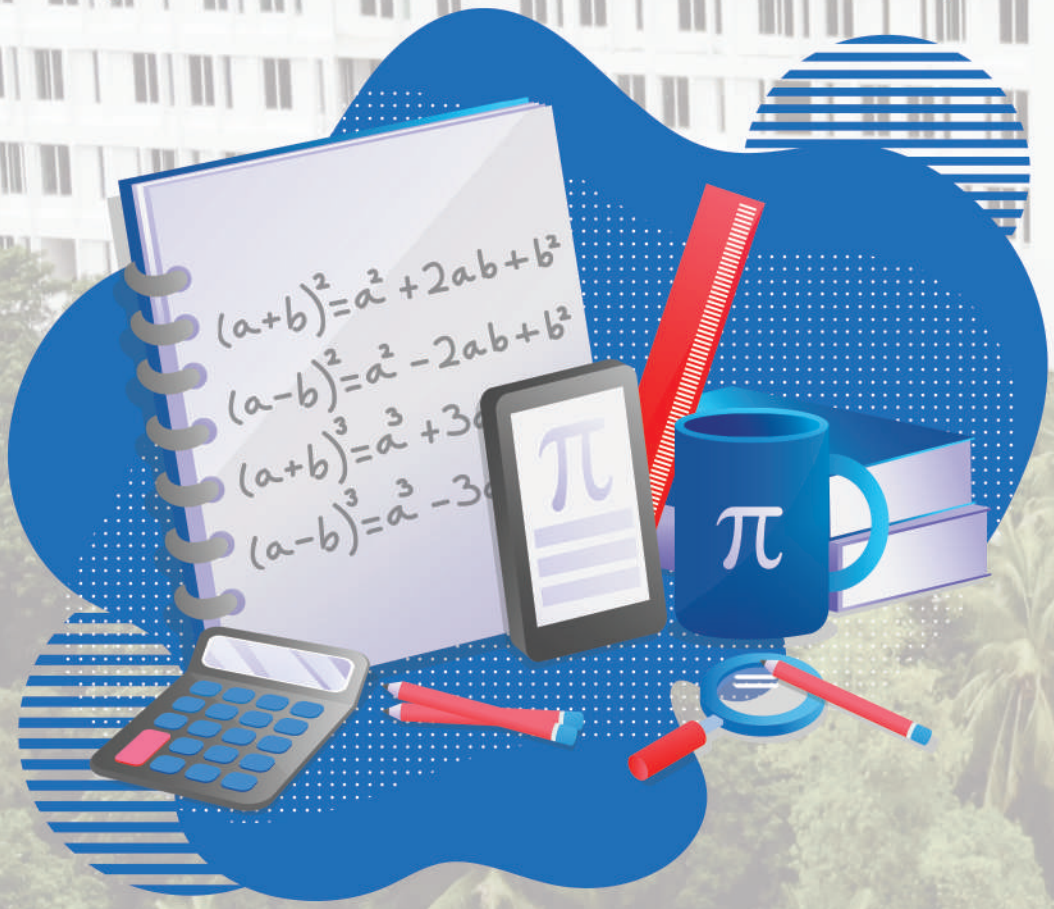
(DEEMED TO BE UNIVERSITY)

STUDENT handbook

2024-25

M.Sc.

(COMPUTATIONAL MATHEMATICS)



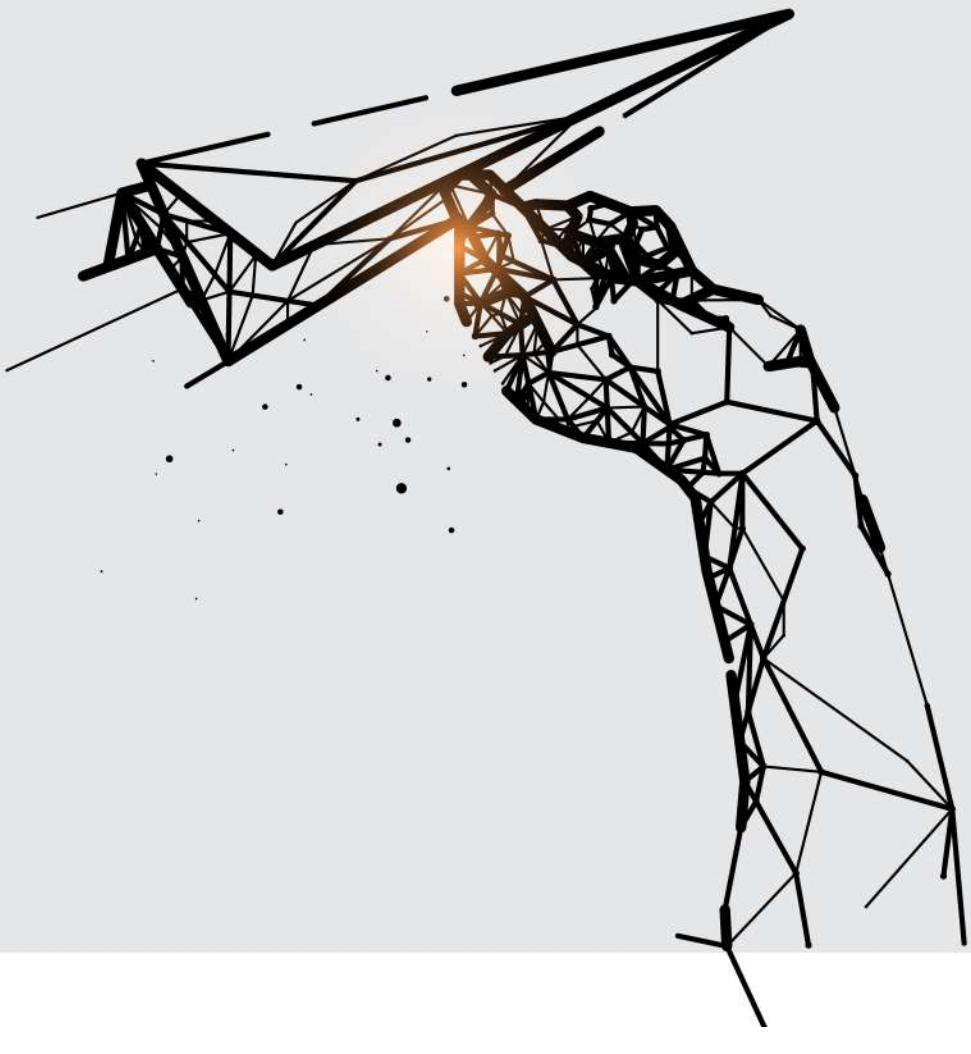
DEPARTMENT OF MATHEMATICS

VISION

To be a globally renowned university.

MISSION

To impart quality higher education and to undertake research and extension with emphasis on application and innovation that cater to the emerging societal needs through all-round development of students of all sections enabling them to be globally competitive and socially responsible citizens with intrinsic values.




CATEGORY 1
UNIVERSITY
BY MHRD, Govt. of India
KL ACCREDITED BY
NAAC WITH A++
GRADE
nirf 2023
NATIONAL INSTITUTIONAL RANKING FRAMEWORK
RANKED 28
AMONG ALL
UNIVERSITIES
43 YEARS OF
EDUCATIONAL
LEADERSHIP

Koneru Satyanarayana,
Chancellor

Sri Koneru Satyanarayana, BE, FIE, FIETE, MIEEE graduated in Electronics and Communication Engineering in the year 1977. Along with Sri Koneru Lakshmaiah, he is the co-founder of the Institute which was established in the year 1980. He is an educationist of eminence and also an industrialist of great repute. He runs a number of industries in and around Vijayawada.

Dr. K. S. Jagannatha Rao
Pro-Chancellor

Prof. K. S. Jagannatha Rao was one of the leading scientists in neuroscience research in globe. He was the Director on Institute for Scientific Research and Technological Advances (INDICASAT AIP), Republic Panama and contributed lot in building innovation in higher education and research in Panama since 2010. He played a key role in building PRISM (Panamanian Research Institutes of Science and Medicine) in Latin America. Dr. Rao has his research area on Brain Research and established Alzheimer's Centre and published 165 papers in leading Biochemistry and Neuroscience Journals, supervised 19 Ph.D students. He is also adjunct faculty of Biomedical Informatics of UTHS, Houston, and Advisory Board Member of UT- El Paso Minority Health NIH program, USA and Adjunct Faculty, Methodist Research Institute, Houston, USA. He was elected Member of Panamanian Association for the Advancement of Science (APANAC) - Considered as National Science Academy of Panama. He received his undergraduate and Ph.D degrees from Sri Venkateswara University, Tirupati. Later, joined in Central Food Technological Research Institute, Mysore. He received Sir C. V. Raman Award by Karnataka State Council of Science and Technology, 2003.

