तार : विश्वविद्यालय
Gram : UNIVERSITY

टेलीफोन : कार्या0 : 2320496
कुलसचिव : निवास : 2321214
फैक्स : 0510 : 2321667

बुन्देलखण्ड विश्वविद्यालय, झाँसी
BUNDELKHAND UNIVERSITY, JHANSI

झाँसी (उ.प्र.) 284128

संदर्भ B.U/Maths./1897

दिनांक 03/12/2022

The Minutes of Meeting of BOS

In reference to the BOS of department of Mathematical Sciences & Computer Applications Institute of Mathematical Sciences & Computer Applications..... held on 28-06-2022 regarding the revision of syllabus in tune with ~~CBCS~~/NEP-2020 and subsequent approval from Academic Council. This is to certify that the syllabus is 100% revised.

Registrar
Bundelkhand University
JHANSI

HOD/Coordinator
Dr. R. K. Saini
Head
Deptt. of Mathematical Sciences
& Computer Applications

बुन्देलखण्ड विश्वविद्यालय, झाँसी
BUNDELKHAND UNIVERSITY, JHANSI Dated

Department of Mathematical Sciences and Computer Applications

Minutes of BOS Meeting

Today on 28th May 2022 from 12:15 PM onwards, a meeting of BOS (Board of Studies) for the session 2022-2023 as per New Education Policy (NEP-2020) for the courses BCA, B.Sc.(Mathematics/Statistics/Computer Science), M.Sc.(Statistics), MCA (As per AKTU), B.Sc. (CS & IT), M.Sc. (CS & IT) held in the department of Mathematical Science & Computer Applications, Bundelkhand University, Jhansi, UP. The following members present in the meeting:

1. Prof. R.K. Saini, BU Jhansi- HOD, Convener of BOS
2. Prof. Ravindra Patel RGPV, Bhopal- External Expert
3. Prof. Vijay Gupta, RGPV, Bhopal- External Expert
4. Prof. Avnish Kumar, BU Jhansi- Member
5. Dr. Alok Verma, BU Jhansi- Member
6. Dr. Saurabh Srivastava BU Jhansi- Member
7. Dr. Dharmendra Badal, BU Jhansi- Member
8. Dr. Dharmendra Kanchan, BU Jhansi- Member
9. Dr. D. Das Prajapati, BU Jhansi- Member
10. Dr. Anil Kevat, BU Jhansi- Member
11. Dr. Sachin Upadhyay, BU Jhansi- Member
12. Mr. Kamal Gupta, BU Jhansi- Member
13. Dr. Punit Matapurkar, BU Jhansi- Member
14. All Teaching Assistants, BU Jhansi- Member

After a through discussion, the following decisions are adopted:-

1. New Education Policy-2020 is adopted for the courses BCA, B.Sc.(Mathematics/Statistics/Computer Science), M.Sc.(Statistics), MCA(As per AKTU), B.Sc. (CS & IT), and M.Sc. (CS & IT), which will be effective session 2022-2023.
2. Panel of examiners for all courses running through the department are signed by members.
3. The syllabus of all the courses as BCA, B.Sc.(Mathematics/Statistics/Computer Science), M.Sc.(Statistics), MCA(As per AKTU), B.Sc. (CS & IT), and M.Sc. (CS & IT), takes a modification upto 20% form previous one, suggested by students and industry persons.
4. According NEP-2020, some value added courses, entrepreneurships programme and employability skill programme and courses are adopted.
5. Discussion for starting the course M.Sc.(Statistics with soft computing) in place of M.Sc.(Statistics) in the department from next academic session.
6. M.Sc. in Data Science, will be the new course in the deptt from session 2022-23.

(Prof. R. K. Saini)
Head

M.A. /M. Sc.
(MATHEMATICS)

In continuation of UG IVth year

Bundelkhand University, Jhansi

(New Education Policy-2020) w.e.f. 2022-23 and onwards

ORDINANCE FOR POSTGRADUATE (SEMESTER SYSTEM) PROGRAMME

ARTS, SCIENCE & COMMERCE FACULITIES (2022 onward)

Program Overview
M.Sc. (Mathematics)

PROGRAM OVERVIEW-

Designed to strengthen student's mathematical background by in depth knowledge of mathematical concepts. The learner has to do a unique three term thesis keeping in mind the research centricity. The answer to the question of what is an MSc in Mathematics lies in understanding how different types of math are categorized. Instead of focusing on a particular type of math such as algebra or calculus, a postgraduate degree in general mathematics allows students to concentrate on number theory and advanced mathematical methods that tie together all the different forms of mathematics they have likely already learned. This degree tends to have a heavy focus on analysis and theory rather than practical uses of math, but most schools also require several application courses for completion. An MSc in Mathematics gives students who want to work in science, engineering, or computing a solid core education. Most degree programs also require a research component, so students can get a feel for how to use their new skills in the real world.

The cost of a Masters in Mathematics depends on what institution you choose to study at. Most degree programs take one to two years to complete, so the cost of tuition should be assessed accordingly. Many careers in science, engineering, technology, and computers are accessible with a Master of Mathematics. In addition, a postgraduate degree in math makes job seekers more attractive to hiring managers in the fields of business and finance who look for the kind of problem solving and analytical skills that are taught in advanced math courses.

After completing MSc in math your career will be more stable and successful. The private plus government sectors both have thousands of job options available for you. The government sector also wants a good mathematician person. Who can manage the data and business model. Every business requires financial activity and data management for better improvement and success. Various companies have a position like numerical operation and accountant. So, career after **MSc maths** is very fruitful for you.

1. **Lecturer in Mathematics:** One of the rewarded and famous profiles this is. Becoming a lecturer is not easy but if you are fully preparing for that then it can be not tough for you.
2. **Scientific Officer:** If you are very good at maths and calculation. Then MSc maths can give you the opportunity to work with the top government sector. In another word, you can apply for a scientific office job in the industry. Such as ISRO (the Indian Space research Organization). DRDO (Defense Research and Development Organization). NAL (National Aeronautics Limited).
3. **Computer & IT:**MSc math also relates to computer science. A career after MSc maths gives you a vast pathway for the computing field. ICT (information and communication technology) is playing a big role in this platform. ICT always offer a new role for math degree students.
4. **General Management**: Every industry does have this position. Because general management is basically responsible for business organizing and employee handling.
5. **Manual Testing**: In this profession, you have to do manual testing for the company. This means you have to find the defect and error.
6. **Data Science Modelers:** We all know about the data science modelers. The demand for data science specialists is huge because every company wants to convert its data into the required information.
7. **Banking – Investment Banking**: Many famous investment banks provide financial advice to the customer. These professions help you increase the equity and debt market.
8. **Statistical Research**: A career in statistical research is very interesting. It presents the company's statistical businesses at a modest and technical level.

9. **Operational Research**: You can also become operational research if you are good at mathematics. Under this profession basically, you have to solve the business profitability, improve efficiency, and complex organization problems.
10. **Junior Research Fellow**: Junior research fellow exam is now conducted by the CBSC. Normally only top candidates only get the JRF post.

Programme Outcomes (POs)

Program outcomes are narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviours that students acquire in their matriculation through the program.

PO-01	Scientific exploration	Capability of comprehending basic scientific principles, mathematical aptitude and theories to propose solutions.
PO-02	Conduct investigations of complex problems	Use explorative aptitude and research methods for analysis and interpretation of data and synthesis of information to provide effective conclusions.
PO-03	Ethics	Apply ethical principles and commit to professional ethics and responsibilities for societal benefits
PO-04	Communication	Communicate effectively scientific findings, and to be able to assimilate, write and present effective reports to give and receive clear instruction.
PO-05	Societal Impact	Acquire and apply advanced knowledge of concepts and participate in sustainable development.
PO-06	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO--07	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest

		context of upcoming scientific change.
PO-08	Professional Enhancement	In addition to core curricula, program offers subjects like communication, Technical and soft skills to enhance personality and employability.
PO-09	Innovative Pedagogy	Use of innovative pedagogical tools such as demo kits in addition to animations, simulations to impart effective teaching and learning process.
PO-10	Dissertation	Dissertation courses are incorporated in the curriculum to provide research and hands on experience to students in problem identification, laboratory work, data analysis and interpretation.
PO-11	Research Problem Solving	Ability to assimilate, evaluate and present research results objectively.

Programme Specific Outcomes (PSOs)

PSOs are statements that describe what the graduates of a specific engineering program should be able to do:

1. **PSO1**: Understand advanced level of differential equations, Complex analysis, real analysis, Functional analysis, and abstract algebra.
2. **PSO2**: Build effective conclusions through review and research gap Identifications.
3. **PSO3**: Demonstrate competence in using mathematical concepts and computational techniques for simulation and modelling.
4. **PSO4**: Exhibit the ability of comprehending the problem and building research-oriented solutions.
5. **PSO5:** Communicate concepts of Mathematics and its applications.
6. **PSO6:** Acquire analytical and logical thinking through various mathematical tools and techniques.
7. **PSO7:** Investigate real life problems and learn to solve them through formulating mathematical models.
8. **PSO8** Attain in-depth knowledge to pursue higher studies and ability to conduct research. Work as mathematical professional.
9. **PSO9:** Achieve targets of successfully clearing various examinations/interviews for placements in teaching, banks, industries and various other organizations/services.

1. INTRODUCTION

1.1 Preamble

This ordinance governs all the rules and regulations as per the NEP 2020 for the traditional post graduate programs (M.A. / M.Sc.(Mathematics) which are not covered by any regulatory bodies (AICTE, BAR Council, PCI, NCTE etc) running in the (Department of Mathematical Sciences & Computer Applications), University campus or its affiliated colleges in Bundelkhand University, Jhansi.

This ordinance supersedes all the previous relevant ordinances, rules and regulations.

1.2 Duration

Bundelkhand University has adopted the semester system in various Postgraduate courses as per directives of Higher Education Department, Uttar Pradesh Government vide letter No 401/seventy-3-2022 dated 09-02-2022 to accelerate the teaching-learning process and enable vertical and horizontal mobility in learning from the academic session 2022- 23 onwards.

The duration of PG courses shall be two years comprising of four semesters. In case a student(s) exits from this programme after completion of the first year (2 semesters),he /she may take exit from the programme and shall be awarded the Degree of Bachelor in Research. After the successful completion of two years (4 semesters) a student shall be awarded the Master's degree in the concerned subject. The maximum duration to complete the course shall be four years.

1.3 Eligibility for Admission

- Candidate, who wishes to seek admission in a course of study prescribed for a post graduate degree of the University, shall be admitted to campus or an affiliated college unless he/ she has:

  -passed the three years Bachelor's degree course Examination of the University of Uttar Pradesh or any other Indian University incorporated by any law in force at the time of admission.
  or
  -passed any other equivalent examination recognized by the University as equivalent thereto.
  -passed any other equivalent examination recognized by a Foreign University as equivalent thereto

- The date of admission shall follow the University academic calendar.

1.4 Choice of Subject and Course Structure

i. University/ College shall admit students as per the eligibility criteria and availability of seats decided by the university.

ii. A student shall take admission to post graduation first year of fourth year of Higher Education program of NEP 2020 after successful completion of Graduate course from NEP 2020 or old course of Science/ Arts/ Commerce/ Management, etc. He/she shall have to choose respective faculty courses as per guidelines of NEP 2020 depending on the number of seats available in concerned subject and eligibility criteria. In case a candidate is willing to change the faculty, the following condition is required-

The candidate should have passed Bachelor degree in Science/ Commerce of NEP 2020 or old courses may take admission in some subjects of Arts faculty (excluding practical subjects like geography, psychology etc). Similarly, the Student from Commerce of NEP or old course of commerce may also be eligible to take admission in Arts subjects. Arts, Management and Commerce candidates cannot be admitted in science subjects.

iii. Student(s) shall select subjects for post-graduation course from the major subjects that he / she had opted in the graduation course and shall continue with the same subjects in all the four semesters of the PG programme.

iv. The course structure shall be as follows:

There shall be four compulsory theory papers in the first semester. In the second and third semester there shall be two compulsory papers and one/two elective papers. The elective papers are the specialization papers.

