeros and Open Mapping Theorem	3
	2.2	Meromorphic functions, the argument principle, Rouche's theorem	3
	2.3	Different versions of Maximum Modulus Theorem	3
	2.4	Schwarz lemma and its application	3
	2.5	Convex functions and Hadmard's theorem.	3
3.	**Compactness and Convergence in the space of Analytic functions:**		**15 (25%)**

	3.1	C(G, Ω), the spaces of continuous functions from open subset G of C to a metric space Ω. Topology of uniform convergence on compact sets	3
	3.2	Normal subset of C(G, Ω), Arzela - Ascoli theorem.	4
	3.3	Space of analytic functions, Hurwitz's theorem, Montel's theorem	4
	3.4	Space of meromorphic functions	4
4.	**Riemann mapping theorem and Factorization theorem:**		**15 (25%)**
	4.1	Riemann mapping theorem	3
	4.2	Weierstrass factorization theorem	10
	4.3	Factorization of functions	2
		Total hours	60

D. Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	gain the many core concepts of complex variable functions.
CO2	infer a basic knowledge of the Complex Analysis.
CO3	apply concepts of this course to signal processing and control theory and to learn some other courses of Mathematics.
CO4	develop and enhance their ability of critical and clear thinking and their planning ability through the proof of the results of real analysis.
CO5	develop their communication skills and an academic practice through self-prepared seminars of real analysis.
CO6	develop their academic leadership through problem solving sessions of real analysis.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	-	-	-	-	-	-	3
CO2	3	3	3	3	-	-	-	-	-	-	3
CO3	3	3	3	3	3	-	-	-	-	-	3
CO4	3	3	3	3	-	-	-	-	-	-	3
CO5	3	3	-	-	-	-	-	3	-	-	3
CO6	3	3	3	3	-	3	-	-	-	-	3

F. Recommended Study Material:

Text Book:

1. J. B. Conway - Functions of one complex variable, Springer Verlag.

Reference Book:

1. W. Rudin, Real and Complex Analysis, McGraw Hill, 1967
2. J. W. Brown and R. V. Churchill; Complex Variables and Applications, McGraw-Hill Education (2009) ninth edition.

URL Links:

http://people.math.sc.edu/girardi/m7034/book/AshComplexVariablesWithHyperlinks.pdf

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) Semester- IV

MA823: BANACH SPACES AND BANACH ALGEBRAS

Credits and Hours

Teaching Scheme	Theory	Total	Credit
Hours/week	4	4	4
Marks	100	100	

A. Objective of the Course:

In this course advance topics of functional analysis like: theory of Normed spaces, Banach spaces and Banach Algebras will be discussed. Also some topics of operator on Banach space will be discussed. It is an advanced level course.

B. Outline of the course:

Sr No.	Title of the unit	Number of hours
1.	Normed Linear Spaces and operators	15
2.	Hahn Banach, Open mapping, closed graph and uniform boundedness theorems	15
3.	Basics of Banach Algebras	15
4.	Commutative Banach Algebras	15
	Total hours:	60

C. Detailed Syllabus:

			Hours
1.	**Normed Linear Spaces and operators:**		**15 (25%)**
	1.1	Normed linear spaces and Banach Spaces (examples and basic properties)	5
	1.2	Bounded linear transformations	4
	1.3	Space of bounded linear transformations	3
	1.4	Dual and second dual of a normed space, Weak and weak* convergence	3
2	**Hahn Banach, Open mapping, closed graph and uniform boundedness theorems:**		**15 (25%)**
	2.1	Hahn-Banach extension theorem	3
	2.2	Open mapping, Closed Graph and Bounded Inverse theorems	5
	2.3	Uniform boundedness principle	2
	2.4	Conjugate of an operator	5
3	**Basics of Banach Algebras:**		
	3.1	Banach algebras, examples	4

	3.2	Regular and singular elements, topological divisors of zero,	3
	3.3	Spectrum of an element and spectral radius, Gel'fand Mazur types theorems	5
	3.4	Radical and Semi-simplicity	3
4.	**Commutative Banach Algebras:**		**15 (25%)**
	4.1	The Gel'fand space, Gel'fand transform	5
	4.2	Complex homomorphisms and maximal ideals	3
	4.3	Applications of the Spectral Radius Formula	2
	4.4	Involution in Banach algebras	2
	4.5	Gelfand – Neumark theorem	3
		Total hours	60

D. Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	understand the many core concepts of Normed spaces, Banach spaces
CO2	understand the many core concepts of Banach algebras and Gelfand Theory
CO3	realize how to put extra efforts to prove the results which they have studied in Hilbert space theory in the absence of geometry.
CO4	through the proof of the theorems, lemmas etc. covered in this course, students will be able to develop and enhance their ability of critical and clear thinking and ability of planning
CO5	find the solutions of the exercises and problems, the students have to analyse it first to solve. Student will be able to develop their communication skill and academic practices through self-prepared seminars
CO6	develop their academic leadership through discussion in a group to solve exercises and queries of this course

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	-	-	3
CO4	3	3	3	3	-	3	3	-	-	-	3
CO5	3	3	3	3	-	3	3	3	-	-	3

CO6	3	3	3	3	-	3	3	-	-	-	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Text Book:

1. G. F. Simmons, Introduction to Modern Analysis, McGraw-Hill Book Company, Inc. 1963

Reference Book:

1. B. V. Limaye, Functional Analysis, New Age International (P) Ltd., 2001
2. R. Larsen, Banach Algebras, Marcell-Dekker, 197
3. V. K. Krishnan, Text book of Functional Analysis; A problem oriented approach, Prentice Hall of India, 2001.
4. S. Ponnusamy, Foundations of Functional Analysis, Narosa Pub. House, 2004
5. Thamban Nair, Functional Analysis-a first course, Printice Hall of India, 2002.
6. E. Kaniuth, A Course in Commutative Banach Algebras, Springer, New York, 2009.

URL Links:

http://www.maths.lancs.ac.uk/~belton/www/notes/fa_notes.pdf
http://home.iitk.ac.in/~chavan/fa_mth405_1.pdf
https://people.math.ethz.ch/~salamon/PREPRINTS/funcana.pdf
http://bass.math.uconn.edu/fa090614.pdf
http://personal.lse.ac.uk/sasane/ma412.pdf
https://www.iith.ac.in/~rameshg/banachalgebras.pdf
http://www.math.nagoya-u.ac.jp/~richard/teaching/s2014/Course_Wilde.pdf
https://math.berkeley.edu/~ceur/notes_pdf/Eur_Math206_BanachSpectral_Notes.pdf
https://people.math.osu.edu/costin.9/7212/C2.pdf

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) Semester- IV

MA824: SPECIAL FUNCTIONS

Credits and Hours

Teaching Scheme	Theory	Total	Credit
Hours/week	4	4	4
Marks	100	100	

A. Objective of the Course:

This course covers theory of special functions. The topic covered may be useful in certain problems of Physics and Engineering.

B. Outline of the course:

Sr No.	Title of the unit	Number of hours
1.	Gamma and Beta functions	15
2.	Hypergeometric function	15
3.	Generalized hypergeometric function	15
4.	The Bessel function	15
	Total hours:	60

C. Detailed Syllabus:

			Hours
1.	**Gamma and Beta functions:**		**15 (25%)**
	1.1	Infinite product	4
	1.2	Gamma function	2
	1.3	Weierstrass definition	3
	1.4	Euler product formula	1
	1.5	Series for $\Gamma'(z)/\Gamma(z)$	1
	1.6	Beta function	2
	1.7	Factorial function.	2
2.	**Hypergeometric function:**		**15 (25%)**
	2.1	Convergence of series	1
	2.2	Integral representation	1
	2.3	Differential equation	2
	2.4	Analyticity of ${}_2F_1[z]$ and its properties	2
	2.5	Contiguous functions relations	3

	2.6	Simple and quadratic transformations	5
	2.7	Kummer's theorem for ${}_2F_1[-1]$.	1
3.	**Generalized hypergeometric function ${}_pF_q[z]$**		**15 (25%)**
	3.1	Convergence of series	1
	3.2	Integral representation	1
	3.3	Differential equation	2
	3.4	Saalschutz's theorem	4
	3.5	Whipple's theorem	3
	3.6	Dixon's theorem	2
	3.7	Confluent hypergeometric function (Integral representation and differential equation)	1
	3.8	Kummer's first and second formula	1
4.	**The Bessel function and generating functions**		**15 (25%)**
	4.1	The Bessel function $J_n(z)$ as ${}_0F_1[z]$	1
	4.2	Differential equation	2
	4.3	Recurrence relations and pure recurrence relation	2
	4.4	Generating function	3
	4.5	Bessel's integral	2
	4.6	Index half an odd integer and Modified Bessel function	1
	4.7	Generating functions of the form $G(2xt - t^2)$	1
	4.8	Sets generated by $e^t\psi(xt)$	2
	4.9	The generating functions $A(t)\exp[-xt/(1-t)]$	1
		Total hours	60

D. Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.