Prof. G P S Varma
Vice-Chancellor

Prof. G P S Varma, Vice-Chancellor, KLEF, is one of the most widely experienced leaders in Indian higher education, known for his commitment to expanding student opportunity, catalyzing academic innovation, and encouraging university's civic engagement and service to society. He adorned the position of Chairman, ISTE (Indian Society for Technical Education)- AP State, TSEMCET Test Committee Member-2021 nominated By Telangana State Govt, APEAMCET Admission Committee Member in 2016 by Andhra Pradesh State Council of Higher Education, Govt. of Andhra Pradesh. He has been a very farsighted Peer Team Visit Member for National Assessment and Accreditation Council (NAAC), Expert Committee Member for University Grants Commission (UGC) Autonomous Visits. He has been an Advisory Council Member for (CEGR) Centre for Education Growth, and Research India International Centre, New Delhi, and Board Member for Big-Data Analytics Forum.

Dr. A. V. S. Prasad

Pro-Vice Chancellor

Dr. A. V. S. Prasad, M.E and Ph.D from JNTU, Hyderabad is a professor in Civil Engineering. He has a rich experience of 33 years in academics which includes 26 years in administration at various cadres ranging from Head of Department, Dean, Principal, Director and Pro-Vice Chancellor. He has served as Director of Audisankara group of institutions and Narayana Group of Institutions for 18 years and was instrumental in getting these institutions accredited by NAAC, NBA, Autonomous and gained many laurels from the State Government, JNTU etc. He has served as Pro-Vice Chancellor of KL University for 3 years.

He has extensive knowledge of administrative system, maintaining statutory norms of bodies like AICTE, UGC etc and has a good understanding of NBA, NAAC procedures and norms. He served as Member, Chairman of Board of Studies at JNTU(A), KLCE(Autonomous) and KL University.

Dr. Venkatram Nidumolu

Pro-Vice Chancellor

Dr. Venkatram Nidumolu, Pro-Vice Chancellor is High performing, strategic thinking professional with more than 15years of administration experience and 20 years of teaching experience in KLEFand 30 years overall experience in the higher education sector. He graduated in B.Tech (ECE) from Acharya Nagarjuna University, pursued M.S degree from BITS, PILANI in software Systems. He received Ph.D award from Acharya Nagarjuna University. He held the positions like HOD, Joint Register, Principal, and Dean-Academics before becoming Pro-Vice Chancellor. He was core member of all NBA, NAAC, & other accreditations since 2004 and he has good experience in handling of quality issues and assessment related practices.

ACRONYMS

Sl No	Acronyms	Full Form
1	KLEF	Koneru Lakshmaiah Education Foundation
1	KLEF	Koneru Lakshmaiah Education Foundation
2	CET	Common Entrance Test
3	KLEEE	KLEF Engineering Entrance Examination
4	JEE	Joint Entrance Examination
5	BT	Biotechnology
6	CE	Civil Engineering
7	CS	Computer Science &Engineering
8	EC	Electronics & Communication Engineering
9	EE	Electrical & Electronics Engineering
10	CM	Computer Engineering
11	ME	Mechanical Engineering
12	AD	Artificial Intelligence & Data Science
13	CI	Computer Science & Information Technology
14	CGPA	Cumulative Grade Point Average
15	SGPA	Semester Grade Point Average
16	LTPS	Lecture, Tutorial Practical, Skill
17	SEE	Semester-End Examinations
18	SIE	Semester-In Examinations
19	OJET	On-the-job Engineering Training
20	IRP	Industrial Relations and Placements
21	PS	Practice-School
22	OPAC	Online Public Access Catalog
23	QCM	Quality Circle Meeting
24	MOOC	Massive Open Online Course
25	MOU	Memorandum of Understanding
26	OD	On Duty
27	(A,B]	Between A and B excluding value A and including value B
28	COE	Controller of Examinations
29	VLSI	Very Large-Scale Integration
30	MTech	Master of Technology
31	COA	Council of Architecture
32	JEE	Joint Entrance Examination
33	NATA	National Aptitude in Architecture

34	PC	Professional Core
35	BSAE	Building Science and Applied Engineering
36	PE	Professional Elective
37	PAECC	Professional Ability Enhancement Compulsory Courses
38	SEC	Skill Enhancement Course
39	OE	Open Elective
40	CTIS	Cloud Technology and Information Security
41	DS	Data Science
42	IoT	Internet of Things
43	IPA	Intelligent Process Automation
44	PCI	Pharmacy Council of India
45	PY	Pharmacy
46	B. Com (H)	Bachelor of Commerce with Honors
47	ACCA	Association of Chartered Certified Accountants
48	HM	Hotel Management
49	BTK	Basic Training Kitchen
50	QTK	Quantitative Training Kitchen
51	ATK	Advanced Training Kitchen
52	MBA	Master of Business Administration
53	BBA	Bachelor of Business Administration
54	MSc (F&C)	Master of Science (Finance & Control)
55	BA	Bachelor of Arts
56	M.Sc.	Master of Science

CHAPTER 1

INTRODUCTION

The President of Koneru Lakshmaiah Education foundation, Er. Koneru Satyanarayana, along with Late Sri. Koneru Lakshmaiah, founded the K L College of Engineering in the Academic year 1980-81. With the mighty vision and restless efforts of Er. Koneru Satyanarayana K L College of Engineering carved a niche for itself through excellence in engineering education, discipline and record numbers of placements and was the leading college in the state of AP. K L College of Engineering achieved NBA Accreditation for all its B.Tech. Programs in 2004 and later re-accredited in 2007. K L College of Engineering was transformed into an autonomous engineering college in the year 2006. In 2008 this college received a record grade of 3.76 on a 4 points scale with “A” Grade from NAAC; and in February 2009, the college, and Accredited by National Assessment and Accreditation Council (NAAC) of UGC as ‘A++’ with highest Grade of 3.57 CGPA on 4-point scale in 2018, through its founding society “Koneru Lakshmaiah Education Foundation” was recognized as Deemed to be University by the MHRD-Govt. of India, Under Section 3 of UGC Act 1956. This Deemed to be University is named as “KLEF”.

Location

KLEF is situated in a spacious 100-acre campus on the banks of Buckingham Canal of river Krishna, eight kilometres from Vijayawada city. Built within a rural setting of lush green fields, the institute is a virtual paradise of pristine nature and idyllic beauty. The campus has been aptly named "Green Fields" and the splendid avenue of trees and gardens bear testimony to the importance of ecology and environment. The campus ambience is most befitting for scholastic pursuits. The University is situated in a built-up area of around 15, 00,000 sq.ft.

Facilities

Central Library: E-Resources

The Central Library is the largest and holds materials to serve the whole University community. It has materials relevant to the Engineering, Science & Humanities courses offered by the University. The library system contains more than one lakh and fifty thousand books and periodicals on all subjects related to the teaching and research interests of the University staff and students. The library has over 65926 electronic journal titles, academic databases and 1519512 eBooks. Access is available on campus on student computers and remotely.

The Data Centre

A State-of-the-Art Data center with advanced servers provides a highly interactive learning environment with full-fledged hardware and software training facilities.

Physical Education – Sports Facilities

KLEF encourages students to explore their latent talents by providing good games and sports facilities.

The institute is equipped with the following –

Sport/Game	No. of Courts	Sport/Game	No. of Courts
Athletic track	1	Handball Court	1
Hockey Field	1	Netball Courts	2
Badminton Courts	4	Throw ball courts	2
Tennikoit Courts	2	Beach Volleyball Court	1
Cricket Field with Net practice	3	Football Field	1
Volleyball Courts	2	Basketball Courts	2
Tennis Courts	2	Kabaddi Courts	2
Kho Kho Court	1	Table Tennis	6
Soft Ball	1	Chess	20
Archery	1	Caroms	12

The University has a State-of-the-Art Indoor Stadium of 30000 sq.ft. with:

- 4 wooden Shuttle Courts/ Basketball Court
- Yoga and Meditation Centre
- Dramatics
- 8 Table Tennis Tables
- Hobby Centre
- Gymnasium for Girls
- Gymnasium for Boys
- Multipurpose room with Chess, Caroms etc.
- Power lifting/Weightlifting

Accommodation – Hostels

- KLEF has separate hostels for boys and girls with well furnished rooms and modern amenities.
- The overall atmosphere is very conducive for the students to concentrate on their studies.
- A state- of – the- art kitchen and spacious dining area has been provided for both the hostels.
- Generators have been provided as power backup. Emphasis has been laid on hygiene and cleanliness for healthy living. A customized menu caters to the student needs, it keeps changing according to their tastes.
- Teaching staff will have to address the academic and personal problems of the students. Round-the-clock security, communication, dispensary facilities are also available.