Student(s) shall have to select one Minor Elective Course as **Minor subject** from any other faculty (except own faculty) or interdisciplinary subject in the first semester of the first year.

v. Student(s) shall take a Research Project /Survey/ Industrial /Field training program in both the years (Semester II and IV). No pre-requisite shall be required for this.

vi. List of Minor Elective Course: The candidate shall select any one subject from the following as minor subject in first year of post graduate course.

S No	Science	Arts	Commerce	Interdisciplinary
1.	Mathematical Biology	Tribal Culture and Heritage	Customer Relation Management	Ancient Medical Sciences
2.	Conservation and Water Resource Management	Principle of Administration and Implications	House Keeping and Hospitality	Traditional Medical Therapy
3.	Natural Resources and Conservation	Socio-Economics and Social Security	Share Market and Banking	Vedic Mathematics
4.	Pollution: Causes and Mitigation	Archeological Sites and Monuments	Retail Management and Accounting	Bio Medical Instrumentation and Health
5.	Computational Resources	Indian Constitution	Insurance Policy and Finance	Disaster, Mitigation, & Management
6.	Organic and Natural Farming	Communicatio n and Soft Skill		Mining Plan and Resource Mapping
7.	Computer Hardware Handling	Sanskrit Knowledge System		Water Treatment System
8.	Computer Software Handling	Technical Translation and Trans creation		Climate Change and Environmental Degradation
9.	Solar and Non Conventional Energy	Urban Economics and Planning		Medicinal and Aromatic Plants Cultivation, extraction and nutraceutical

				Values
10.	Cyber Crime	Actuarial Economics		
11.	Bee Keeping, Aquaculture and Fish Farming	Social Sector and Gender Economics		Non Conventional Energy Resource
12.	Entrepreneurship in Microbial and Botanical Products	Environmental Economics		Soil and Water Testing
13.				

Elective papers: The student(s) shall select any twosubject from the following as elective subject

Elective Table no-1(a) (Third Semester)

S. No.	Paper Code / Paper name
1	70653 Fluid Dynamics
2	70654 Mathematical Statistics
3	70655 Advance Operation Research

Elective Table no-1(b) (Third Semester)

S. No.	Paper Code / Paper name
1	70656 Graph Theory
2	70657 Special Function
3	70658 Java Programming

Elective papers: The student(s) shall select any twosubject from the following as elective subjects

Table no-1(c) (Fourth Semester)

S. No.	Paper Code / Paper name
1	70663 Partial Differential Equations
2	70664 Theory Relativity
3	70665 Bio-Mathematics

Table no-1(d) (Fourth Semester)

S. No.	Paper Code / Paper name
1	70666 Theory of Queues
2	70667 Theory of Fuzzy Sets and Applications
3	70668 Numerical Solution of ODE & PDE

2. **SEMESTER AND CREDIT DISTRIBUTION**

An academic year for post graduate program is divided into four semesters. The Odd semester may be scheduled from July to December and Even semester from January to June.

Fourth Year

	VII Sem	**Credits**	**VIII Sem**	**Credits**
Major	Theory – 04 Papers Or Theory – 04 Papers Practical -02	5 Credits each Total Credits=20 Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 **Total Credits=20**	Theory – 04 Papers Or Theory – 04 Papers Practical -02	5 Credits each Total Credits=20 Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 **Total Credits=20**
Minor	Minor Elective-1 paper of 04 credits	04 Credits **Total Credits=04**		
Research Project/ Industrial training/ Survey/ Field Training	One of each 04 Credits	04 Credits **Total Credits=04**	One of each 04 Credits	04 Credits **Total Credits=04**
Total Credits		28		24
Total in Both Semester	**52 Credit**			

Fifth Year

Semester	**IX**	**Credits**	**X**	**Credits**
Major	Theory – 04 Papers Or Theory – 04 Papers Practical -02	5 Credits each Total Credits=20 Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 **Total Credits=20**	Theory – 04 Papers Or Theory – 04 Papers Practical -02	5 Credits each Total Credits=20 Or 4 Credits each Total Credits=16 2 Credit each Total Credits=4 **Total Credits=20**
Research Project / Industrial	One of each 04 Credits	04 Credits	One of each 04 Credits	04 Credits

training / Survey		**Total Credits=04**		**Total Credits=04**
Total Credits		24		24
Total in Both Semester	**48 Credit**			

3. **ATTENDANCE**

The expression "a regular course of study" wherever it is used in these Ordinances, means attendance of at least 75% of the lectures and other teaching in campus / affiliated college in the subject for the examination at which a candidate intends to appear and at such other practical work (such as work in a laboratory) as is required by any Statute, Ordinance or Regulation in force for the time being in the University.

A shortage up to 5% of the total number of lectures delivered or practical work done in each subject may be condoned by the principal of the college/ Head of the Department (in case of University Campus) concerned.

A further shortage up to 10% may be condoned only by the Vice- Chancellor on the specific recommendation of the principal of the college/Head of the Department concerned (in case of University Campus).

4. **EXAMINATIONS**

1. There shall be examinations at the end of each semester as, for odd and even semesters in accordance with the academic calendar of the university. A candidate who does not pass the examination in any course(s) shall be permitted to appear in such failed course(s) in the subsequent examinations upto the maximum duration of the course.
2. A candidate should get enrolled/ registered for the first semester examination and is mandatory. If enrolment/ registration is not possible owing to shortage of attendance / rules prescribed OR belated joining or on medical grounds, such students shall not be permitted to proceed to the next semester. Such students shall re-dothe first semester in the subsequent term of that semester as a regular student; however, a student of first semester shall be admitted in the second semester, if he/she has successfully completed the first semester.
3. **It shall be mandatory for the student(s) to register for examination in each and every semester (i.e. to fill up the examination form with the requisite fee). If a student fails to register for the examination in any semester, he or she shall not be allowed to appear in that semester as a back paper student. Such student(s) shall appear in the (next) subsequent examination of that semester.**

5. EVALUATION

The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade point. Evaluation for each course shall be done by a Continuous Internal Assessment (CIA) by the concerned course teacher as well as by end semester examination and will be consolidated at the end of course. The evaluation must be continuous and holistic and should be based on following parameters:

i. Academic assessment
ii. Skill assessment
iii. Physical assessment
iv. Personality assessment
v. Extra-curricular assessment

5.1 THEORY PAPER

Semester Examinations shall be conducted by the university as mentioned in the academic calendar. The Question paper will be set by the examiners appointed by the Vice Chancellor based on the recommendation of the board of studies. The pattern of the question paper shall be as given in annexure II.

i. Internal Assessment(C.I.A.) –25%weightageofacourse

- Test/ Mid-Term Assessment - 10 marks
- Term paper/Presentation on given project/assignment - 10marks
- Attendance/activities – 05marks

ii. End Semester Exam (External examination)– 75% weightage of course

5.2 PRACTICAL PAPER

Practical examinations will be conducted by the examiners appointed by the Vice Chancellor on the recommendations of the Board of Studies. Each student has to present the practical records.

i. Internal Assessment(C.I.A.) –25%weightageofacourse

- Test/ Mid-Term Assessment - 10 marks
- Term paper/Presentation on given project/assignment - 10marks
- Attendance/activities – 05marks

ii. End Semester Exam (External examination)– 75% weightage of a course

MINIMUM PASSING STANDARD

1. The minimum passing standard for combined external and internal examinations for each subject/paper shall be 45%,i.e. 45 out of 100 marks for theory and practical courses. The minimum passing standard for Aggregate in a semester end Examination shall be 45%.
2. Continuous Internal Assessment (CIA) shall be ensured by the Principal of the colleges / HODs for the Campuses courses. The Principal of the colleges / HODs of the Campus shall provide the marks of the same to the university and it shall be mandatory to maintain the records of the same till the maximum duration of that course.
3. The internal assessment, field training and practical examination awards of a student who fails in any

semester examination shall be carried forward to the next examination.

4. It shall be mandatory for a student to secure minimum 45% marks (i.e. 34/75) in the theory and practical paper separately.

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PROVISION FOR BACK PAPERS AND EX-STUDENTS

A Back Paper (B.P.) candidate shall be promoted to next semester. The back paper facility in a semester provides promotion to the next semester and another opportunity to obtain a minimum of the pass marks assigned for an individual paper or in the aggregate. Following category of students of Bundelkhand University shall be eligible for back paper facility as under,student shall be required to pass in minimum two subject papers in each semester. However, at the end of each year, it shall be mandatory for a student to pass in at least two subjects papers and elective paper otherwise he/she shall be deemed as failed and will be treated as a year back / ex- student.

5. Students shall get the attempts to appear in the Back paper examination in the subsequent odd /even semester till the maximum duration of the said course.
6. Special back paper examination shall be held only for regular students of the final year of PG course.
7. The candidates who fail in more than three of the total papers, will be deemed as failed. These candidates can appear only in subsequent examination of that semester as Ex- Students.

8. PROMOTION RULES

8.1Semester Course & Examination:

The students who have taken admission in any post-graduation programme in a session and who have put in the minimum percentage of attendance for appearing at the Examination, presented himself/herself for internal assessment and have filled in the examination form in time for appearing at the End Semester Examination shall be allowed to appear at the respective examinations.

8.2Declaration of results

After appearing in the Examination of both the semesters in a particular year, the student can be put in the following categories in the context of declaration of the results of the Semester Examination:

Passed
Promoted with Back Paper(s)
Failed

8.3 Promotion to next Semester:

All students under category Passed and promoted with back papers shall be promoted to the next Semester.

"Failed" students may clear their UNCLEARED courses in subsequent examinations as ex-students.

Students promoted with back papers shall clear their back papers in subsequent examinations as ex-students.

A student who has failed in a course shall get two more chances to clear this course subject to the maximum duration for passing the course. Further, each candidate shall have to clear all the courses within the maximum period of seven years from the date of his/her latest admission.

A candidate who has qualified for the Degree shall be placed in the First / Second Division as per following table:

8. **COMPUTATION OF SGP AND CGPA**

The guidelines formulated by Bundelkhand University shall be followed in order to bring uniformity in evaluation system of every CBCS based Course and computation of the SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average)basedon students' performance in examination. The number of core, elective, open elective papers and foundation papers and the required credit for each paper shall be formulated by respective Board of Studies (BOS) and faculty board. For the purpose of computation of work load the UGC proposed mechanism is adopted i.e. one credit=1 Theory period of one hour duration, 1credit= 1Tutorial period of one hour duration, 1credit=1 Practical period of one hour duration. The credit(s) for each theory paper/practical/tutorial/dissertation will be as per the respective Board of Studies of departments.

Letter Grade	**Numerical grade**
O (outstanding)	10
A+ (Excellent)	9
A(very good)	8
B+(Good)	7
B(average)	6
F(Fail)	<5
Ab (Absent)	0

The minimum passing marks shall be 45%of the maximum marks as prescribed in the University Examination and 45%of marks in the aggregate marks in the subject including internal / sessional marks.i.e. Minimum Passing Grade is "B".

A student who obtains Grades "O" or "B" shall be considered as PASSED. If a student secures "F" grade, he/she shall be considered as FAILED and shall have to re appear in the examination**.** It is mandatory for a student to earn the required SGPA as in each semester. If a student is not able to secure 45% / B grade in any theory / practical / internal / sessional / viva-voce / internship / project examination, the awarded grade point shall be ZERO (0).