E. Course Outcomes:

At the end of the course, the students would be able to

CO1	investigate and derive the properties of special functions along with their existence, conclude inter-relations between such functions, derive alternate representations of Special Functions in various forms and demonstrate use of Special Functions in Lie Algebra, Number theory and Physics.
CO2	develop their academic leadership through discussion in a group to solve exercises, queries of this course and develop communication skills through self-prepared

	seminar.
CO3	describe and analyze the generalized Hypergeometric function, the Bessel functions, the Confluent hypergeometric function, Generating Function relations along with their properties in a researched based problem.
CO4	through the proof of the exercises and problems, the students have to analyze it first and solve using the techniques of this course.
CO5	achieve the knowledge to analyse the problems using the methods of special functions, which helps in exploring the role of special functions in other areas of science and technology.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	3	3	-	-	-	3	-	-	-
CO2	3	3	-	-	-	3	3	3	-	-	3
CO3	3	-	3	3	-	-	-	-	-	-	3
CO4	3	-	3	3	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	3

F. Recommended Study Material:

Text book:

1. E. D. Rainville, Special Functions, Macmillan Co., New York, 1960

Reference Books:

1. G. E. Andrews, R. Askey, and Ranjan Roy, Special Functions, Cambridge University Press, 1999.
2. Z. X. Wang and D. R. Guo, Special Functions, World Scientific Publ., Singapore, 1989.
3. G. N. Watson, A treatise on the theory of Bessel functions, Cambridge University press, Cambridge, UK, 1996.

URL Links:

http://www.math.odu.edu/~jhh/ch115.PDF
http://www.math.ku.dk/~henrikp/wosfa/book-of-abstracts.pdf
http://www.math.tamu.edu/~fnarc/psfiles/special_fun.pdf
http://web.mst.edu/~lmhall/SPFNS/sfch5.pdf

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) Semester- IV

MA825: PROBLEMS AND EXERCISES IN MATHEMATICS - 4

Credits and Hours

Teaching Scheme	Theory	Total	Credit
Hours/week	4	4	4
Marks	100	100	

A. Objective of the Course:

Problem related to above subjects as well as other branches of Mathematics will be discussed in this course. It is very helpful to develop the problem solving skill of the student which is a very important aspect of Mathematics and it will be helpful the students who want to make carrier in higher mathematics.

B. Outline of the course:

Sr No.	Title of the unit	Number of hours
1.	Mathematical Methods	10
2.	Advanced Complex Analysis	10
3.	Banach Spaces and Banach Algebras	10
4.	Special Functions	10
5.	General Mathematics	10
6.	Elective course	10
	Total hours	60

C. Detailed Syllabus:

		Hours
1.	Problems and Exercises in Mathematical Methods	10 (17%)
2.	Problems and Exercises in Complex Analysis	10 (17%)
3.	Problems and Exercises in Banach spaces and Banach Algebras	10 (16%)
4.	Problems and Exercises in Special Functions	10 (17%)
5.	Problems and Exercises in general mathematics	10 (17%)
6.	Problems pertaining to Elective course offered	10 (16%)
	Total	60

D. Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.

- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.
- In this course, emphasizes will be given to problem solving.
- Teacher will solve some problems in the class.
- Students will solve problems in the class with the help of the faculty members.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	understand the theory part of courses they have studied
CO2	enhance his/her thinking which would be helpful to them who are preparing for competitive examinations.
CO3	Encourage/inspire to go for research in Mathematics
CO4	develop their academic leadership through discussion in a group to solve exercises and queries of this course
CO5	find the solutions of the exercises and problems, the students have to analyse it first to solve. Student will be able to develop their communication skill and academic practices through self-prepared seminars.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	-	-	-	-	-	-	3
CO2	3	3	3	3	-	-	-	-	-	-	3
CO3	3	3	3	3	-	-	-	-	-	-	3
CO4	3	3	3	3	-	3	-	-	-	-	3
CO5	3	3	3	3	-	3	3	3	-	-	3
CO6	3	3	3	3	-	3	-	-	-	-	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Reference Books:

All books mentioned in above syllabus as text books and reference books.