Facilities in the Hostels

- Protected drinking water
- State of the art kitchen, dining hall
- Newspapers, telephones, toilets and bathrooms are well maintained.
- Every student in the hostel is provided with a cot, study table, chair and a rack.
- Fan and light are also provided in each room.
- Gas & Steam based hygienic food preparation.
- Palatable regional, national and international cuisines
- Cleanliness and Safety STD/ISD Facilities

- Medical Kits and First Aid Boxes Soft drinks, snacks, Fruits etc.
- Laundry Stationary shop

Hostel Rules and Regulations

- Students are hereby informed that while staying in the hostel, it is essential to be responsible for maintaining dignity by upholding discipline.
- They must be obedient to the hostel warden/floor in –charges. Valuable items like jewelry etc. should not be kept with students while staying in the hostel.
- It is student's own responsibility to safeguard her/his Laptops, Money by locking suitcases and bags.
- If any loss is found, management will not take any responsibility. Students must intimate to the hostel authorities before giving police complaints against losses.
- Students are not allowed to indulge in smoking; consumption of Alcohol, Narcotic drugs etc., and defaulters will be strictly viewed upon.
- Students are directed that after locking their rooms they must hand over the keys to security and can collect them on returning to the hostel.
- Students must switch off Fans, Lights, Geysers, A/C's etc., before leaving their rooms.
- Visitors are not allowed inside the hostel at any time; however, they are allowed into the visitor's hall with the prior permission of the warden.
- Only family members listed by the parents are allowed to contact the student. Visiting hours are up to 7.30 pm only and after 7.30 pm visitors are required to leave the premises.
- Hostel students are not allowed to come into the hostel after 3.00 pm for morning shift students and 6.00pm for day shift students.
- Those students who are utilizing the computer lab, library etc., after the times specified must submit the permission slip to the security while entering the hostel.
- During public holiday outings, those who seek permission to leave the hostel will have to obtain written permission from the warden. Permission will be given only to those students who get permission from parents to leave the hostel during holidays/outings.
- Moving out of campus without permission is strictly prohibited. Strict study hours from 7.30 am to10.30 pm shall be maintained in the hostel.
- The hostellers must be in their allotted rooms during study hours. The general complaints of any kind should be noted in the complaint register, which is available at the hostel office.
- Registered complaints will only be entertained. Any health problem should be brought to the notice of Warden/Floor In – charge for necessary treatment.

Transportation

The institution runs 80 buses covering all the important points in Vijayawada City, Mangalagiri, Guntur and Tenali towns with a total seating capacity of 4000 students in two shifts. Transport is available 24 hrs., In case of any emergency in the institute /hostels. Transportation is available for conducting industrial tours and visits etc. Regular transport facility available up to 10PM.

Healthcare

A full-fledged health Centre with all the facilities is established to cater the needs of the students, staff, Faculty and the public in the adopted villages. It consists of three doctors (Homoeopathy, Ayurvedic and Allopathy).

Cafeteria

KLEF has a spacious canteen with the latest equipment and hygienic environment which provides

quality food and prompts service and caters to the needs of all the students and staff. A central cafeteria of 1500 sq.m. is available on the campus. Mini cafes and fast-food centers are available in various blocks. The canteen is open from 6:30 a.m. to 8:30 p.m. There is a wide variety of North- Indian and South-Indian cuisine and the students enjoy the pleasure of eating during the breaks. Cool aqua water for drinking is available.

Placements

KLEF has meticulously planned to make all its outgoing students employed. The University had installed the infrastructure, employed well experienced faculty, designed and delivered programs that help to enhance the communication and soft skills which are required for making the students employable. An excellent system is in place that considers all the issues that make a student employable. The University has been successful for the last 7 years in employing all the students who have registered and eligible for placement through its offices located across the country. About 50 trained personnel work extensively to make the students ready for recruitment by the industry.

Counselling and Career Guidance

A special Counselling Cell consisting of professional student counselors, psychologists, and professors counsels/helps the students in preparing themselves to cope with studies, perform well in the tests & various competitions. This Cell provides its services to the students in getting the solutions for their personal problems and provides career guidance with the help of the Industrial Relations and Placements (IRP) department. A group of 20 students are allotted to each faculty member who counsels them regularly and acts as their mentor.

Social Service Wings

KLEF has a social service wing which is used to channelize the social service activities of the faculty, staff and students. It has adopted 5 nearby villages and conducts activities like medical camps, literacy camps and educates the villagers regarding hygiene and health care on a regular basis.

NSS/NCC Wings

NCC/NSS is a credit course designed with an intent to transform NCC/NSS activities into curricular activities from an extracurricular thereby providing credits to students involved in NCC/NSS along with other attended advantages to the students in the university.

Hobby Clubs

Wholly and solely managed by the students, contributed much to the cultural life of the campus and to the cultural evolution of the students. Few student bodies and clubs operate in the campus like music society, dance club, drama society, literary and debating club, English press club, drawing club, painting club, mime club, computer club etc. Students manage entire activities and budget of the organization for the entire semester in advance. Around 4000 students are active members of the Hobby Clubs.

Life Skills and Inner Engineering

KLEF feels that it is its responsibility to mold the students as good human beings, contributing to the country and to society by producing responsible citizens. Along with the regular programs every student admitted into KLEF undergoes a one-week special life skills /orientation program. Through this program, KLEF is producing the students with clarity of thoughts and charity at heart. Strict regularity, implicit obedience, courtesy in speech and conduct, cleanliness in dress. Life skills and inner engineering teach a student his/her obligation towards GOD, himself /herself his/her country and fellow human beings. Every student is encouraged to practice his/her own religious faith and be

tolerant and respectful towards other religions.

Technical Festival

KLEF organizes various programs for the all-round development of the students.

The technical festival and project exhibition is organized in the odd semester (October) every year to elicit the innovative ideas and technical skills of the students.

Cultural Festival

The cultural festival in the even semester (February) of every year is the best platform for the students to exhibit their talents and creativity. Through these festivals KLEF is imparting organizational skills, leadership skills, competitive spirit, and team behavior skills to our students. Along with the knowledge, KLEF festivals provide recreation to the student community.

Center for Innovation, Incubation and Entrepreneurship (CIIE)

KLEF being a pioneering institute supporting Academics and Research in Engineering, Science and Technology is endowed with the entire infrastructure and highly experienced faculty, has a Centre for Innovation, Incubation and Entrepreneurship (CIIE) that comprises of: Innovation Centre which aims to inculcate a spirit of innovation. Incubation Centre which aims to incubate innovations through prototype product development. Entrepreneurship Development Centre (EDC) which aims at fostering entrepreneurial skills among the students.

Department of Mathematics

The department of Mathematics focuses on pure and applied mathematics catering to the professional needs of students of varied backgrounds. The department is offering courses for students majoring in Science, Engineering, Commerce and Business Administration. The department is offering M.Sc. Program in Applied Mathematics and Research Program leading to Ph.D.

Vision

Department of Mathematics strives to be internationally recognised for academic excellence.

Mission

- To create an ambience of Mathematical thinking and applying the same to solve complex engineering problems.
- To develop Mathematical model to solve problems at global level.
- To collaborate with other campus entities, individuals, professional associations and local community organizations.

Facilities

Library

Department of Mathematics caters to the needs of the students and teachers with its huge and updated volume of books offline and online. The library has an extensive and quality collection of over 1000 books and volumes of journals magazines and newspapers. Remote access to online database like Manupatra, LexisNexis, SCC Online, etc. is available at the library. We can comfortably accommodate the studentson rolling basis.

Classrooms

Comfortable classrooms with adequate seating capacity are available at Department of Mathematics. The classrooms are well equipped for digital method of teaching. Projectors, speakers are pre-installed to give best mode of teaching.

CHAPTER 2

PROGRAMS LIST AND ELIGIBILITY CRITERIA

Program	Duration	Eligibility	Percentage of Marks in the Qualifying Exam
M.SC. (COMPUTATIONAL MATHEMATICS)	2 years	B.SC.	60%

CHAPTER 3

PROGRAM EDUCATIONAL OBJECTIVES (PEOs) AND PROGRAM OUTCOMES (POs)

Program Educational Objectives (PEOs)

PEO	DESCRIPTION
1	Apply mathematics and technology tools (MATLAB) to solve modelling problems.
2	Understand the use of mathematical tools and concepts in other fields.
3	Communicate, and work with people of diverse backgrounds in individual and group settings, in an ethical and professional manner.
4	Critically analyze information and concepts to adapt to advances in knowledge and technology in the workplace.