9.1 The University, adopts absolute grading system where in the marks are converted to grades, and every semester results will be declared with semester grade point average(SGPA) and year result will be declared with year grade point average (YGPA). The Cumulative Grade Point Average (CGPA) will be calculated in end of final semester. The grading system except pharmacy department will be with following letter grades and grade points scale as given below:

Table

Level	Outstanding	Excellent	Very Good	Good	Average	Fail
Letter Grade	O	A+	A	B+	B	F
Grade Points	10	9	8	7	6	0
Score (Marks) Range (%)	≥90 (90-100)	<90, ≥80 (80-89.99)	<80, ≥70 (70-79.99)	<70, ≥60 (60-69.99)	<60, ≥45 (50-59.99)	<45 (0-35.99)

1.1 A student obtaining Grade "F" shall be considered failed and will be required to reappear in the examination. Such students after passing the failed subject in subsequent examination / will be awarded with grade respective of marks he/she scores in the subsequent examination/s.

1.2 The University has the right to scale/moderate the theory exam / practical exam / internal exam / sessional marks of any subject wheneverrequired for converting of marks into letter grades on the basis of the result statistics of university as in usual practice, i.e. marks obtained in decimal will be converted in nearest integer.

9. **CONVERSION OF GRADES IN TO PERCENTAGE**

1.3 Conversion formula for the conversion of CGPA into Percentage is **CGPA Earnedx10= Percentage of marks scored.**
Illustration: CGPA Earned8.2 x10=82.0%

2. AWARD OF DIVISION

Division shall be awarded only after the final semester examination based on integrated performance of the student for all the semesters as per following details.

2.1 A student who qualifies for the award of the degree securing "B" or above grades in all subjects pertaining to all semesters, and in addition secure as a CGPA of 8.0 and above shall be declared to have passed the examination in **FIRST DIVISION WITH HONOURS**.

2.2 A student who qualifies for the award of the degree securing "B" or above grades in all subject pertaining to all semesters, and in addition secures a CGPA of 7.0 and above shall be declared to have passed the examination in **FIRST DIVISION**.

2.3 A student who qualifies forthe award of the degree securing "B" or above grades in all subjects pertaining to all semesters, and in addition secures a CGPA of 5.0 and above shall be declared to have passed the examination in **SECOND DIVISION**.

10. **UNFAIR MEANS:**

Cases of unfair means in the End Semester Examinations and Mid-Term Tests shall be dealt as per the rules laid by the University.

Note:

1. Those students who are NOT eligible for promotion to next year shall have to reappear in the coming examination as ex-students. However, the marks of internal assessment shall be carried forward in such cases.

2. Scrutiny facility and Challenge evaluation facility shall be available for those students who want to improve their grades.

	Semester wise titles of the paper in M.Sc./ M.A. Mathematics course								
Year	**Semester**	**Course Code**	**Paper Title**	**Compulsory/Elective**	**Internal**	**External**	**Total**	**credits**	**Cumulative minimum credits require for the award of the degree**
Bachelor(Research) in Mathematics									
First Year	**(After B.Sc.) VII / Equivalent to M.Sc. I Sem**	60651	Advanced Abstract Algebra	Compulsory paper I	25	75	100	5	28
		60652	Real Analysis	Compulsory paper II	25	75	100	5	
		60653	Differential Equations	Compulsory paper III	25	75	100	5	In 15x28 =420 Hours
		60654	Integral equations	Compulsory paper IV	25	75	100	5	
			Minor Elective	Elective 1(a) (Interdisciplinary)	25	75	100	4	
		600655	Research Project/Industrial Training/Field Training		25	75	100	4	
				Total	**150**	**450**	**600**	**28**	
	(After B.Sc.) VIII / Equivalent to M.Sc. II Sem	60656	Topology	Compulsory paper I	25	75	100	5	24 In 15x24 =360 Hours
		60657	Complex Analysis	Compulsory paper II	25	75	100	5	
		60658	Differential Geometry	Compulsory paper III	25	75	100	5	
		60659	Numerical Analysis	Compulsory paper IV	25	75	100	5	
		600660	Research Project/Industrial Training/Field Training		25	75	100	4	
				Total	**125**	**375**	**500**	**24**	
	Grand Total VII and VIII Semester Or Grand Total I and II Semester				275	825	1100	28+24 =52	132*+52 = 184

Second Year	**(After B.Sc.) IX / Equivalent to M.Sc. III Sem**	70651	Number Theory	Compulsory paper I	25	75	100	5	24 In 15x24 =360 Hours
		70652	Mathematical Methods	Compulsory paper II	25	75	100	5	
			Elective	Choose from elective table-**1(a)**	25	75	100	5	
			Elective	Choose from elective table-**1(b)**	25	75	100	5	
		700659	Research Project/Industrial Training/Field Training		25	75	100	4	
				Total	**125**	**375**	**500**	**24**	
Master in faculty	**(After B.Sc.) X / Equivalent to M.Sc. IV Sem**	70661	Functional Analysis	Compulsory paper I	25	75	100	5	24 In 15x24 =360 Hours
		70662	Measure Theory	Compulsory paper II	25	75	100	5	
			Elective	Choose from elective table-**1(c)**	25	75	100	5	
			Elective	Choose from elective table-**1(d)**	25	75	100	5	
		700669	Research Project/Industrial Training/Field Training		25	75	100	4	

		Total	**125**	**375**	**500**	**24**	
		Grand Total IX and X Semester Or Grand Total III and IV Semester	250	750	1000	24+24=48	184+48=232

	Semester wise titles of the paper in PGDR/Doctor of Philosophy in mathematics								
Year	**Semester**	**Course Code**	**Paper Title**	**Compulsory/Elective**	**Internal**	**External**	**Total**	**credits**	**Cumulative minimum credits require for the award of the degree**
	PGDR in mathematics								
	XI	-	Paper I	Elective paper I	25	75	100	6	16 In 15x16 =240 Hours
		-	Paper II	Elective paper II	25	75	100	6	
		-	Research Methodology	Compulsory Paper III	25	75	100	4	
			Research Project/Industrial Training/Field Training	Qualifying	25	75	100	1	232+16=248
Doctor of Philosophy in Mathematics									
	XII - XVI			**Ph.D. Thesis**					

M.Sc. (Mathematics) First Semester Paper
ADVANCED ABSTRACT ALGEBRA

Dept of Math. Sci.and Comp. Applications		**Batch: 2022-24**
Program: M. Sc.		**Current Academic Year: 2022-23**
Branch: Mathematics		**Semester: I**
1	Course Code.	**50872**
2	Course Title	**ADVANCED ABSTRACT ALGEBRA**
3	Credits	**5**
4	Contact Hours (L-T-P)	60-30-00
5	Course Objective	1. To familiarize students with basic concepts of group, subgroup, quotient group and permutation groups, and given an idea of the normal subgroup, sylow groups, internal and external directproduct. 2. To make students familiar with the concept of homomorphism, isomorphism, automorphism,ring, integral domain, field, ideal ,quotient ring, prime and maximal ideal, Irreducible polynomials, principal ideal domains, unique factorization domains, Extension of fields: algebraic extensions, roots of polynomials and splittingfields.
6	Course Outcomes	CO1: Understand the concept of Symmetric group, Alternating group, Simple group, Homomorphism of group, Isomorphism of group, conjugate elements, Class equation, Solvable group, Direct product, CO2: Complete knowledgeofIdeals, prime ideal, Maximal ideals, Euclidean ring, Unique factorization domain, Quotient field, Finite field, Modules CO3:Know the concepts of Algebraic extension, Finite extension, Splitting field, Normal extension, Field extension CO4: Develop the understandingabout Automorphism group, Fixed field, Fundamental theorem of galois theory, Fundamental theorem of algebra, Polynomial solvable by radicals, Straight edge and compass construction

7	Learning outcome	This course helps to develop abstract mathematical thinking. After completion of this course, the student will be able to understand the composition series Jordan Holder Theorem, solvable group, Nilpotent groups Further they will understand field extension, galios theory which helps in appearing various competitive exams and develops research aptitude.
8	**Syllabus and Teaching Plan**	

Unit No.	**Unit Name**	**L T P 60 30 00**	**CO Mapping**
I	**Group**	**Total Lec= 30**	
I. 1	Symmetric group, Alternating group, Simple group	6=4(L) +2(T)	CO1
I. 2	Homomorphism of group, Isomorphism of group	4=2(L)+2 (T)	CO1
I. 3	conjugate elements, Class equation of finite group, cauchys theorem for finite group	6=4(L)+2 (T)	CO1
I. 4	Lagranges theorem, sylows theorem, Jordan holder theorem	5=3(L)+2 (T)	CO1
I. 5	Solvable group, Direct product	9=6(L)+3 (T)	CO1
II	**Ring, Modules**	**Total Lec= 23**	
II. 1	Ideals, prime ideal	6=4(L)+2 (T)	CO2
II. 2	Maximal ideals	4=3(L)+ 1 (T)	CO2
II. 3	Euclidean ring, Noetherian rings	5=4(L) +1(T)	CO2
II. 4	Unique factorization domain	2=1(L) +1 (T)	CO2
II. 5	Quotient field	3=1(L) +2 (T)	CO2
II. 6	Finite field	3=2(L)+1 (T)	CO2
III	**Extension field**	**Total Lec=16**	
III. 1	Algebraic extension	4=3(L)+1 (T)	CO3
III.2	Finite extension	3=2(L) +1(T)	CO3
III. 3	Splitting field, roots of unity	3=2(L)+1 (T)	CO3
III. 4	Normal extension, Field extension	3=2(L) +1(T)	CO3
III.5	Automorphism of field extension	3=2(L)+1 (T)	CO3
IV	**Galois theory**	**Total Lec= 21**	
IV. 1	Elements of galois theory	4=3(L)+1 (T)	CO4
IV. 2	Automorphism group	2=1(L) +1 (T)	CO4
IV. 3	Fixed field	2=1(L)+1 (T)	CO4
IV.4	Fundamental theorem of galois theory	3=2(L)+1 (T)	CO4
IV.5	Fundamental theorem of algebra	2=2(L)	CO4
IV.6	Polynomial solvable by radicals	4=3(L) +1 (T)	CO4
IV.7	Straight edge and compass construction	4=3(L) +1 (T)	CO4

9	Mode of examination	Theory	
10	Marks Distribution	Internal examination	External Examination
		25 Marks	75 Marks
11	Reference books	• I. N. Herstain, Topics in Algebra, Wiley EasternLtd., New Delhi. • P. B. Bhatacharya, S. K. Jain and S. R. Nagpal, Basic Abstract Algebra (2ndEdition) Cambridge University Press, Indian Edition. • Algebra, Vivek Sahai and Vikas Bist, Narosa Publication Publishing House. • V. K. Khanna and S. K. Bhamri, A course in abstract Algebra, 4th.Ed.. • John B. Fraleigh, A First Course in Abstract Algebra, Seventh Edition, Pearson Education.	