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) Semester- IV

MA827: STATISTICAL METHODS AND PROBABILITY THEORY

Credits and Hours

Teaching Scheme	Theory	Total	Credit
Hours/week	4	4	4
Marks	100	100	

A. Objective of the Course:

In this course different type of Statistical techniques will be discussed. The topics covered in this course are applicable to data analysis.

B. Outline of the course:

Sr No.	Title of the unit	Number of hours
1.	Discrete Probability Distributions	10
2.	Continuous Probability Distributions	15
3.	Parametric Estimation	15
4.	Statistical Inference	20
	Total hours:	60

C. Detailed Syllabus:

			Hours
1.	**Discrete Probability Distributions:**		**10 (17%)**
	1.1	Discrete Random Variables	1
	1.2	Expectation, Variance, Moments and Moment Generating function	2
	1.3	The Binomial Distribution	2
	1.4	The Negative Binomial Distribution	2
	1.5	The Poisson Distribution	3
2.	**Continuous Probability Distributions:**		**15 (25%)**
	2.1	Continuous Random Variables	2
	2.2	The Exponential, Gamma and Chi-Square Distributions	4
	2.3	The Normal Distribution	4
	2.4	Vector Random Variables and Distribution of Functions of Vector Random Variables	2
	2.5	Independent Random Variables	1
	2.6	Dispersion matrix and correlations Covariance, Correlation, and Moments	2
3.	**Parametric Estimation:**		**15 (25%)**
	3.1	Sampling and Sampling Distributions	4
	3.2	Law of Large Numbers and Central Limit Theorem	2
	3.3	Problem of Point Estimation: Unbiased Estimation, Maximum Likelihood Estimation	4

	3.4	Interval Estimation: Confidence Intervals based on Sampling from Normal Distribution: Mean, Variance, Proportion, Difference in mean	5
4.	**Statistical Inference:**		**20 (33%)**
	4.1	Introduction to Hypothesis: Simple and Composite Hypotheses	3
	4.2	Types of Errors in Tests of Hypotheses, Power of a Statistical Test	4
	4.3	Hypotheses Tests based on Sampling from Normal Distributions: Mean, Variance, Several Means, Several Variances	7
	4.4	Categorical Data: Association and Independence	3
	4.2	Test of Independence of Attributes	3
		Total hours	60

D. Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.

E. Course Outcomes:

At the end of this course, student will be able to

CO1	interpret and apply probability techniques in problem solving.
CO2	define random variables and its probability distribution and determine transformation of random variables.
CO3	compute the moments (mean and variance) and the moment generating function of random variable
CO4	understand the important properties of known probability distributions (Binomial, Poisson, Normal, t, χ^2 and F distributions), and use of central limit theorem, apply tests of hypotheses in different areas of science.
CO5	solve the problems of competitive examinations like UGC-NET (Mathematical Sciences),GATE related to probability and statistics
CO6	develop their communication skills through self-prepared seminar, illustrate, and explain ideas contained in data analysis problems.

Course articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	3	3	3	-	-	-	-	-	-
CO2	3	-	3	3	3	-	-	-	-	-	-
CO3	3	-	3	3	3	-	-	-	-	-	-
CO4	3	-	3	3	3	-	-	-	-	-	-
CO5	3	3	3	3	3	-	-	-	-	-	3
CO6	3	3	-	-	-	3	3	3	-	-	3

F. Recommended Study Material:

Text-Books

1. Robert Hogg, Elliot Tanis, Probability and Statistical Inference,2009.
2. Mood and Graybill, Introduction to the theory of Statistics,Mc-GrawHill, 1974.
3. Goon A. M. , Gupta M K and Dasgupta B., Fundamentals of Statistics Vol 1, 2002.