Program Outcomes (POs)

PO	DESCRIPTION
1	To identify, formulate, abstract and analyze complex, real life or engineering problems using the principles of mathematical techniques.
2	To apply the mathematical concepts in the fields of high-end research and recognize their need and prepare for lifelong learning.
3	To apply mathematics tools (MATLAB, R, and MINITAB) for a better decision making in complex situations.
4	To maintain the core of mathematical and technical knowledge this is adaptable for solid foundation for lifelong learning.
5	To apply ethical principles of mathematical techniques for the commitment of professional ethics, responsibilities and socio-economic needs of the society.
6	Ability to do interdisciplinary research among allied subjects related to applied mathematics.
7	Use symbolic and numerical software as part of practical computation.

CHAPTER 4

ACADEMIC REGULATIONS

This document supplements the KLEF rules and regulations to assist all students. It is required that every individual must abide by these regulations. The regulations stated in this document are subject to change or can be relaxed/modified without prior notice at the discretion of the Hon'ble Vice Chancellor.

Terminology

- **Academic Bank of Credits (ABC):** It helps the students to digitally store their academic credits from any higher education institute registered under ABC in order to award Certificate / Diploma / Degree / Honors based on the credits earned by the student. All the credits acquired by the students are stored digitally by registering into Academic Bank of Credits (ABC) portal. It also supports retaining the credits for a shelf period and continue their program study with multiple breakovers.
- **Academic Council:** The Academic Council is the highest academic body of the University and is responsible for the maintenance of standards of instruction, education and examination within the University. The Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.
- **Academic Pathways:** Students of all programs of study are given the opportunity to choose their career pathways viz. Employability, Innovation and Research. Each of these pathways prepares the students in a unique way, enabling them to achieve the heights of their career.
- **Academic Year:** It is the period necessary to complete an actual course of study within a year. It comprises of two consecutive semesters i.e., Odd and Even Semester.
- **Backlog Course:** A course is considered to be a backlog if the student has obtained a failure grade (F).
- **Betterment:** Betterment is a way that contributes towards improving the students' grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.
- **Board of Studies:** Board of Studies (BOS) is an authority as defined in UGC regulations, constituted by Vice Chancellor for each of the department separately. They are responsible for curriculum design and update in respect of all the programs offered by a department.
- **Branch of Study:** It is a branch of knowledge, an area of study or a specific program (like Analytical Chemistry, Organic Chemistry etc.,)
- **Certificate course:** It is a course that makes a student gain hands-on expertise and skills required for holistic development. It is a mandatory, non-credited course for the award of degree.
- **Choice Based Credit System:** The institute adopts Choice Based Credit System (CBCS) on all the programs offered by it which enables the students to choose their courses, teachers and timings during their registration. This enables the students to decide on the courses to be done by them in a specific semester according to their interests in other activities.
- **Clinical course:** A course that help students develop their legal proficiency skills.
- **Compulsory course:** Course required to be undertaken for the award of the degree as per the program.
- **Course Handout:** Course Handout is a document which gives a complete plan of the course. It contains the details of the course viz. Course title, Course code, Pre-requisite, Credit structure, team of instructors, Course objectives, Course rationale, Course Outcomes and the relevant syllabus, textbook(s) and reference books, Course delivery plan and session plan, evaluation

method, chamber consultation hour, course notices and other course related aspects. In essence, course handout is an agreement between students (learners) and the instructor.

- **Course Outcomes:** The essential skills that need to be acquired by every student through a course.
- **Course Withdrawal:** Withdrawing from a Course means that a student can drop from a course within the first week of the odd or even Semester (there is no withdrawal for summer semester). However, s/he can choose a substitute course in place of it by exercising the option within 5 working days from the date of withdrawal.
- **Course:** A course is a subject offered by the University for learning in a particular semester.
- **Credit Point:** It is the product of grade point and number of credits for a course.
- **Credit Transfer:** The procedure of granting credit(s) to a student for course(s) undertaken at another institution.
- **Credit:** A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture hour per week or two hours per week of tutorials/ self-learning/ practical/ field work during a semester.
- **Cumulative Grade Point Average (CGPA):** It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed upto two decimal places.
- **Curriculum:** Curriculum is a standards-based sequence of planned experiences where students practice and achieve proficiency in content and applied learning skills. Curriculum is the central guide for all educators as to what is essential for teaching and learning, so that every student has access to rigorous academic experiences.
- **Deceleration:** Students may opt for a smaller number of courses in a semester or distribute the selection of courses across regular and summer semesters in order to cope up with their learning pace or to take part in other activities like innovative projects, pursuing their startups or doing research work.
- **Degree:** A student who fulfils all the Program requirements is eligible to receive a degree.
- **Department:** An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff and other resources.
- **Detention in a course:** Student who does not obtain minimum prescribed attendance in a course shall be detained in that course. Refer to Attendance & Detention Policy.
- **Dropping from the Semester:** A student who doesn't want to register for the semester should do so in writing in a prescribed format before commencement of the semester.
- **Elective Course:** A course that can be chosen from a set of courses. An elective can be Professional Elective, Open Elective, Management Elective and Humanities Elective.
- **ERP:** ERP (Enterprise Resource Planning) system is a comprehensive software solution designed to streamline and automate various administrative, academic, and financial processes within the University. It manages student information, including admissions, registration, enrollment, attendance, grades, and academic records.
- **Evaluation:** Evaluation is the process of judging the academic work done by the student in her/his courses. It is done through a combination of continuous in-semester assessment and semester end examinations.
- **Grade Point:** It is a numerical weight allotted to each letter grade on a 10 - point scale.
- **Grade:** It is an index of the performance of the students in a said course. Grades are denoted by alphabets.
- **Humanities Elective**: A course offered in the area of Liberal Arts.

- **In-Semester Evaluation**: Summative assessments used to evaluate student learning, acquired skills, and academic attainment during a course.
- **Legal Institution Visit:** Visit to a legal institution such as court, tribunals, law commissions as per the academic requirement.
- **LMS:** LMS stands for Learning Management System. It is a platform used in the institution to manage and deliver courses. Students can access learning resources, participate in online discussions, submit assignments, take assessments, and communicate with their instructors and peers.
- **Make-up Test:** An additional test scheduled on a date other than the originally scheduled date.
- **Multi-Section Course:** Course taught for more than one section.
- **Overloading:** Registering for more number of credits than normally prescribed by the Program in a semester.
- **Pre-requisite:** A course, the knowledge of which is required for registration into higher level course.
- **Professional Core:** The courses that are essential constituents of legal discipline are categorized as Professional Core courses.
- **Professional Elective**: A course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.
- **Program Educational Objectives:** The broad career, professional, personal goals that every student will achieve through a strategic and sequential action plan.
- **Program Outcomes:** Program outcomes are statements that describe what students are expected to know or be able to do at the end of a program of study. They are often seen as the knowledge and skills students will have obtained by the time they have received their intended degree.
- **Program:** A set of courses offered by the Department. A student can opt and complete the stipulated minimum credits to qualify for the award of a degree in that Program.
- **Project:** A 'project' means and includes case study, research paper, article as suitable to the objectives of the Course and at the discretion of the Course Coordinator.
- **Registration**: Process of enrolling into a set of courses in a semester/ term of the Program.
- **Re-Registration:** Student who are detained in courses due to attendance or marks criteria as per their regulation are given a chance to re-register for the same and complete it during the summer term.
- **Semester End Examinations:** It is an examination conducted at the end of a course of study.
- **Semester:** It is a period of study consisting of 16$\pm$1 weeks of academic work equivalent to normally 90 working days including examination and preparation holidays. The odd Semester starts normally in July and even semester in December.
- **Seminar Paper:** A 'seminar paper' is a research report written by students under the supervision of Research Guide that evolves their course-based knowledge, accounting for a grade on the topics of contemporary relevance and of interest. It is a credit-based course.
- **Single Section Course:** Course taught for a single section.
- **Social Service:** An activity designed to promote social awareness and generate well-being; to improve the life and living conditions of the society.
- **Student Outcomes:** The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioral.
- **Substitution of Elective course:** Replacing an elective course with another elective course as opted by the student.

- **Summer term:** The term during which courses are offered from May to July. Summer term is not a student's right and will be offered at the discretion of the University.
- **Supplementary**: A student can reappear only in the semester end examination for the Theory component of a course, subject to the regulations contained herein.
- **Underloading:** Registering for lesser number of credits than normally prescribed for a semester in that Program.