BUNDELKHAND UNIVERSITY JHANSI		
DEPARTMENT OF MATHEMATICAL SCIENCES AND COMPUTER APPLICATIONS		Batch 2022-2023
Program M.Sc (Mathematics)		Current Academic Year 2022-2023
Branch: Differential Equations		First Semester
1	Course Code	60653
2	Course Title	Differential Equations
3	Credits	6
4	Contact Hours (L-T-P)	04-04-00
5	Course Type	Compulsory
6	Course Objective	1. How to create mathematical model of any physical situation. 2. To understand the various parameters of the physical situation and then making a rough mathematical model. 3. Posing a corresponding precise mathematical problem and analyzing it, trying to find an exact or approximate solution. 4. Comparing the result with the experimental data to check the validity of the model.
7	Course Outcome	CO1:Basic Concepts CO2:Differential equation of first order and first degree CO3:Differential equation of first order but not of first degree CO4:Second order equations CO5:Initial and boundary value problems CO6:Series Solutions CO7:Solution of Laplace, Heat and Wave equations using the method of separation of variables
8	Course Description	**Basic Concepts:** Origins and formulation, Order and degree Linear and nonlinear Solution of a differential equation Wronskian **Differential equation of first order and first degree:** Equations in which variables are separated Homogeneous equation Reducible to homogeneous Linear differential equations Reducible to linear form Exact differential equation Change of variables Integrating factor **Differential equation of first order and but not of first degree:** Solvable for p Solvable for x or y. Homogeneous equation Clairaut's equation **Second order equations:** Complete solution in terms of a known integral Removal of first derivative Transformation of the equation by changing the independent variable Method of Variation of parameters Singular Solutions Simultaneous equations Total differential equations **Initial and boundary value problems:** Existence and uniqueness theorem Strum- Liouville equation **Series Solutions:** Series solution of a differential equations Legendre's Function Bessel's Function **Solution ofLaplace, Heat and Wave equations using the method of separation of variables**

Syllabus Outline		CO Mapping
Unit Number	Unit Name	
I	**Basic Concepts**	
1.1	Origins and formulation	CO1
1.2	Linear and nonlinear	CO1
1.3	Solution of a differential equation	CO1
1.4	Wronskian	CO1
II	**Differential equation of first order and first degree**	
2.1	Equations in which variables are separated	CO2
2.2	Equations in which variables are separated	CO2
2.3	Homogeneous equation	CO2
2.4	Reducible to homogeneous	CO2
2.5	Linear differential equations	CO2
2.6	Reducible to linear form	CO2
2.7	Exact differential equation	CO2
2.8	Change of variables	CO2
2.9	Integrating factor	CO2
III	**Differential equation of first order but not of first degree**	
3.1	Solvable for p	CO3
3.2	Solvable for x	CO3
3.3	Solvable for y	CO3
3.4	Homogeneous equation	CO3
3.5	Clairaut's equation	CO3
IV	**Second order equations**	
4.1	Complete solution in terms of a known integral	CO4
4.2	Removal of first derivative	CO4
4.3	Transformation of the equation by changing the independent variable	CO4
4.4	Method of Variation of parameters	CO4
4.5	Singular Solutions	CO4
4.6	Simultaneous equations	CO4
4.7	Total differential equations	CO4
V	**Initial and boundary value problems**	
5.1	Existence and uniqueness theorem	CO5
5.2	Strum- Liouville equatiuon	CO5
VI	**Series Solutions**	
6.1	Series solution of a differential equations	CO6
6.2	Legendre's Function	CO6
6.3	Bessel's Function	CO6
VII	**Solution ofLaplace, Heat and Wave equations using the method of separation of variables**	
7.1	Laplace Equation	CO7
7.2	Heat Equation	CO7
7.3	Wave Equation	CO7

Mode of Examination	Theory		
	CA	MTE	ETE
Weightage Distribution	5%	20%	75%
Text Book	Differential Equations by Simmons G.F		
Other References	Introduction of Ordinary Differential Equations by Rabenstein Theory of Ordinary Differential Equation by Coding E.A.		

Department of Mathematical Science and Computer Application			Batch:2022-23
Program: M.Sc.		**CurrentAcademicYear:2022-23**	
Subject: Mathematics		**Semester: I**	
1	**CourseCode**	60654	
2	**CourseTitle**	**Integral Equation**	
3	**Credits**	5	
4	**ContactHours (L-T-P)**	60-30-0	
	CourseType	Compulsory	
5	**CourseObjective**	1. The objective of the course module is to study Integral Equations and to know that what is the relationship between the integral equations and ordinary differential equations and how solved the linear and non linear integral equations by different methods with some problems which give rise to Integral Equations. 2. Problems in which integral equations are encountered include radiative energy transfer and oscillation of a string, membrane, or axle. 3. Students will have much better and deeper understanding of the fundamental concepts of a weak and a strong relative minimum of an integral.	
6	**CourseOutcomes**	**CO1:**Understand the basic definitions and identities for integral equations, various methods to solve Volterra integral equations of first and second kind. **CO2:**Categorize and solve different integral equations using various techniques. **CO3:**To gain knowledge about various type of Kernal and solving methods. **CO4:**Learn methods to solve various mathematical problems using different techniques. **CO5:**Describe importance of Green's function method for solving boundary value problems associated with non homogeneous ordinary and partial differential equations	
7	**CourseDescription**	This course emphasizes concepts and techniques for solving integral equations from an applied mathematics perspective. Material is selected from the following topics: Volterra and Fredholm equations, Fredholm theory, the Hilbert-Schmidt theorem; the Hilbert Problem.Using the newly developed methods, the author successfully handles Fredholm and Volterra integral equations, singular integral equations, integro-differential equations and nonlinear integral equations, with promising results for linear and nonlinear models. Many examples are given to introduce the material in a clear and thorough fashion. In addition, many exercises are provided to build confidence, ease and skill in using the new methods.	
8	**Outlinesyllabus**		COMapping
	Unit1	**Linear integral equation**	
	A	Definition, Classification of Linear Integral Equations, Fredholm Integral Equations, Volterra Integral Equations, Singular-Integral Equations,	CO1,
	B	Types of Kernels, Symmetric Kernel, Separable Kernel, Resolvent Kernel, Iterated Kernel, Solution OfKernals, Problems	CO1,CO2

	C	Relations between differential and integral equations, Leibnitz Rule of Differentiating Under The Integral SignFormula for converting a multiple integral into a single ordinary integral	CO1,CO2
	Unit2	**Conversion of ordinary differential equations into integral equations**	
	A	Introduction , Initial value problem, Method converting an initial value problem into a volterra integral equation	CO1
	B	Boundary value problem, Method converting an initial value problem into a Fredholm integral equation	CO1,CO2
	C	Alternative method and formulae, Problems	CO2
	Unit3	**Homogeneous Fredholm Integral equation second kind**	
	A	Definition and threoms, Characteristic values and characteristic function	CO1,CO2,CO3
	B	Separable kernels,Topic based problem	CO2,CO3
	C	Resolvent kernels, Topic based problem	CO2,CO3
	Unit4	**Method of successive Approximation**	
	A	Iterated kernels or function, problem	CO2,CO3
	B	Reciprocal functions, problem	CO3,
	C	Neumann series, problem	CO3,
	Unit5	**Symmetric kernels and Green theorem**	
	A	Symmetric kernels & regularity conditions	CO2,CO4
	B	Hilbert-Schmidt theorem, Reisz-Fischer's theorem.	CO4
	C	Green Theorem, Problem	CO5
	Modeof examination	Theoretical	

	Textbook/s*	1. RaisinghaniM D ,2016, Integral Equations and Boundary Value Problems, S Chand Publication 2. Swarup Shanti,2020 Integral Equations, Krishna Publication
	OtherReferences	1. Potter and J. Goldberg, 2000, Mathematical methods, Prentice Hall of India 2. Kanwal R. P., 1997, Linear integral equations, Academic Press, New York 3. Lovin, W.W. 2005 Linear Integral EquationDover Publications Cochram J.A An Analysis of Linear Integral Equations

REAL ANALYSIS

Dept of MathSci.and Comp. Applications		**Batch: 2022-24**
Program: M. Sc.		**Current Academic Year: 2022-23**
Branch: Mathematics		**Semester: I**
1.	**Course Code.**	60652
2.	**Course Title**	**REAL ANALYSIS**
3.	**Credits**	**5**
4.	**Contact Hours (L-T-P)**	60-30-00
5.	**Course Type**	Compulsory paper II
6.	**Course Objective**	3. Preliminaries to learn the basic concept of Set Theory in details including Metric Space, Connected Sets, Compact Sets and BWP. 4. To inculcate Knowledge about Extended Real Numbers, Functions, Limit and Continuity. 5. To inculcate Knowledge about the theoretical Concept of Differentiability. 6. To inculcate Knowledge about the theoretical Concept of Riemann–Stieltjes integral. 7. To learn and understand the basics of Series and Sequences
7.	**Course Outcomes**	CO1: Students shall develop the sound understanding of the Set Theory, Real Numbers, Series and Sequences. CO2: Students shall be able to understand the theoretical concept of Functions, Limit and Continuity. CO3: Students shall develop the deep understanding of the theoretical Concept of Differentiability. CO4: Students shall develop the knowledge and understanding of the Riemann–Stieltjes integral.
8.	**Learning Outcomes**	This course helps to develop mathematical concept and thinking about the Principles of Mathematical Analysis. After completion of this course, the student will be able to understand the theoretical knowledge of Real Numbers, Continuity, Differentiability and Integrability which helps in appearing various competitive exams and also inculcate research aptitude.

Syllabus and Teaching Plan			
Unit No.	**Unit Name**	**L T P** **60 30 00**	**CO Mapping**
I	**Basic concept of set theory, Real Number System**	**Total Lec= 17**	
I. 1	Completeness property in 'R'	2=1(L)+1(T)	CO1
I. 2	Countable and uncountable sets	3=2(L)+1(T)	CO1
I. 3	Limit point, open set closed set, dense sets,	5=3(L) +2(T)	CO1
I. 4	Neighborhoods of a set	3=2(L) +1(T)	CO1
I. 5	Bolzano Weiertrass theorem	4=2(L)+ 2(T)	CO1
II	**Extended real number system**	**Total Lec= 20**	
II. 1	Limit and continuity of real function and their properties	3=2(L)+1(T)	CO2
II. 2	Continuity and Compactness	3=2(L)+1(T)	CO2
II. 3	Continuity and Connectedness	5=3(L)+ 2(T)	CO2
II. 4	Discontinuity of different kind	2=2(L)	CO2
II. 5	Discontinuity of Functions, Derivability	2=2(L)	CO2
II. 6	Example based on continuity, connectedness	2=1(L)+1(T)	CO2
II. 7	Example based on discontinuity	3=2(L)+1(T)	CO2
III	**Mean value theorem**	**Total Lec= 19**	
III. 1	Derivatives, Derivativeness of higher order and continuity of Taylor Theorem	2=2(L)	CO3
III.2	Fundamental theorem on integral calculus	6=3(L) +3(T)	CO3
III. 3	Taylors theorem for function of two variables	4=2(L)+2 (T)	CO3
III. 4	Example based on fundamental theorem on integral calculus	2=2(L)	CO3
III.5	Illustrative example on Taylors theorem	3=2(L)+1(T)	CO3
III. 6	Illustrative example on mean value theorem.	2=1(L)+1(T)	
IV	**R-S integrals**	**Total Lec= 11**	
IV. 1	Basic definition's of Riemann integral	5=3(L)+2 (T)	CO4
IV. 2	Integrability of continuous and monotonic functions	2=2(L)	CO4
IV. 3	Some example on R-S integrals problem	4=2(L)+2 (T)	CO4
V	**Series & Sequencing**	**Total Lec= 7**	
		7=5(L)+ 2(T)	CO4
VI	**Definition and existence of the integral, Integral as a limit of sum**	**Total Lec=16**	
VI.1	Improper integrals and their convergence	3=2(L)+1 (T)	CO4
VI.2	Comparison text, mu-test, Abels test	3=2(L) +1(T)	CO4
VI.3	Drichlets test	2=2(L)	CO4
VI.4	Integral as a parameter and its differentiability and integrability	2=2(L)	CO4
VI.5	Example on R-S integrals	3=2(L)+1 (T)	CO4
VI.6	Example on proper and improper integrals	3=2(L)+1 (T)	CO4

9	**Mode of Examination**	Theory (Descriptive)	
10	**Marks Distribution**	Internal Assessment	External Examination
		25 Marks	75 Marks
11	**Reference Books**	(1) Principles Mathematical Analysis: Walter Rudin (2) Introduction to Real Analysis: Robert G. Bartle (3) Real and Complex Analysis: Walter Rudin	

Complex Analysis

Dept of Math. Sci.and Comp. Applications		**Batch: 2022-24**
Program: M. Sc.		**Current Academic Year: 2022-23**
Branch: Mathematics		**Semester: II**
1	Course Code.	**1037**
2	Course Title	**Complex Analysis**
3	Credits	**5**
4	Contact Hours (L-T-P)	60-30-00
5	Course Objective	This course is aimed to provide an introduction to the theories for functions of a complex variable. The concepts of analyticity, Cauchy-Riemann relations and harmonic functions, Complex integration and complex power series are presented. Discuss the classification of isolated singularities and illustrate the applications of the calculus of residues in the evaluation of integrals. Students will study properties of conformal mappings and their relations with analytic functions
6	Course Outcomes	CO1: Discuss Function of a complex variablethe concept of complex number and its algebra calculates continuity, differentiability, analyticity of a function and analyze the derivative of a function.Describe the concept of analytic function and check the analyticity of the functions. CO2: Demonstrate the understanding of conformal mappings and Construct conformal mappings between many kinds of domain, Linear and bilinear transformations CO 3 Illustrate the concept of complex integration, write the Green's theorem, anti-derivative theorem, Cauchy-Goursat theorem, Cauchy's integral formula, Liouville theorem, Morera's theorem CO 4: Discuss the concept of singularities, Fundamental theorem of algebra, Taylor and Laurent series CO 5: Explain Cauchy's residue theorem, evaluate the definite integrals using Cauchy's residue theorem
	Program Outcomes (PO's)	PO1: Mathematical knowledge: Application of Mathematical knowledge in various fields of science, engineering and management etc. PO2: Nature of Mathematics: Understand the concise, precise and rigorous nature of Mathematics. PO3: Critical thinking: Develop the skill to think critically on abstract concepts of Mathematics.