Reference Books

1. Vijay K Rohatgi and AK Md Ehsanes Saleh, Probability and Statistics. John Wiley & Sons, 2001.
2. George G. Roussas, An Introduction to Probability and Statistical Inference. Academic Press,2003.

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF APPLIED SCIENCES

M. Sc. (Mathematics) Semester- IV

MA829-COMPUTER PROGRAMMING AND MATHEMATICAL ALGORITHMS

Credits and Hours

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	2	4	6	2 Theory + 2 Practical = 4 Total credits
Marks	50	50	100	

A. Objective of the Course:

This course covers some of mathematical algorithms and coding of these algorithms to computer language will be performed on computers.

B. Outline of the course:

Sr No.	Title of the unit	Number of hours
1.	Basics of C programming	15
2.	Functions, Files and Structure	15
3.	Programme to be performed on Computers	30
4.	Programme to be performed on Computers	30
	Total hours:	90

C. Detailed Syllabus:

			Hours
1.	**Basics of C programming:**		**15 (25%)**
	1.1	Structure of a C program; The concept of function. Constants, Variables in C, integer family; float family; character family, define statement. Data types and declaration of variables. Preprocessors in C; include statement; function prototype error	03
	1.2	Arithmetic and relational operators in C. Precedence and associativity of operators; standard library functions. Arithmetic expressions; logical expressions	03
	1.3	input – output functions; I/O format string; precision of numbers; field width	02
	1.4	Control statements: if, if-else; switch statement. Loops : while, do–while, for; break and continue statements;	05
	1.5	Pointers – address of a variable, pointer variable, pointers and array	02
2.	**Functions, Files and Structure:**		**15 (25%)**
	2.1	Function definition, automatic, static and external variables. calling a function; recursive functions; function prototype – forward reference; pointers in functions; passing by values and passing by reference	07

	2.2	File management: opening a file; closing a file; reading from a file; fscanf() and fprintf() functions writing to a file	04
	2.3	Structures: declaration of structures, accessing structure members; structure initialization, nested structure, array of structures; structure assignment, structure as function arguments	04
3.	**Programme to be performed on Computers:**		**30 (25%)**
	3.1	Elementary problems of number theory: sum of digits of a number reverse order of digits of a number, primes, perfect, Fibonacci numbers, factorization of a number	10
	3.2	Roots of quadratic equation, maximum/minimum and average of n–numbers	10
	3.3	Values of some number theoretic functions; values of sin(x), cos(x), e^x. Solution of f(x) = 0, by using numerical methods	10
4.	**Programme to be performed on Computers:**		**30 (25%)**
	4.1	Sorting of a sequence	04
	4.2	Operations on matrices, Gauss elimination method and its applications.	10
	4.3	Newton's form of polynomial, interpolation polynomial, divided difference table	10
	4.4	Numerical integration, numerical solutions of differential equations	06
		Total hours	90

D. Instructional Method and Pedagogy:

- At the starting of the course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of classical writing board or multi-media projector or OHP etc.
- At the starting of the lecture, teacher will recall what he/she covered in the last lecture.
- At the end of the lecture, teacher will summarize the topics covered in the lecture and inform the students about the topics he/she planned to cover in the next lecture.

E. Course Outcome (COs):

At the end of the course, the students will be able to

CO1	write computer programs for some of Mathematical Problems
CO2	apply their knowledge of programming language to solve some of real life problems
CO3	develop their academic leadership through discussion in a group to solve exercises and queries of this course
CO4	through the writing of programs, students will be able to develop and enhance their ability of critical and clear thinking and ability of planning
CO5	find the solutions of the problems, the students have to analyse it first to solve it, develop algorithm and then write a code

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	-	-	-	-	-	3
CO2	3	3	3	3	3	-	-	-	-	-	3
CO3	3	-	3	3	3	3	-	-	-	-	3
CO4	3	3	3	3	3	-	-	-	-	-	3
CO5	3	-	3	3	3	-	-	-	-	-	3

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

F. Recommended Study Material:

Reference Books:-

1. P. B. Mahapatra, Thinking in C Including object orientated programming with C++, Wheeler Publishing, New Delhi
2. B. W. Kernighan and D. M. Ritchie, The C programming Language, Prentice Hall of India Pvt. Ltd. 1990.
3. V. Rajaraman, Computer Programming in C, Prentice Hall of India Pvt. Ltd. 1995.