Academic Instructions

- Student should communicate in English with faculty and other students while he/ she is in campus.
- Students are expected to wish/greet all officials of the KLEF with due respect.
- Students should be courteous and polite while communicating with all Faculty & staff.
- Students should maintain silence and/or speak in a polite way in and around the classrooms, library, laboratories, and offices of the Deans, Program Chairs, Senior Officials, faculty rooms and corridors of academic buildings.
- It must be noted that shouting, talking in loud voice or in chorus, using indecent, abusive and discourteous language anywhere within the institution premises are considered serious acts of indiscipline and are punishable.
- Students should not loiter during the free time in the university campus.
- Students should not issue any public or press statement, send letters to editors, government, public servants or notaries without prior permission and approval of the Registrar of KLEF in writing.
- Students should keep the status, dignity, prestige and reputation of KLEF high and not engage in anything that might directly or indirectly undermine the standing of the institution.
- Students must always adhere to a prescribed/decent dress code befitting the dignity of a technical/professional student within the campus.
- Ragging of any student is a serious act of indiscipline and has been totally banned by the Hon'ble Supreme Court of India.
- A student found involved in any form of ragging, verbal or physical, inside or outside the institutional campus, hostels, or buses shall be treated as per the anti-ragging rules of the KLEF.
- Students must not be involved in quarreling or fighting or any indecent verbal or physical activity among themselves, or with staff and faculty or visitors.
- Direct or indirect involvement in any such activity will be considered as serious breach of discipline and strict disciplinary action will be taken against the students that engage in such activities.
- Students are not allowed to sit on the steps, boundary walls on the higher floors of any building, or engage in gossiping, making noise or any other such activity.

Working Hours

The University operates between 7:20am to 5:00pm (in shifts) on all weekdays.

Class Environment

The institute is a community of learners. Students have a responsibility of creating and maintaining an environment that supports effective learning to receive effective instructions in classrooms and laboratories. KLEF expects students to conduct themselves in an orderly and cooperative manner by adhering to University Rules & Regulations.

Laboratory Environment

A conducive learning environment in the laboratory is essential and the students are advised to follow the guidelines mentioned below:

- Always listen carefully to the faculty especially for the safety precautions to take in the moot court or laboratories.
- Accidents resulting in injuries may occur if precautions are not taken.
- Eating in moot court hall or laboratories is strictly prohibited.
- Proper dress code is to be followed as prescribed by faculty.
- Students should familiarize themselves with the location of all the equipment which may be available.
- Follow evacuation procedures quickly and quietly, if needed.
- Students should always conduct themselves in a responsible and cautious manner. Risky behaviors such as pushing, running, jumping etc., are unwarranted.
- Only materials required to complete and record the experiment instructions, (e.g. pencils, books, memorials, paper, etc.) should be brought into the moot court hall or laboratory.
- Equipment must be carefully handled to prevent breakage or damage, otherwise appropriate penalties/disciplinary action may be levied/imposed.
- Any accident, no matter how small or big, must be reported to the concerned faculty immediately.

Registration Process

For every course, the student must undertake the registration process prior to commencement of the coursework, based on the following conditions:

- Registration into a course will be permitted only for such courses, which are offered by KLEF in that semester.
- A student must clear the pre-requisite(s) if any, to register in to a course.
- KLEF reserves the right to register.
- Registration for add/drop/change of a course will be permitted only within one week from the scheduled date of commencement of classes.
- Students can register upto a maximum of 26 credits of their choice in a semester to meet their program requirements.
- KLEF reserves the right to withdraw within one week of the commencement of the semester any elective course offered, if adequate number of students have not registered or for any other administrative reasons. In such cases, the students are permitted to register for any other elective course of their choice provided they have fulfilled the eligibility conditions.
- KLEF reserves the right to cancel the registration of a student from a course or a semester or debar from the degree on disciplinary / plagiarism grounds.
- A student is solely responsible to ensure that all conditions for proper registration are satisfied. If, there is any clash in the timetable, it should be immediately brought to the notice of the Academic coordinator for necessary corrective action. The registration may be cancelled for a course or the entire semester either by KLEF if any irregularity is found at a later stage

Student Course Registration Process

To complete the student registration, student login to new ERP portal with their valid login credentials. After login student should click on Academic Registrations Student Course Registration. Now Student can view the courses and sections in dropdown menus. Student can select the sections against the courses on their own choice as mentioned in the following screen shot. Student can view the timetable on top of the selection of each course and section.

After completing the selection student need to click on Save to save the timetable. After duly verifying the timetable student needs to click on Submit to complete the Registration process. On successful completion of registration, a pop-up message, “Student Registration Successfully Completed” appears.

CHAPTER 5

PROGRAM CURRICULUM

M.Sc. (Computational Mathematics) Program Curriculum

For an academic program the curriculum is the basic framework that will stipulate the credits, category, course code, course title, course delivery (Lectures / Tutorials / Practice / Skill / Project/ Case Study /etc.), in the Choice Based Credit System. However, all such are essentially designed, implemented and assessed in Outcome Based Education Framework.

Program Structure

- An Academic Year is made of two semesters each is of, approximately 18 weeks duration andeach semester is classified as:
    - Odd Semester (July–December)
    - Even Semester (December –May).
- All courses are categorized into three streams even, odd and dual semester courses.
- Even semester courses are offered only during even semester i.e., January-May, Odd semester courses are offered only during odd semester i.e., July-December and dual semester courses are offered during both even & odd semesters.
- Program is a set of courses offered by the University that a student can opt and complete certain stipulated credits to qualify for the award of a degree.
- A student can opt for dissertation either by means of research at the University (or) through Internship at an Industry; this is however allowed during 3rd (or) 4th semesters only.

Course Structure

- Every course has a Lecture-Tutorial-Practice-Skill (L-T-P-S) component attached to it.
- Based upon the L-T-P-S structure the credits are allotted to a course using the following criteria.
    - Every 1 hour of Lecture / Tutorial session is equivalent to one credit.
    - Every 2 hours of Practical session is equivalent to one credit.
    - Every 4 hours of skill-based practice is equivalent to one credit.

Course Classification

Any course offered under M.Sc. (Computational Mathematics) program is classified as:

- **Induction Courses:** Student who gets admitted into B.Tech. program must complete a set of Induction courses for a minimum period of 3 weeks and obtain a “Satisfactory” result prior to registering into 1st Semester of the Program.
- **Bridge Courses:** Courses which are required to bridge the continuity among the Basic Sciences Courses / Engineering Sciences Courses / Professional Core Courses and are identified through gap analysis carried out using feedback obtained from various academic stakeholders are termed as Bridge Courses. These courses also do not yield any credits but require a “Satisfactory” result to register into the attached professional courses.
- **Humanities Arts & Social Science Courses (HAS):** Humanities Arts & Social Science Courses provides students an opportunity to complement their legal education in their chosen fields of interest.
- **Basic Science Courses (BSC):** Basic science courses are the foundation of all science education. They provide students with the knowledge and skills they need to understand

the natural world. Basic science courses typically cover Mathematics, Physics, Chemistry, Biology etc., Basic science courses are essential for students who want to pursue careers in science, engineering, medicine, and other STEM fields.

- **Engineering Science Courses (ESC):** Engineering sciences courses are a subset of basic science courses that are specifically designed for engineering students. These courses provide students with the knowledge and skills they need to understand the physical principles that underlie engineering design and analysis.
- **Professional Core Courses (PCC):** Professional core courses are a set of courses that are essential for all engineering students. These courses provide students with the knowledge and skills they need to be successful in their chosen engineering discipline.
- **Professional Elective Courses (PEC):** Professional electives are a set of courses that are chosen by students to supplement their engineering education. Professional electives are a great way for students to customize their engineering education and prepare for their future careers. By choosing electives that are relevant to their interests and goals, students can gain the knowledge and skills they need to be successful in their chosen field.
- **Open Elective Courses (OEC):** Open electives are a set of courses that are not specifically related to engineering, but that can provide students with knowledge and skills that are valuable in a variety of fields. Open electives are a great way for students to broaden their horizons and explore their interests outside of engineering. By choosing electives that are relevant to their interests and goals, students can gain the knowledge and skills they need to be successful in a variety of fields.
- **Skill Development Courses (SDC):** Skill development courses can provide students with the knowledge and skills they need to use specific software or hardware. This can be especially important for students who are interested in pursuing a career in a particular field.
- **Project Research & Internships (PRI):** Project, Research and Internships can help students gain a better understanding of their chosen field by giving them the opportunity to apply their knowledge and skills to real-world problems. These can help students explore their interests by giving them the opportunity to work on projects that they are passionate about.
- **Social Immersive Learning (SIL):** Social immersive learning is a type of experiential learning that allows students to learn by interacting with others in a simulated environment. This type of learning can be especially beneficial for B.Tech students because it can help them develop their soft skills, such as communication, teamwork, and problem-solving.
- **Audit Courses (AUC):** Any course offered in the University that has no assessment of student performance and no grading. Though “Satisfactory” completion of audit courses doesn’t acquire any credit but they are part of the graduation requirements.
- **Value-Added Courses (VAC):** Courses leading to certification and those which are conducted exclusively for employability are referred to as value added courses. Though “Satisfactory” completion of value-added courses doesn’t acquire any credit, but they are part of the graduation requirements.

Course Precedence

The following are the guidelines for registering into courses with pre-requisites.