		PO4: Problem analysis: Develop the ability to analyze a problem logically and dissect into micro-parts and thus resolving the problem to accessible components. PO5: Mathematical logic and Ethics: Formulates and develops mathematical arguments in logical manner and Realize and understand professional, ethical and cultural responsibilities.

7	Learning outcome	In the end of the course students will learn the fundamental concepts of complex integration, contour integration to evaluate complicated real integrals using residue calculus and also know how to construct conformal mappings. After completion of this course, the student will be able to understand complex analysis which helps in appearing various competitive exams and develops research aptitude.
8	**Syllabus and Teaching Plan**	

Complex Analysis		**L 60 T 30 P 00**	**CO Mapping**
Unit No.	**Unit Name**	**No. of Teachings days 90**	
I	**Funtion of a complex variable**	**Total Lec= 17**	
I. 1	Concept of limit, continuity and differentiability of complex functions	2=1(L)+1 (T)	CO1
I. 2	Analytic functions	3=2(L)+1(T)	CO1
I. 3	Cauchy-Riemann equations	5=3(L)+2(T)	CO1
I. 4	Harmonic functions	3=2(L)+1(T)	CO1
I. 5	Orthogonal system	4=2(L)+2(T)	CO1
II	**Elementary function**	**Total Lec= 20**	
II. 1	Mapping by elementary functions	3=2(L)+1(T)	CO2
II. 2	Linear and bilinear transformations	3=2(L)+1(T)	CO2
II. 3	Fixed points	5=3(L)+2 (T)	CO2
II. 4	Cross ration	2=2(L)	CO2
II. 5	Inverse points	2=2(L)	CO2
II. 6	Critical points	2=2(L)	CO2
II. 7	Conformal transformations	3=2(L)+1(T)	CO2
III	**Complex integration**	**Total Lec=19**	
III. 1	Line integral	2=2(L)	CO3
III.2	Cauchy fundamental theorem	6=3(L)+3(T)	CO3
III. 3	Cauchy integral formula	4=2(L)+2(T)	CO3
III. 4	Morera's theorem	2=1(L)+1(T)	CO3
III.5	Liouville theorem	3=2(L)+1(T)	CO3
III. 6	Maximum modulus theorem	2=1(L)+1(T)	CO3
IV	**Singularities**	**Total Lec= 16**	
IV. 1	Basic definition of singularities	5=3(L)+2(T)	CO4
IV. 2	Zeros of an analytic function	2=2(L)	CO4
IV. 3	Taylor and Laurent series	9=7(L)+2(T)	CO4

IV.4	Fundamental theorem of algebra	2=2(T)	CO4
VI	**The calculus of Residue**	**Total Lec=16**	
VI.1	Residue at a pole	3=2(L)+1(T)	CO5
VI.2	Computation of residue at a finite pole	3=2(L)+1(T)	CO5
VI.3	Cauchy Residue theorem	2=2(L)	CO5
VI.4	residue at a pole of order greater than unity	2=2(L)	CO5
VI.5	Example on residue theorem	3=2(L)+1(T)	CO5
VI.6	Computation of residue at infinity	3=2(L)+1(T)	CO5
15 Week Working Days. = 90 Days (Excluding Holidays) in each semester. Each Teaching shall consist of 60 minutes time duration.			

References:

1. Lars V. Ahlfors (2017). Complex Analysis (3rd edition). McGraw-Hill Education.
2. Joseph Bak& Donald J. Newman (2010). Complex Analysis (3rd edition). Springer.
3. James Ward Brown & Ruel V. Churchill (2009). Complex Variables and Applications (9th edition). McGraw-Hill Education.
4.Conway, John B., Functions of One Complex Variable, II, Graduate Texts inMathematics, 159, Springer-Verlag, New York, 1995.
5. E.T. Copson (1970). Introduction to Theory of Functions of Complex Variable. Oxford University Press.
6. Theodore W. Gamelin (2001). Complex Analysis. Springer-Verlag.
7. George Polya& Gordon Latta (1974). Complex Variables. Wiley.
8. H. A. Priestley (2003). Introduction to Complex Analysis. Oxford University Press.
9. E. C. Titchmarsh (1976). Theory of Functions (2nd edition). Oxford University Press.
10. Churchill, Ruel V. and Brown, JamesWard, Complex Variables and Applications, fourth edition, McGrawHill Book Co., New York, 1984.
11. Schaum's Outline of Complex Variables, 2ed by By Murray Spiegel, Seymour Lipschutz, John Schiller, Dennis Spellman

Kk

Department of mathematical sciences and computer applications			
Program: M.Sc. (2 year)		**Current Academic Year: 2022-23**	
Branch: (Mathematics)		**Semester: II**	
1	**Course Code**		
2	**Course Title**	**Differential Geometry**	
3	**Credits**	4	
4	**Contact Hours (L-T-P)**	2-0-2	
	Course Type	Compulsory	
5	**Course Objective**	To get introduced to the concept of a regular parameterized curve. To Understand the concept of curvature of a space curve and signed curvature of a plane curve. To be able to understand the fundamental theorem for plane curves. To get introduced to the notion of Serret-Frenet frame for space curves and the involutes and evolutes of space curves with the help of examples. To be able to compute the curvature and torsion of space curves. To be able to understand the fundamental theorem for space curves. To get introduced to the concept of a parameterized surface with the help of examples. To Understand the idea of orientable/non-orientable surfaces. To get introduced to the idea of first fundamental form/metric of a surface. To Understand the normal curvature of a surface, its connection with the first and second fundamental form and Euler's theorem. To Understand the Weingarton Equations, mean curvature and Gaussian curvature	
6	**Course Outcomes**	**CO-1:** Define the equivalence of two curves.find the derivative map of an isometry.analyse the equivalence of two curves by applying some theorems. **CO-2: D**efines surfaces and their properties. express definition and parametrization of surfaces.express tangent spaces of surfaces. **CO-3: E**xplain differential maps between surfaces and find derivatives of such maps. **CO-4: I**ntegrate differential forms on surfaces.list topological aspects of surfaces.define the concept of manifolds.give examples of manifolds and investigate their properties.	
7	**Course Description**	Analyse the equivalence of two curves by applying some theorems. express definition and parametrization of surfaces. express tangent spaces of surfaces. explain differential maps between surfaces and find derivatives of such maps.	
8	**Outline syllabus**		**COMapping**
	Unit No.	**Unit Name/Topics**	
	I	**Definition of space curve, arc length, tangent, normal, binormal**	
	I. 1	The principal normal, Binormal, Helices.	CO1,CO2
	I. 2	Equation of osculating plane	CO1,CO2
	I. 3	Numerical based on osculating plane	CO1,CO2
	I. 4	Serret-Frenet formula	CO1,CO2
	I. 5	Necessary and sufficient condition for curve to be a plane	CO1,CO2
	II	**Fundamental existence theorem for space curves, Helices, evolutes**	

		and involutes	
	II. 1	Curvature and torsion of the involute of given curve	CO1, CO2
	II. 2	Find Involutes of a circular helix are plane curve	CO1, CO2
	II. 3	Equation of evolutes of a curve	CO1, CO2
	II. 4	Locus of the centre of curvature is on evolute	CO1, CO2
	II. 5	Curvature and torsion of an evolute	CO1, CO2
	II. 6	Example based on torsion	CO1, CO2
	II. 7	Example based on involute and evolutes of circular helix	CO1, CO2
	III	**Interpolation with unevenly space points**	CO3,CO4
	III. 1	Lagranges interpolation formulae	CO3,CO4
	III.2	Example Based on Lagranges formula	CO3, CO4
	III. 3	Harmit's formulae	CO3, CO4
	III. 4	Example Based on Hermite formula	CO3, CO4
	III.5	Interpolation with cubic splines	CO3, CO4
	III. 6	Inverse interpolation	CO3, CO4
	IV	**A brief account of Bezier curve**	
	IV. 1	Definition of surface, tangent plane, surfaces of revolution	CO3, CO4
	IV. 2	Conoid and Helicoids	CO3, CO4
	IV. 3	Envelopes and developable surfaces	CO3, CO4
	V	**Matrix and direction coefficients**	
	V.1	Second fundamental form	CO3, CO4
	V.2	Meusnier's theorem	CO3, CO4
	VI	**Euler's theorem and Dupin's indicatrix**	
	VI.1	Gaussian curvature	CO3, CO4
	VI.2	Normal curvature	CO3, CO4
	VI.3	Geodesic curvature	CO3, CO4
	VI.4	Liouville's formulae	CO3, CO4
	VI.5	Differential equation of a geodesic	CO3, CO4
	VI.6	Fundamental theorem on surfaces.	CO3, CO4
	Mode of Examination	Theory	
		CA / MTE / ETE	
	Weightage Distribution	5% / 20% / 75%	
	Textbook/s*	1. John Mc Cleary: Geometry from a differentiable Viewpoint. (Cambridge Univ. Press). 2. Andrew Pressly, Elementary Differential Geometry (Springer Verlag, UTM). 3. Barret O'Neil, Elementary Differential Geometry, Academic Press (2006). 4. C.Baer, Elementary Differential Geometry, Cambridge Univ. Press (2010).	
	Other References	1. 1. W. Klingenberg: A course in Differential Geometry (Springer Verlag). 2. J. M. Lee : Riemannian Manifolds, An Introduction to Curvature (Springer Verlag)	

Numerical Analysis

Dept of Math. Sci.and Comp. Applications		**Batch: 2022-24**
Program: M. Sc.		**Current Academic Year: 2022-23**
Branch: Mathematics		**Semester: II**
1	Course Code.	**1038**
2	Course Title	**Numerical Analysis**
3	Credits	**5**
4	Contact Hours (L-T-P)	60-30-00
5	Course Objective	To provide the knowledge of various numerical methods of solving the•differential equations, algebraic or tranacendental equations ,interpolation, numerical differentiation, and integration.
6	Course Outcomes	CO1: Solve the algebraic or transcendental equations using numerical methods CO2: Solve Interpolation, factorial notations, inverse interpolation. CO3: study numerical differentiation. CO4: Calculate numerical integration using an appropriation method CO5: Evaluate differential equation by Euler's method and its variants, Runge- Kutta second order and fourth order methods and Numerical solution of ordinary differential equations by various others methods
	Program Outcomes (PO's)	PO1: Mathematical knowledge: Application of Mathematical knowledge in various fields of science, engineering and management etc. PO2: Nature of Mathematics: Understand the concise, precise and rigorous nature of Mathematics. PO3: Critical thinking: Develop the skill to think critically on abstract concepts of Mathematics. PO4: Problem analysis: Develop the ability to analyze a problem logically and dissect into micro-parts and thus resolving the problem to accessible components. PO5: Mathematical logic and Ethics: Formulates and develops mathematical arguments in logical manner and Realize and understand professional, ethical and cultural responsibilities.