- Every course may have one or more of its preceding course(s) as pre- requisite(s).
- To register for a course, the student must successfully be promoted in these course(s) earmarked as pre-requisite(s) for that course.

Summer Term Courses:

The following are the guidelines for registering into courses with pre-requisites. KLEF offers summer term courses during May and June. The following are the guidelines to register into courses offered in Summer Semester.

- A student may register for course/s in each summer term by paying the stipulated fee.
- Students registering for more than one (1) summer course must ensure that there is no clash in the time table.
- A student can register into a detained course or a not-registered course (course offered in regular semester, but student failed to register due to the non- compliance of pre-requisite condition but has paid the fee.) A student can also register for other than the above two mentioned categories of courses only if they are permitted for acceleration.
- In any case, a student can register only for a maximum of 12 credits during summer term.
- Attendance & Promotion policy for summer term is same as compared to the regular semester except for condonation policy. Condonation is not applicable for summer term courses.

CHAPTER 6

REQUIREMENTS FOR THE AWARD OF DEGREE

The student is awarded a M.Sc. (Computational Mathematics) degree provided she/he

- Must successfully earn 80 credits, as stipulated in the program structure.
- Must have successfully obtained a minimum CGPA of 5.5 at the end of the program.
- Must have finished all the above-mentioned requirements in less than twice the period mentioned in the Academic structure for each program, which includes deceleration period chosen by the student, deceleration imposed by KLEF or debarred from the KLEF.

Name of the Program			M. Sc Computational Mathematics	
Course Category	No. of courses	No. of credits	Total credits	Minimum CGPA required
AUC	**0**	***0***	80	5.5
HAS	**1**	***0***		
PCC	**10**	***39***		
FCC	**1**	***4***		
PEC	**3**	***12***		
OEC	**2**	***6***		
PRI	**2**	***19***		
VAC	**1**	***0***		

Award of Degree

A student having cleared all the courses and met all the requirements for the award of degree with:

- 5.5 ≤ CGPA < 5.75 will be awarded Pass class.
- 5.75 ≤ CGPA < 6.75 will be awarded Second class.
- 6.75 ≤ CGPA < 7.75 will be awarded First class.
- CGPA ≥ 7.75 will be awarded First class with Distinction provided the student has cleared all the courses in first attempt and must have fulfilled all the program requirements in two years duration.

CHAPTER 7

ATTENDANCE RULES AND DETENTION POLICY

Attendance Policy for Promotion in a Course

The student must maintain minimum 85% of attendance to be promoted in a course and to appear for Sem End Examination. In case of medical exigencies, the student/parent should inform the principal within a week by submitting necessary proofs and in such cases the attendance can be condoned up to an extent of 10% by Principal on the recommendation of the committee established for condonation.

- Attendance in a course shall be counted from the date of commencement of the classwork only and not from the date of his/her registration.
- Attendance for the students who are transferred from other institutes and for new admissions, attendance must be considered from the date of his/her admission.
- In case of attendance falling marginally below 75% due to severe medical reasons or any other valid reasons, the Principal / Program chair may bring such cases, along with valid and adequate evidence to the notice of the Dean Academics. The condonation board formed by Vice-Chancellor under the chairman ship of Dean-Academics will consider any further relaxation in attendance from the minimum attendance percentage requirement condition after going through case by case.

Attendance based Marks:

There are no specific marks attached to attendance as such, however, if the Course Coordinator of a course desires to award certain marks, for attendance in a course, She/he can do so based on following guidelines, which thereby must be clearly reflected in the respective course handouts which should duly be approved by the Dean Academics. For any course, not more than 5% marks can be allotted for attendance.

The distribution of marks for attendance is [85,88]=1 mark, [89,91]=2marks, [92,94]=3marks,[95,97]=4marks and [98,100]=5marks, below 85%, even in case of condonation,"0" marks. The marks, if allotted for attendance will have to be considered for all L-T-P-S components of a course cumulatively but not specifically for theory component for any course.

Attendance Waiver:

Students maintaining a CGPA ≥ 9.00 and SGPA ≥ 9.00 in the latest completed semester get a waiver for attendance in the following semester. Students who thus utilize an attendance waiver will be awarded the marks allocated for attendance (if any) based on their performance in an advanced assignment specified by the course coordinator (emerging topics related to the course). S/he can appear in all assessments and evaluation components without being marked ineligible due to attendance-based regulations.

Attendance Condonation for Participation in KLEF / National / International Events

Only those students nominated / sponsored by the KLEF to represent in various forums like seminars / conferences / workshops / competitions or taking part in co- curricular / extra- curricular events will

be given compensatory attendance provided the student applies in writing for such a leave in advance and obtain sanction from the Principal basing on the recommendations of the Head of the Department (HoD) for academic related requests; or from the Dean Student Affairs for extracurricular related requests. For participation in the KLEF's placement process the names of students will be forwarded by the placement cell in-charge to the respective Heads of the Departments. Students participating in KLEF/National/International events like technical fests, workshops, conferences etc., will be condoned for 10% of total classes conducted for each course in the semester.

Course Based Detention Policy

In any course, a student must maintain a minimum attendance as per the attendance policy for promotion in a course, to be eligible for appearing in the Sem-End examination. Failing to fulfill this condition, will deem such student to be detained in that course and become ineligible to take semester end exam.

Eligibility for Appearing in Sem-End Examination

A Student registered for a course and maintained minimum attendance of 70% is eligible to write the Semester-End Examination for that course unless found ineligible due to one or more of the following reasons:

- Shortfall of attendance
- Detained
- Acts of indiscipline
- Withdrawal from a course

CHAPTER 8

ASSESSMENT AND EVALUATION PROCESS

The assessment is conducted in formative and summative modes with a weightage of 60% for Semester-In evaluation and 40% for Semester-End Evaluation.
The distribution of weightage for various components of formative and summative modes are decided and notified by the course coordinator through the course handout after approval by the Dean Academics, prior to the beginning of the semester. Students are advised to refer the course handout to get more detailed information on assessment.

- Sem-In tests and the Semester-End Examinations will be conducted as per the Academic Calendar.
- Students may have to take more than one examination in a day during Sem-In exams, Semester-End Examinations /Supplementary examinations.
- Examinations may be conducted on consecutive days, beyond working hours and during holidays.

Semester-In Evaluation

The following are the guidelines for the Semester-In evaluation:

- The process of evaluation is continuous throughout the semester.
- The distribution of marks for Semester-In evaluation is 60% of aggregate marks of the courses.
- To maintain transparency in evaluation, answer scripts are shown to the students for verification, within one week of conduct of exam. If there is any discrepancy in evaluation, the student can request the course-coordinator to re-evaluate.
- The solution key and scheme of evaluation for all examinations are displayed by the Course-Coordinator in the appropriate web portal of the course, on the day of the conduct of examination.
- In case the student is unable to appear for any evaluation component owing to hospitalization, participation in extra/ co-curricular activities representing KLEF/ state/ country; the Dean Academics can permit to conduct of re- examination for such students.
- In case a student has missed any of the two in-semester evaluations, S/he is eligible for and will be provided with an opportunity of appearing for re- examination.

Semester End Examination

- The distribution of marks for Semester-End evaluation is 40% of aggregate marks of the Course.
- The pattern and duration of Sem End examination are decided and notified by the Course Coordinator through the Course handout, after approval from the Dean Academics.
- To maintain transparency in evaluation, answer scripts are shown to the students for verification. If there is any discrepancy in evaluation, the student can request the Controller of Examinations to re-evaluate.
- If a student earns ‘F’ grade in any of the courses of a semester, an instant supplementary exam(for only Semester End Exam component) will be provided within a fortnight of the declarationof the results.

Assessment of Project/Research-Based Subjects

All project or research-based subjects must have a defined time limit for completion. The specific time limits and schedule for monitoring and evaluating student performance will be announced each term. The final project report, after obtaining a plagiarism certificate, will be considered, and evaluated by the panel of examiners. Student project reports must follow the guidelines prescribed by the Dean of Academics.

Absence in Assessment and Examination

If a student fails to take any formative assessment component (due to ill-health or any valid reason), no second chance will be given, and zero marks will be awarded for the same. In cases of excused absence, the instructor may provide an opportunity to the student to reappear in quizzes or assignments or any other internal assessment criteria based on the approval from the principal & the concerned Head of the Department in written. If a student fails to write Sem-In Exam-I or obtained less than 50% marks in Sem-In Exam-I, he must attend remedial classes and maintain a minimum 85% of attendance in remedial classes to be eligible for Make-up test for Sem-In exam-I. Further, the number of remedial classes to be conducted shall be 50% of regular classes held till the Sem-In exam-I. However, there is no make-up test for Sem-In Exam-II or for the Laboratory exams.
A student's absence for Sem-In exams under the following circumstances are only considered for makeup test.