	Programme Specific Outcomes (PSO's)	PSO1 : Scientific thinking and logical abilities. PSO2 : Application of Mathematical principles in practical situations and software developments. PSO3 : Analyze any problem to micro-levels and solve the problem step by step. PSO4 : Owning up responsibility for logical comprehension and preparedness for constant improvement

7	Learning outcome		This course helps to develop abstract mathematical thinking This course is an introduction to the numerical analysis. The primary objective of the course is to develop the basic understanding of numerical algorithms and skills to implement algorithms to solve mathematical problems After completion of this course, the student will be able to understand the numerical analysis which helps in appearing various competitive exams and develops research aptitude.
8		**Syllabus and Teaching Plan**	

L T P Numerical Analysis **60 30 00**			
Unit No.	**Unit Name**	**No. of Teachings days 90**	**CO Mapping**
I	**Solution of algebraic and transcendental Equation**	**Total Lec = 13**	
I. 1	Bisection	2=1(L)+1(T)	CO1
I. 3	Regula-Falsi method	2=1(L)+1(T)	CO1
I.4	Newton –Raphson	3=2(L)+1(T)	CO1
I.5	Secant method	3=2(L)+1(T)	CO1
I.6	Rate of convergence	3=2(L)+1(T)	CO1
II	**Interpolation**	**Total Lec = 33**	
II.1	Finite Differences	2=1(L)+1(T)	CO2
	Forward , backward and central differences	2=1(L)+1(T)	CO2
II.2	Symbolic relation and separation of symbols	2=1(L)+1(T)	CO2
II. 3	factorial notations,	2=1(L)+1(T)	CO2
II.4	differences of a polynomial	2=1(L)+1(T)	CO2

II.5	newton formula for interpolation	2=1(L)+1(T)	CO2
II.6	central differences formulae	3=2(L)+1(T)	CO2
II.7	Bessel formula	3=2(L)+1(T)	CO2
II.8	Stirling formulae, with unevenly space points,	3=2(L)+1(T)	CO2
II.9	Lagranges formula	3=2(L)+1(T)	CO2
II.10	Hermite formula	6=4(L)+2(T)	CO2
II.12	Inverse interpolation	3=2(L)+1(T)	CO2
III	**Numerical differentiation**	**Total Lec =5**	
III. 1	Maximum and minimum value of tabulated functions,	5=3(L)+2(T)	CO3
IV	**Numerical integration**	**Total Lec = 15**	
IV.1	Trapezoidal rules	3=2(L)+1(T)	CO4
IV.2	Simpson's 1/3,3/8 rules	6=4(L)+2(T)	CO4
IV.3	Weddle's rules	3=2(L)+1(T)	CO4
IV.4	Newton cotes, Integration formulae	3=2(L)+1(T)	CO4
V	**Numerical solution of ordinary differential equations**	**Total Lec = 24**	
V.1	Solution by Taylor series	2=1(L)+1(T)	CO5
V.2	Picard's methods	3=2(L)+1(T)	CO5
V.3	Euler's methods	3=2(L)+1(T)	CO5
V.4	Runge method	3=2(L)+1(T)	CO5
V.5	Runge-Kutta forth order method	6=5(L)+1(T)	CO5
V.6	Predictor corrector method, Millne's Methods	6=6(L)	CO5
15 Week Working Days. = 90 Days (Excluding Holidays) in each semester. Each Teaching shall consist of 60 minutes time duration.			

References:

(1). Numerical Analysis: S.S.Sastry
(2). Numerical Method: Jain, Iyenger Jain

DepartmentofMathematicalScienceandComputerApplication			**Batch2022-24**
Program:M.SC./M.A. MATHEMATICS		**CurrentAcademicYear:2022-23**	
Branch:Mathematics		**Semester:II**	
1	**CourseCode**		**PaperCode:60656**
2	**CourseTitle**	TOPOLOGY	
3	**Credits**	5	
4	**Contact Hours(L-T-P)**	4-2-0	
	CourseType	Compulsory	
5	**CourseObjective**	1. The objective of the course is to present an introduction to Elements of topology, connected and disconnected spaces 2. Theobjectiveofthiscourseistounderstandthe compactness in matric spaces. 3. Familiar withbasicand deep knowledge of different types spaces	
6	**CourseOutcomes**	**CO1:**Elements of Toplogy spaces with connected spaces. **CO2:**Connected and disconnected spaces. **CO3:**Compactness in metric spaces. **CO4:**Completely Normal Space. **CO5:**Product space **CO6:**Urysohn's lemma	
7	**CourseDescription**	**Define** Elements of Toplogy spaces with connected spaces. **Describe**Connected and disconnected spaces and theorems based on this. **Describe**Compactness in metric spaces and theorems based on this. **Define** Completely Normal Space and theorems based on this. **Define**Product space and theorems based on this **Describe** Urysohn's lemma basic property tietze and embedding with its extensions	
8	**Outlinesyllabus**		COMapping
	Unit1	**Elements of Topological Space, Connected and disconnected Spaces**	
	A	Basic properties of Topological spaces, connected & disconnected set Component	CO1
	B	Separable spaces, Elements of Topological spaces, Elements with connected spaces	CO1

	C	Some basic property of disconnected spaces, Subspace of real line is connected, Union with subset's of topological space	C02
	D	Locally connected spaces,	CO2
	E	Compact spacesand its Theorem's,	CO2
	F	Theorem based on component of topological space, Multiple connected spaces, with it'stheorem	CO2
	Unit2	**Compactness in metric spaces and Completely Normal Spaces**	
	A	Compact set, Lindelof space, Locally compact, Para compact,	CO3
	B	Hausdorff-space, Theorem on Hausdorff space, Heine-Borel theorem for 'R' and it's Application's	CO3
	C	Locally compact T_2-space, Lebesgue covering Lemma,	CO3
	D	Basic property of Completely Normal Spaces	CO4
	E	Completely Normal Spaces theorem's and its application	CO4
	Unit3	**Product space and Urysohn's Lemma**	
	A	Weak Topologies, Product space with Hausdorff-space	CO5
	B	Tychnoff theorem and its application's	CO5
	C	Some basic property of Urysohn's Lemma its application, Urysohn's Embedding Theorem	CO6
	D	Theorem on countable space	CO6
	E	Tietze extension Theormand its examples	CO6
	Mode ofexaminati on	Theory	
	Textbook/s*	**ReferenceBooks:** 1. Introduction to Topology and Modern Analysis by G.F.Simmons 2. Topology by J.N.Sharma 3. General Topology by Munkers	

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Department of mathematical sciences and computer applications			
Program: M.Sc. (2 year)		**Current Academic Year: 2022-23**	
Branch: (Mathematics)		**Semester: III**	
1	**Course Code**		
2	**Course Title**	**Advance Operation Research**	
3	**Credits**	4	
4	**Contact Hours (L-T-P)**	2-0-2	
	Course Type	Compulsory	
5	**Course Objective**	Use core competence acquired in various areas of Mechanical engineering to solve techno managerial issues for creating innovative products that leads to better livelihoods and economy of resources. To establish themselves as effective collaborators and innovators to address technical, managerial and social challenges. To equip students for their professional development through lifelong learning and career advancement along with their organizational growth. To serve as a driving force for proactive changes in industry, society and nation.	
6	**Course Outcomes**	**CO-1:**Define and formulate linear programming problems and appreciate their limitations. Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action. **CO-2:**Conduct and interpret post-optimal and sensitivity analysis and explain the primal-dual relationship. **CO-3:** Develop mathematical skills to analyse and solve integer programming and network models arising from a wide range of applications. **CO-4:** Effectively communicate ideas, explain procedures and interpret results and solutions in written and electronic forms to different audiences.	
7	**Course Description**	This course is devoted to mathematical modelling of hard optimisation problems. We focus on integer programming techniques to solve these optimisation problems. During this course techniques as branch and bound, cutting panes and column generation will be discussed as well as the theory needed to understand these techniques. Furthermore, partially by using LP and ILP solvers, some of these techniques will be implemented.	
8	**Outline syllabus**		**COMapping**
	Unit No.	**Unit Name/Topics**	
	I	**Non linear programming:**	
	I. 1	Quadratic programming: Convex sets & convex function, Kun-Tucker Conditions	CO1,CO2
	I. 2	Kun-Tucker Conditions for non-negative constraints, Kun-Tucker Conditions for non-negative constraints for quadratic programming problem.	CO1,CO2
	I. 3	Wolfe's Method	CO1,CO2
	I. 4	Beale's method.	CO1,CO2
	I. 5	Simplex method for quadratic programming.	CO1,CO2

	II	**Separable programming:**			
	II. 1	Separable functions,			CO1, CO2
	II. 2	Reducible to separable forms.			CO1, CO2
	II. 3	Separable programming problem, convex programming.			CO1, CO2
	II. 4	Piece-wise linear approximation of non-linear function			CO1, CO2
	II. 5	Reduction of separable programming problem to L.P.P.			CO1, CO2
	II. 6	Separable programming algorithm			CO1, CO2
	II. 7	Example based on separable algorithm.			CO1, CO2
	III	**Geometric Programming:**			
	III. 1	Formulation of geometric programming problem (unconstrained type).			CO3,CO4
	III.2	To derive necessary condition for optimality.			CO3, CO4
	III. 3	To find the expression minimum F(x).			CO3, CO4
	III. 4	Formulation of geometric programming problem: with equality constraints.			CO3, CO4
	III.5	To obtain normality and orthogonality conditions			CO3, CO4
	III. 6	Problem with inequality constraint.			CO3, CO4
	IV	**Dynamic Programming:**			
	IV. 1	Decision tree and Bellmans principal optimality,			CO3, CO4
	IV. 2	State the principal of optimality in dynamic programming., it's basic features			CO3, CO4
	IV. 3	Optimal subdivision problem.			CO3,CO4
	V	**Dynamic Programming with model:**			
	V.1	Model I: minimum path problem.			CO3, CO4
	V.2	Model II: single additive constraints, multiplicatively separable return			CO3, CO4
	V.3	Model III: single additive constraints, additively separable return, Model: IV, Model:V			CO3, CO4
	VI	**Queueing Theory (Waiting Lines Models)**			
	VI.1	Transient and Steady States, Traffic Intensity, The poisson process (Pure birth process).			CO3, CO4
	VI.2	Properties of poisson process of aarivals, distribution of departure (pure death process)			CO3, CO4
	VI.3	Erlang service time distribution (E_k)., Classification of queueing models.			CO3, CO4
	VI.4	Model I: (M/M/1): (∞/FCFS) Birth and Death model.			CO3, CO4
	VI.5	Model II: General Erlang Queueing model (Birth death process) (M/M/1): (∞/ SIRO), Model III: (M/M/1) : (N/ FCFS)., MODEL IV(A) .(M/M/S): (∞/FCFS).			CO3, CO4
	VI.6	Some illustrative example on given models.			CO3, CO4
	Mode of Examination	Theory			
		CA	MTE	ETE	
	Weightage Distribution	5%	20%	75%	
	Textbook/s*	5. "Introduction to Operations Research" by F S Hiller and G J Leiberman. 6. "Nonlinear and Dynamic Programming" by G Hadley			
	Other References	7. "Operations Research – An Introduction" by H ATaha.			

		8. “Operations Research” by Gupta Prem Kumar and Hira D S. 9. “Operations Research” by Panneerselvam and R	

Department of mathematical sciences and computer applications			
Program: M.Sc. (2 year)		**Current Academic Year:2022-23**	
Branch: (Mathematics)		**Semester: III**	
1	**Course Code**		
2	**Course Title**	**Mathematical Method**	
3	**Credits**	4	
4	**Contact Hours (L-T-P)**	2-0-2	
	Course Type	Compulsory	
5	**Course Objective**	The M.Sc. Mathematics programme aims to prepare students with a deep understanding of mathematical concepts, research oriented attitude and skill of application of mathematical and computational tools and techniques in formulation and solution of real world problem. It is specially designed to prepare students for a successful career in academic institution, research institution and industry.	
6	**Course Outcomes**	**CO-1:** students will be able to communicate mathematical ideas with clarity and coherence, both written and verbally. **CO-2:** They will be able to conduct independent research in specialized areas of mathematics, teach courses in mathematics or subjects with high mathematical content at school and college level, and work in industry involving applications of mathematics. **CO-3:**Students will gain a range of techniques employing the Laplace and Fourier Transforms in the solution of ordinary and partial differential equations. **CO-4:**They will also have an appreciation of generalized functions, their calculus and applications.	
7	**Course Description**	The M.Sc. Mathematics programme, offered by the Department of Mathematics, blends of pure mathematics, applied mathematics and basic computer science. This programme covers theoretical, computational and practical aspects of mathematics. In the curriculum, the core mathematics courses are designed to build a strong foundation in the subject, the laboratory based courses provide the exposure and training in application-oriented practical subjects.	
8	**Outline syllabus**		**COMapping**
	Unit No.	**Unit Name**	
	I	**Fourier Integral theorem**	
	I. 1	Basic properties of fourier integral	CO1,CO2
	I. 2	Infinite fourier transform	CO1,CO2
	I. 3	Infinite Fourier sine and cosine transform	CO1,CO2
	I. 4	Finite fourier transform	CO1,CO2
	I. 5	Finite fourier sine and cosine transform	CO1,CO2

	II	**Laplace Transform**	
	II. 1	Piece-wise or sectional continuity	
	II. 2	Function of exponential order	CO1, CO2
	II. 3	Laplace transform	CO1, CO2
	II. 4	Notation	CO1, CO2
	II. 5	Some standard results	CO1, CO2
	II. 6	Periodic functions	CO1, CO2
	II. 7	Problems	CO1, CO2
	III	**Inverse Laplace Transform**	
	III. 1	Definition and threoms	CO3,CO4
	III.2	Null function	CO3, CO4
	III. 3	Uniqueness of inverse Laplace transform	CO3, CO4
	III. 4	Partial Fractions	CO3, CO4
	III.5	Heaviside's expansion formula	CO3, CO4
	III. 6	The complex inversion formula	CO3, CO4
	IV	**Application to Differential Equations**	
	IV. 1	Differential Equation and Notation	CO3, CO4
	IV. 2	Worked examples	CO3, CO4
	IV. 3	Solution of simultaneous ordinary Differential Equation	CO3, CO4
	V	**Application to Integral Equations**	
	V.1	Topic based theorems and formulae	CO3, CO4
	V.2	Exercise	CO3, CO4
	VI	**Application of Fourier Transforms to Boundary Value Problems**	
	VI.1	Application of infinite fourier transform	CO3, CO4
	VI.2	Theorems and formulae	CO3, CO4
	VI.3	Topic based exercise	CO3, CO4
	VI.4	Application of finite fourier transform	
	VI.5	Theorems	CO3, CO4

	VI.6	Formulae and examples			CO3, CO4
	Mode of Examination	Theory			
		CA	MTE	ETE	
	Weightage Distribution	5%	20%	75%	
	Textbook/s*	10. "Mathematical Methods" by G Shanker Rao 11. "Fundamental Methods of Mathematical Economics" by Chiang and Wainwright.			
	Other References	12. "Mathematical Methods in the Physical Sciences" by Mary L Boas. 13. "Mathematical Methods for Physicists" by Arfken. 14. "Mathematical Methods for Engineers and Physicists" by A K Mukhopadhyay. 15. "Mathematical Methods" by Potter M C. 16. "Mathematical Methods in the Physical Sciences" by Mary L Boas.			

Special Functions

Dept of Math. Sci.and Comp. Applications		**Batch: 2022-24**
Program: M. Sc.		**Current Academic Year: 2022-23**
Branch: Mathematics		**Semester: III**
1	Course Code.	
2	Course Title	**Special Functions**
3	Credits	**5**
4	Contact Hours (L-T-P)	60-30-00
5	Course Objective	This course will enable the students to • Understand the properties of special functions like gauss hypergeometric, Legender functions with their integral representations • Understand the concept of Bessels function, Hermite function, Lagurre functions etc, with its properties like recurrence relations, orthogonal properties, generating functions etc • Understand how special function is useful in differential equations.
6	Course Outcomes	CO1: Explain and illustrate Gamma function and beta function CO2: Describe Legendre Polynomial CO3:. Explain Bessel functions CO4: Understand Hermit polynomial CO5Understand Laguerre Polynomial CO6Familiar with Hypergeometric functions CO7Explain Jacobis polynomial
	Program Outcomes (PO's)	PO1: Mathematical knowledge: Application of Mathematical knowledge in various fields of science, engineering and management etc. PO2: Nature of Mathematics: Understand the concise, precise and rigorous nature of Mathematics. PO3: Critical thinking: Develop the skill to think critically on abstract concepts of Mathematics. PO4: Problem analysis: Develop the ability to analyze a problem logically

		and dissect into micro-parts and thus resolving the problem to accessible components. PO5: Mathematical logic and Ethics: Formulates and develops mathematical arguments in logical manner and Realize and understand professional, ethical and cultural responsibilities.
	Programme Specific Outcomes (PSO's)	PSO1 : Scientific thinking and logical abilities. PSO2 : Application of Mathematical principles in practical situations and software developments. PSO3 : Analyze any problem to micro-levels and solve the problem step by step. PSO4 : Owning up responsibility for logical comprehension and preparedness for constant improvement
7	Learning outcome	This course helps to develop abstract mathematical thinking. After This course students will be able to explain the applications and the usefulness of these special functions. Classify and explain the functions of different types of differential equations.Understood purpose and functions of gamma and beta functions . After completion of this course, the student will be able to understand various special functions which helps in appearing various competitive exams and develops research aptitude
8	**Syllabus and Teaching Plan**	
	Special Functions	**L T P** **60 30 00**

Unit No.	**Unit Name**	**No. of Teachings days 90**	**CO Mapping**
I	**Gamma function and beta function**	**Total Lec= 15**	
I. 1	Eulers Integral	2=1(L)+1(T)	CO1
I. 2	Properties and transformation of Gamma function	6=4(L)+2(T)	CO1
I. 3	Different forms of Beta function, Relation between beta and gamma function	5=3(L)+2(T)	CO1
I. 5	Legendre Duplication Formula	2=1(L)+1(T)	CO1
II	**Legendre Polynomial**	**Total Lec= 14**	
II. 1	Legendre differential equation and its solution	2=2(L)	CO2
II. 2	Generating function , Recurrence relation	5=3(L)+2 (T)	CO2
II. 3	Laplace integrals and orthogonal properties	3=2(L)+1 (T)	CO2
II. 5	Beltramis result, Christoffel's expansion, Rodrigues formula	4=2(L) +2(T)	CO2
III	**Bessel functions**	**Total Lec= 10**	
III. 1	Bessels differential equation and its solution	3=2(L)+1 (T)	CO3
III.2	Recurrence formula, Generating function	7=5(L) +2 (T)	CO3

IV	**Hermit polynomial**	**Total Lec= 11**	
IV. 1	Hermit differential equation and its solution	3=2(L)+1(T)	CO4
IV. 2	Generating function, rodrigues formula	4=2(L) + 2(T)	CO4
IV. 3	Orthogonal property, recurrence relations	4=2(L)+2(T)	CO4
V	**Laguerre Polynomial**	**Total Lec=12**	
V. 1	Laguerre differential equation and its solution	3=2(L)+1(T)	CO5
V. 2	Generating function, rodrigues formula	4=2(L)+ 2(T)	CO5
V.3	Orthogonal property, recurrence relations	5=3(L)+ 2(T)	CO5
VI	**Hypergeometric functions**	**Total Lec=18**	
VI.1	GuassHypergeometric equation and its solution	3=2(L)+1(T)	CO6
VI.2	Integration and Differentiation of hypergeometric function	5=5(L)	CO6
VI.3	Kummers theorem, Gauss theorem, Vandermundes theorem	3=2(L) +1 (T)	CO6
VI.4	Confluent HyperGeometric function	2=2(L)	CO6
VI.5	Integral representation of confluent hyper Geometric function	3=2(L)+1(T)	CO6
VI.6	Dixons theorem	2=1(L)+1 (T)	CO6
VII	**Jacobis polynomial**	**Total Lec=10**	
VII.1	Generating function, rodrigues formula	5=4(L)+1(T)	CO7
VII.2	Orthogonal property, recurrence relations	5=4(L)+1(T)	CO7
15 Week Working Days. = 90 Days (Excluding Holidays) in each semester. Each Teaching shall consist of 60 minutes time duration.			

Reference Books:

(1). Rainville,E.D,;SpecialFunctions,TheMncmillnnco.,Newyork1971

(2). Theory of Function of a complex variable by E.T.Copson

(3)

Saran.N.,SharmaS.D.andTrivedi,•SpecialFunctionwithapplication,Pragatipr akashan,1986.

Department of mathematical sciences and computer applications			
Program: M.Sc. (2 year)		**Current Academic Year:2022-23**	
Branch: (Mathematics)		**Semester: IV**	
1	**Course Code**		
2	**Course Title**	**Fuzzy Sets and Applications**	
3	**Credits**	4	
4	**Contact Hours (L-T-P)**	2-0-2	
	Course Type	Compulsory	
5	**Course Objective**	To develop the fundamental concepts such as fuzzy sets, operations and fuzzy relations. To lean about the fuzzification of scalar variables and the defuzzification of membership functions. To learn three different inference methods to design fuzzy rule-based system. To develop fuzzy decision making by introducing some concepts and also Bayesian decision methods. To learn different fuzzy classification methods	
6	**Course Outcomes**	1. understand the basic ideas of fuzzy sets, operations and properties of fuzzy sets and also about fuzzy relations. 2. understand the basic features of membership functions, fuzzification process and defuzzification process. 3. design fuzzy rule-based system.gain the knowledge about fuzzy C-Means clustering. 4. know about combining fuzzy set theory with probability to handle random and non-random uncertainty, and the decisionmaking process.	
7	**Course Description**		
8	**Outline syllabus**		**COMapping**
	Unit No.	**Unit Name/Topics**	
	I	**First Unit**	
	I. 1	Basic Concept of Fuzzy Sets & Motivation	CO1,CO2
	I. 2	Fuzzy sets and their representations	CO1,CO2
	I. 3	Membership functions and their designing	CO1,CO2
	I. 4	Type of fuzzy sets, Convex fuzzy sets	CO1,CO2
	I. 5	Alpha-level cuts	CO1,CO2
	I. 6	Zadeh's extension principal	CO1, CO2
	I. 7	Geometric interpretation of fuzzy sets	CO1, CO2
	II	**Second Unit**	
	II. 1	Fuzzy relations, Projections and cylindrical extension	CO1, CO2
	II. 2	Fuzzy equivalence relations, fuzzy compatibility relations	CO1, CO2
	II. 3	Fuzzy ordering relations, Composition of fuzzy relations	CO1, CO2
	II. 4	Fuzzy Numbers, Arithmetic operations on fuzzy numbers	CO1, CO2
	II. 5	Fuzzy Logic, fuzzy propositions, fuzzy quantifiers	CO1, CO2
	II. 6	Linguistic variables, Fuzzy inference	CO3,CO4

	II. 7	Fuzzy measures, Possibility Theory and fuzzy sets			CO3,CO4
	II. 8	Possibility theory versus probability theory			CO3, CO4
	III	**Third Unit**			
	III. 1	Fuzzy mapping rules and fuzzy implication rules			CO3, CO4
	III.2	Fuzzy rule-based models for function approximation and their type			CO3, CO4
	III. 3	Types: The Mamdani, TSK and standard additive models			CO3, CO4
	III. 4	Fuzzy Implications and Approximate Reasoning			CO3, CO4
	III.5	Decision making in fuzzy environment: Fuzzy Decisions			
	III. 6	Fuzzy linear programming, Fuzzy multi-criteria analysis			CO3, CO4
	III. 7	Multi-objective decision making			CO3, CO4
	Mode of Examination	Theory			
		CA	MTE	ETE	
	Weightage Distribution	5%	20%	75%	
	Textbook/s*	17. 1. Timothy J.Ross - Fuzzy logic with engineering applications, 3rd edition, Wiley,2010. 18. George J.KlirBo Yuan - Fuzzy sets and Fuzzy logic theory and Applications, PHI, New Delhi,1995.			
	Other References	3. S.Rajasekaran, G.A.Vijayalakshmi - Neural Networks and Fuzzy logic and Genetic Algorithms, Synthesis and Applications, PHI, New Delhi,2003.			