- Pre-approved participation in University/State/National/International co- curricular and extra-curricular activities.
- Ill health and medical emergencies for the student leading to hospitalization with certification by the doctor stating inability of student to attend Sem-In exams clearly within the necessary dates.
- Death of immediate family member

Remedial Classes and Remedial Exam

The following categories of students are recommended to attend Remedial classes:

- Students who did not attend or obtain a minimum of 50% marks in the Sem-In examination-1.
- Students for whom the learning objectives of CO1/CO2 are not attained in the Sem-In examination-1.
- Any other student may also be permitted to attend remedial classes as per the discretion of the Principal.

The following are the guidelines to conduct remedial classes:

- Remedial classes are scheduled to be conducted usually one- or two- weeks after the conclusion of Sem-In exam-1.
- The number of remedial classes to be conducted shall be 50% of regular classes held until the Sem-In exam-I.
- Remedial classes MUST NOT be scheduled during regular class work hours.

The following are the guidelines for remedial exams:

- Students attending remedial classes must maintain attendance of minimum 80% in classes conducted under remedial classes, without fail for being eligible for attending remedial exam.

- After conduction of remedial test, the Sem-in exam-1 marks will be updated by considering the weightage of 75% of marks obtained by student in remedial exam, and 25 % of marks obtained by student in regular exam; with a CAP of 75% in overall marks.

Grading Process

At the end of all evaluation components based on the performance of the student, each student is awarded grade based on absolute/relative grading system. Relative grading is only applicable to a section of a course in which the number of registered students is greater than or equal to 25. Choice of grading system is decided by the Course-Coordinator with due approval of Dean Academics and is specified in the course handout.

Absolute Grading

The list of absolute grades and its connotation are given below

Performance	Letter Grade	Grade Point	Percentage of marks
Outstanding	O	10	90-100
Excellent	A+	9	80-89
Very Good	A	8	70-79
Good	B+	7	60-69
Above Average	B	6	50-59
Average	C	5	46-49
Pass	P	4	40-45
Fail	F	0	0-39
Absent	AB	0	Absent

Relative Grading

The following table lists the grades and its connotation for relative grading:

LetterGrade	Grade Point	Grade Calculation
O	10	total marks >= 90% and total marks >= mean + 1.50σ
A+	9	μ+0.50σ <= total marks < μ+1.50σ
A	8	μ <= total marks < μ+0.50σ
B+	7	μ-0.50σ <= total marks < μ
B	6	μ-1.00σ <= total marks < μ-0.50σ
C	5	μ-1.25σ <= total marks < μ-1.00σ
P	4	μ-1.50σ <= total marks < μ-1.25σ or ≥40
F	0	total marks <μ-1.50σ or total marks <=39
AB	0	Absent

μ is the mean mark of the class excluding the marks of those students who scored ≥ 90% and ≤40% after rounding the percentages to the next highest integer. σ is the standard deviation of the marks.

SGPA and CGPA

The SGPA is the ratio of sum of the product of the number of credit s with the grade points scored by a student in all the courses and the sum of the number of credits of all the courses undergone by a student, in a semester.

Where 'Ci' is the number of credits of the i^{th} course and *'Gi'* is the grade point scored by the student in the i^{th} course.

The CGPA is also calculated in the same manner considering all the courses undergone by a student over all the semesters of a program, where 'Si' is the SGPA of the i^{th} semester and *'Ci'* is the total number of credits in that semester.

- The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.
- CGPA can be converted to percentage of marks: 10 X CGPA -7.5
- A student appearing for a course having practical integrated with theory and in case obtains less than 40% in either of practical or theory component of semester end examination, and in such case the student must reappear for the component only in which he has secured less than 40%. Till successful attainment of minimum 40% of both components, the student remains in the F grade for that course.
- Audit/Certificate courses are graded as satisfactory (S) or non- satisfactory (NS) only.
- At the end of each semester, the KLEF issues a grade sheet indicating the SGPA and CGPA of the student. However, grade sheets will not be issued to the student if he/she has any outstanding dues.

Illustration of Computation of SGPA and CGPA

SGPA Computation

Course	Credits	Grade Letter	Grade Point	Credit Point (Credit X Grade)
Course 1	3	A	8	3 X 8 = 24
Course 2	4	B+	7	4 X 7 = 28
Course 3	3	B	6	3 X 6 = 18
Course 4	3	O	10	3 X 10 = 30
Course 5	3	C	5	3 X 5 = 15
Course 6	4	B	6	4 X 6 = 24
	20			139

Thus, SGPA =139/20 =6.95

CGPA Computation

Item	Semester					
	I	II	III	IV	V	VI
Credits	20	22	25	26	26	25
SGPA	6.9	7.8	5.6	6.0	6.3	8.0

Thus, $CGPA = \frac{(20*6.9+22*7.8+25*5.6+26*6.0+26*6.3+25*8.0)}{(20+22+25+26+26+25)} = 6.73$

Betterment

A student may reappear for semester end examination for betterment only in the theory part of the course for improving the grade, subject to the condition that, the student has passed the course, his/her CGPA is ≤ 6.75 and the grade in the respective course to be equal to or lower than "C". In the case of reappearing for a course, the best of the two grades will be considered. A Student can re-register in any course in any semester during the program for improvement of grade if the current grade in the course is lower than B+ and with due approval from Dean Academics in accordance with academic regulations. A student cannot reappear for semester end examination in courses with their L-T/ST-P-S Structure like 0-0-X-X, Project, and Seminar Paper.

Rustication

A student may be rusticated from the KLEF on disciplinary grounds, based on the recommendations of any empowered committee, by the Vice Chancellor.

Award of Medals

KLEF awards Gold and Silver medals to the top two candidates in each program after successful completion of their study. The medals are awarded based on their CGPA during the Annual Convocation with the following constraints:

- The grade obtained through betterment/ supplementary will not be considered for this award.
- S/he must have obtained first class with distinction for the award of Gold or Silver-medal.

Academic Bank of Credits

ABC helps the students to digitally store their academic credits from any higher education institute registered under ABC in order to award Certificate/Diploma/Degree/Honors based on the credits earned by the student. All the credits acquired by the students are stored digitally by registering into Academic Bank of Credits (ABC) portal. It also supports retaining the credits for a shelf period and continue their program study with multiple breakovers. Students may exit from their current program of study due to any unforeseen reasons or to focus on their chosen career path. In such cases, the student may break for a period of time (preferably not in the middle of an academic year) and may continue with the program of study at a later stage. Moreover, students must be able to complete their program by not exceeding the maximum duration of the program. If not, they may be issued with a Certificate, diploma, degree or honors based on the credits acquired over the period of time for all the programs approved by UGC.

CHAPTER 9

PROMOTION

Credit Transfer between KLEF and other Institution

a. **Credit transfer from KLEF to other institutions:** Student studying in KLEF can take transfer to another institution under the following conditions:

i. KLEF has signed MOU with the institution.

ii. However, a student, after seeking transfer from KLEF can return to KLEF after a semester or year. Based on courses done in the other institution, equivalent credits shall be awarded to such students.

b. **Credit transfer from another institution to KLEF:** A student studying in another institution can take transfer to KLEF under the following conditions:

i. When a student seeks transfer, equivalent credits will be assigned to the student based on the courses studied by the student.

ii. The student, when transferred from other institutions, has to stick to the rules and regulations of KLEF.

iii. To graduate from KLEF, a student must study at least half of the minimum duration prescribed for a program at KLEF.

Credit Transfer through MOOCs

Undergraduate students can get credits for MOOCs courses recommended by KLEF up to a maximum of 20% of their minimum credits required for graduation. The discretion of allocation of MOOCs courses equivalent to the courses in the curriculum lies with the office of the Dean Academics.

A student may also be permitted to obtain 20 credits through MOOCs in addition to the minimum credits required for graduation. These 20 credits can also be utilized to acquire a Minor degree or an Honors degree if the courses are pronounced equivalent to those specified for the respective degrees by the office of the Dean Academics. These additional credits through MOOCs if to be considered for CGPA/Minor/Honors degree must be approved by Dean Academics prior to enrollment in the respective MOOCs.

Students acquiring additional credits for Honors / Minor degree must adhere to the rules governing the award of the respective degree, otherwise, a student applying for registering into additional credits through MOOCs must possess a minimum CGPA of 7.5 till that semester.

CHAPTER 10

STUDENT COUNSELLING AND FEEDBACK

Student Counselling

Effective academic counselling, career counselling, and personal counselling foster student success and are an integral part of the institutional environment. Academic counselling provides students with clear pathways for successful and timely completion of their academic goals, through either degree or certificate programs at two-year colleges or transfer to four-year colleges or universities. Career counselling provides information about a wide variety of employment opportunities available in chemistry-based careers. Personal counselling leads to successful completion of educational and career goals with good moral and ethics.