Department of Mathematical Science and Computer Application		Batch: 2022-23
Program: M.Sc.		**CurrentAcademicYear:2022-23**
Subject: Mathematics		**Semester: IV**
1	**CourseCode**	
2	**CourseTitle**	**Graph Theory**
3	**Credits**	5
4	**ContactHours (L-T-P)**	4-2-0
	CourseType	**Elective**
5	**CourseObjective**	This is a standard course in graph theory, assuming little introductory knowledge of graphs. It aims is to present all usual basic concepts of graph theory, graph properties (with simplified proofs) and formulations of typical graph problems. This is also supplemented with some abstract-level algorithms for the presented problems, and with some advanced graph theory topics. Although the content of this course is primarily targeted at mathematics students, it is accessible also to others.
6	**CourseOutcomes**	Completion of this course the students will be able to: **CO1** Use definitions in graph theory to identify and construct examples and to distinguish examples from non-example. **CO2** To understand the concept of vertex connectivity and edge connectivity in graphs. **CO3** To develop the under-standing of Geometric duals in Planar Graphs. **CO4**To understand Konigsberg Seven Bridge Problem. **CO5**To understand the concept of digraphs, Euler digraphs and Hamiltonian digraphs. **CO6**To analyze new networks using the main concepts of graph theory. **CO7** To introduce the idea of coloring in graphs. **CO8** To have an idea of automorphism groups of graphs
7	**CourseDescription**	Any successful complex system started as a simple system! This course focuses on the traditional graph theory knowledge and analysis of simple graphs that model simple systems, preceding the complex networks course that model complex systems. The course presents a selection of commonly used topics and proof techniques, providing the basis for understanding and performing analysis of patterned networks. Graph theory provides a professional sandbox for the exploration of new terminology and results in discrete mathematics, and its results have applications in many areas of the computing, social, and natural sciences. The intellectual discipline of justifying an argument is valuable

		independentlyof mathematics so it is important for learner to further to develop this skill.	
8	**Outlinesyllabus**		**COMapping**
	Unit-1	**Graph**	
	A	Introduction to graph, Simple graph Degree of a graph,	CO1
	B	Regular graph, Complete graph, Bipartite Graph,Digraph,	CO2
	C	Sub graph,Complement of a graph	CO3
	Unit-2	**Traversing a graph**	
	A	Walks, Path, Circuits,	CO1,CO4
	B	Connectedness of a graph,Planner graph,Binary relation	CO4,CO5
	C	Matrix representation of graphs adjacency, incidence matrices	CO6
	Unit-3	**Euler and Hamiltonian graphs**	
	A	Euler's formula, Eulerian graphs,Hamiltonian graphs and circuits,	CO2,CO7
	B	Existence theorem for Eulerian and Hamiltonian graph, Vertex removal,Cut vertices	CO7,CO8
	C	Separable graphs ,Isomorphism	CO2,CO8
	Unit-4	**Tree graph**	
	A	Tree, Spanning tree, Breadth-first search	CO9
	B	Depth first search,Cut sets and tie sets.	C1O

	Modeof examination	Theoretical			

	Weightage Distribution	30%	20%	50%	
	Textbook/s*	1.Applied Graph Theory by C.W. Marshall 2.Graph theory with applications by J.K. Bondy& U.S.R. Murty			
	OtherReferences	1. S. Pirzada, An introduction to graph theory; Universities Press, Orient.Blackswan, 2013. 2. R. B. Bapat, Graphs and matrices; Hindustan Book Agency, New Delhi. 3. R. Balakrishnan, K. Ranganathan, A textbook of graph theory, Springer,Verlag, New York			

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	1	2	1	2	2	2	2
CO2	1	1	1	1	1	1	2	2	2	2
CO3	1	2	2	1	2	1	2	2	2	1
CO4	1	2	1	1	2	1	2	1	2	2
CO5	1	2	1	1	1	1	2	2	2	2
CO6	1	2	1	1	2	1	2	2	1	2

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

DepartmentofMathematicalScienceandComputerApplication			Batch2022-24
Program:M.SC./M.A. MATHEMATICS		CurrentAcademicYear:2022-23	
Branch:Mathematics		Semester:IV	
1	CourseCode		PaperCode:70662
2	CourseTitle	Measure Theory	
3	Credits	5	
4	Contact Hours(L-T-P)	4-2-0	
	CourseType	Compulsory	
5	CourseObjective	1. The objective of the course is to present an introduction to Sets and Functions. 2. TheobjectiveofthiscourseistounderstandMeasure of different functions Integral and Lebesgue Measurable function. 3. Familiar withbasic and deep knowledge of different types Measures.	
6	CourseOutcomes	**CO1:**ESets, Measure and exterior and interior **CO2:**Different type of functions **CO3:**Lebesgue Measurable Functions. **CO4:**Different theorems **CO5:**Extensions of a measure	
7	CourseDescription	**Define** Sets and Lebesgue of a measure. **Describe**Different types functions. **Describe**deep knowledge of different theorems base on measure. **Define** also its extension	
8	Outlinesyllabus		COMapping
	Unit1	Sets and functions	
	A	Basic Concept of Sets, Measure and Measurable Sets,	CO1
	B	Lebesgue Measure of a Set, Exterior and Interior measure	CO1

	C	Measurable Space	C02
	D	Measurable functions,	CO2
	E	Equivalent function,	CO2
	F	Simple Function,	CO2
	Unit2	**Lebesgue Measurable functions,Theorems**	
	A	Lebesgue Measurable functions,	CO3
	B	Characteristic function,	CO3
	C	Lebesgue integral of a function	CO3
	D	First mean value theorem	CO4
	E	Conversions of measure	CO4
	F	Reisz Theorem	CO4
	G	D.F.Egor's Theorem	CO4
	Unit3	**Extension of a measure**	
	A	Extension of a measure	CO5
	B	Continuous and absolute continuous function	CO5
	C	Indefinite integral and differential function	CO6
	D	Increasing and decreasing function	CO6
	E	Function of a bounded variation	CO6
	Mode ofexaminati on	Theory	
	Textbook/s*	**ReferenceBooks:** 1. Measure theory by P. R. Halmos 2. Measure Theory by K. P. Gupta	

Partial Differential Equations

Dept of Math. Sci.and Comp. Applications		**Batch: 2022-24**
Program: M. Sc.		**Current Academic Year: 2022-23**
Branch: Mathematics		**Semester: IV**
1	Course Code.	
2	Course Title	**Partial Differential Equations**
3	Credits	**5**
4	Contact Hours (L-T-P)	60-30-00
5	Course Objective	Familiarise students with basic concepts of partial differential equations and learn to solve first-order differential equations and formation of PDEs. Explore the methods to solve linear differential equation of nth order with constant coefficients and variable coefficients. Students will also master the technique of separation of variables to solve PDEs and able to derive heat and wave equations.. This course is an introduction to partial differential equations. The primary objective of the course is to develop the advance understanding of partial differential equations
6	Course Outcomes	CO1: Explain and illustrate how to form the differential equations and solve the linear equations of first order and first degree. CO2: Describe and solve the non linear differential equation CO3:. Explain Partial Differential equation with constant coefficient homogeneous and non homogeneous equations CO4: Describe the PDEs of second order and classification of PDEs of second order , Monges method
	Program Outcomes (PO's)	PO1: Mathematical knowledge: Application of Mathematical knowledge in various fields of science, engineering and management etc. PO2: Nature of Mathematics: Understand the concise, precise and rigorous nature of Mathematics. PO3: Critical thinking: Develop the skill to think critically on abstract concepts of Mathematics. PO4: Problem analysis: Develop the ability to analyze a problem logically and dissect into micro-parts and thus resolving the problem to accessible components. PO5: Mathematical logic and Ethics: Formulates and develops mathematical

		arguments in logical manner and Realize and understand professional, ethical and cultural responsibilities.
	Programme Specific Outcomes (PSO's)	PSO1 : Scientific thinking and logical abilities. PSO2 : Application of Mathematical principles in practical situations and software developments. PSO3 : Analyze any problem to micro-levels and solve the problem step by step. PSO4 : Owning up responsibility for logical comprehension and preparedness for constant improvement

7	Learning outcome		This course helps to develop abstract mathematical thinking This course is an introduction to the Partial differential equations. After completion of this course, the student will be able to understand and solve the partial differential equations which helps in appearing various competitive exams and develops research aptitude. .
8		**Syllabus and Teaching Plan**	
L T P Partial Differential Equations 60 **30 00**			

Unit No.	**Unit Name**	**No. of Teachings days 90**	**CO Mapping**
I	**Partial Differential Equation of first order**	**Total Lec = 15**	
I. 2	Langrage's Linear Equation	5= 3(L)+2(T)	CO1
I. 3	Langrage's Solution of Partial Differential Equation of first order	5= 3(L)+2(T)	CO1
II.	**Non Linear equation**	**Total Lec = 30**	
II. 1	Special Type of equation	10= 7(L)+3(T)	CO2
II. 2	General method of Solution	5= 3(L)+2(T)	CO2
II. 3	Charpit's Method	7= 5(L)+2(T)	CO2
II. 4	Jacobi's Method	8= 6(L)+2(T)	CO2
III	**Partial Differential equation with constant coefficient**	**Total Lec = 20**	
III. 1	Homogeneous linear with Constant coefficient,	5= 3(L)+2(T)	CO3
III.2	Solution of Partial Differential equation , Short Method, General method	5= 4(L)+1(T)	CO3

III. 3	Non-homogeneous equation with constant coefficient,	5= 3(L)+2(T)	CO3
III. 4	Equation reducible to Homogeneous linear form	5= 3(L)+2(T)	CO3
IV	**Partial Differential Equation of second order**	**Total Lec = 25**	
IV.1	Solution of Partial Differential equation of second order	5= 3(L)+2(T)	CO4
IV.2	Classification of linear partial differential equation of second order	5= 3(L)+2(T)	CO4
IV.3	Canonical form and reduction to canonical form	5= 4(L)+1(T)	CO4
IV.4	Monge's method	10= 7(L)+3(T)	CO4
15 Week Working Days. = 90 Days (Excluding Holidays) in each semester. Each Teaching shall consist of 60 minutes time duration.			

Reference Books:

1. Ordinary differential Equation by M. D. RaiSinghni
2. Differential Equation by Sharma and Gupta
3. Element of Partial Differential Equation by I.N. Sneddon