Mentors, Advisers, counsellors, and faculty members should help students (UG and PG) develop educational goals and guide their professional development via networking opportunities, confidence building, and career planning. A strong collaboration among faculty, counsellors, and advisers at the institution and their students and parents should be fostered and sustained in order to increase students' successful graduation, transfer, job placement, and achievement of career goals.

The following are the various parameters that are taken into consideration in the respective counselling process:

Academic Counselling

A mentor or counsellor pays personal attention to and monitors student's academic progress. Students meet the allotted counsellor every fortnight and counsellor record the academic issues faced by the students, if any. The academic progress of the student is tracked by the counsellor and the same is informed to the parents of the students every month. A consolidated counselling report is submitted by the Department Academic Counselling Board to the Office of Dean Academics through the Professor In-Charge of the Department. Office of Dean Academics discusses with the departments to understand the various aspects that contribute to the development of the students and the ways to address & resolve the issues faced by their students. The outcome of the meeting may be in identifying the best practices to be adopted by the mentors to effectively guide the students, training to be adopted for students and mentors, therapeutical sessions to be arranged in consultation with psychologists, teaching learning practices to be improved, etc.

Career Counselling

The skill development and student progression division play an exemplary role in the overall progress and career growth of the students. SWEAR (Strengths, Weakness, Eligibility, Availability and Resources) analysis is done for the students at regular intervals in order to identify their strengths, weaknesses, interests, career category of interest (employability, research or entrepreneurship), pre-existing knowledge, aspects to improve, etc. The survey results are analysed and necessary insights are derived from it for the appropriate planning by the skill development and student progression division and communicated to the departments. Necessary training programs in areas like soft skills, communication, life skills like yoga, meditation are arranged under the aegis of skill and sports division through experts from appropriate industry as trainers.

Psychological Counselling

Mentors are encouraged to guide the students on various aspects mentioned below to ensure the overall development of the students. Mentors are given necessary professional development

programs to effectively guide the students on these aspects to ensure the holistic development of the students. As the students go to the mentor for regular interaction as a part of their timetable, they establish a good connection with them and be ready to listen to the mentor on the areas they should focus upon in order to excel well in academics. Some of the varies aspects the mentor advices the students upon are time management, classroom activities, anti-ragging policy, positive attitude, human values, motivational lectures, self-awareness, gender sensitization, family relations, peer relations, physical-emotional-mental health, sports, cultural activities, hostel room/home related. In spite of the best efforts of the mentor in guiding the students on the aspects mentioned above, in some of the cases the students may need the support of the psychologists to overcome their mental health issues. In such cases, the mentors are required to recommend those students to the psychologists for further action. Based on the counselling feedback received from the counsellors, the department chair recommends the student for personal or psychological counselling by psychologists, if required for the improvement of student's academic progress and behavioural process. The University appointed psychologists will counsel the student and provide few recommendations to improvise the personal attitude and professional career growth. The same will be forwarded to the parents of the student.

Feedback System

Monitoring of feedback is a continuous process. Feedback is obtained from students and parents on various aspects. Feedback is taken through personal interaction with students, interaction with parents in addition to mid-semester and end-semester feedback. The following are the different feedbacks:

- Student General Feedback: General Feedback is taken from the students on the aspects like Course Contents, Teaching Learning Process, Outcomes, Resources and Evaluation twice in every semester (Mid semester and End Semester Feedback) in a structured format floated by Office of Dean Academics.
- Student Satisfaction Survey: Student Satisfaction Survey to all innovative methods and approaches should be recorded at appropriate intervals and the process should be refined based on that. Students should be sensitized on the process and methods and their understanding of the same should be assured.
- Student Exit Feedback: Exit feedback is taken from the final year students on the aspects like entrance test, admission process, Course Contents, Teaching Learning Process, Outcomes, Resources and Evaluation, placements etc.
- Stakeholders Feedback: Stakeholders feedback for design and review of syllabus is taken at the end of every semester from Students, Alumni, Academic Peers, Parents and Industry Personnel.
- Faculty Satisfaction Survey: Satisfaction Survey is taken from the existing faculty on Course Contents, Teaching Learning Process, Outcomes, Resources and Evaluation once in every semester in a structured format floated by Office of Dean Academics.

The feedback collected from students and other stakeholders will be duly analyzed, classified, summarized and finally, a consolidated Action Taken Report will be prepared over the collective issues raised by the students and the stakeholders in the feedback. The finalized Action Taken Report will be forwarded to the Board of Studies and after obtaining approval in the Academic Council, suggested amendments will be made to the curriculum.

CHAPTER 11

PROGRAM STRUCTURE

Koneru Lakshmaiah Education Foundation Department of Mathematics M.Sc. (Computational Mathematics) Y23 Course Structure (2023-24)											
Sl No	**Sem**	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**S**	**Cr**	**CH**	**Pre-requisite**
1	1	23UC5201	Professional Communication Skills	AUC	0	0	4	0	0	4	NIL
2	1	23CT5101	Linear Algebra	PCC	2	2	0	0	4	4	NIL
3	1	23CT5102	Relational Algebra and Database Management System	PCC	2	0	2	4	4	8	NIL
4	1	23CT5103	Applied Discrete structures	PCC	2	2	0	0	4	4	NIL
5	1	23CT5104	Mathematical Modelling & Numerical Methods using MATLAB	PCC	2	0	2	0	3	4	NIL
6	1	23CT5105	Computational Thinking for Structured Design THROUGH C++	PCC	2	0	2	4	4	8	NIL
7	2	23UC5102	Essentials of Research Design	PRI	2	0	2	0	3	4	NIL
8	2	23CT5201	Data Structures and Design of Algorithms	PCC	2	0	2	4	4	8	CTSD
9	2	23CT5202	Probability and Statistics	PCC	2	0	2	4	4	8	NIL
10	2	23CT5203	Matrix Computation	PCC	2	0	2	4	4	8	LA
11	2		PE-1		2	0	2	0	3	4	
12	3	23CT6101	Minor Project	PRI	0	0	4	4	3	8	ERD, MMNM
13	3	23CT6102	Mathematical Programming	PCC	2	2	0	0	4	4	DS
14	3	23CT6103	Transform Techniques for Engineering	PCC	2	2	0	0	4	4	LA
15	3		FLEXI-CORE COURSE	PCC	2	2	0	0	4	4	Relevant Course
16	3	23UC6103	VAC	VAC	2	0	0	0	0	0	NIL
17	ANY		OPEN ELECTIVE - 1	OEC	3	0	0	0	3	3	NIL
18	3		PE-2		2	0	2	0	3	4	
19	3		PE-3		2	0	2	0	3	4	
20	ANY		OPEN ELECTIVE - 2	OEC	3	0	0	0	3	3	NIL
21	4	23CT6201	Major Project	PRI	0	0	24	16	16	40	SPO, TTE, MIP, CTSD
			Total Credits						80		

Flexi Core Courses					**L**	**T**	**P**	**S**	**Cr**	**CH**	PRE-REQUISITE
1	3	23CT6110	Stochastic Processes & Optimization		2	2	0	0	4	4	P&S
2	3	23CT6111	Quantum Computing		2	2	0	0	4	4	MMNM
3	3	23CT6112	Applied Geometry & Computer Graphics		3	0	2	0	4	5	DS
Professional Electives											
			PE-1								
1	2	23CT5204	Data Science & Visualization	PE	2	0	2	0	3	4	RADMS
2	2	23CT5205	Essentials of Machine Learning	PE	2	0	2	0	3	4	LA, DS
3	2	23CT5206	Cryptography & Security	PE	2	0	2	0	3	4	LA
			PE-2								PRE-REQUISITE
1	3	23CT6104	Data Warehousing & Data Mining	PE	2	0	2	0	3	4	DSV
2	3	23CT6105	Deep Learning Concepts	PE	2	0	2	0	3	4	ML
3	3	23CT6106	Crypt Analysis & Cyber Defense	PE	2	0	2	0	3	4	ISC
			PE-3								PRE-REQUISITE
1	3	23CT6107	Introduction to Big Data Analytics	PE	2	0	2	0	3	4	DSV
2	3	23CT6108	Cognitive Computing	PE	2	0	2	0	3	4	ML
3	3	23CT6109	Introduction to Blockchain & Cryptocurrencies	PE	2	0	2	0	3	4	ISC

CHAPTER 12

ARTICULATION MATRIX

Program Articulation Matrix

S.No	Course Code	Course Name	Category	L	T	P	S	Credits	PO							
									1	2	3	4	5	6	7	8
1	23UC5201	Professional Communication Skills	Core	0	0	4	0	0					5			
2	23CT5101	Linear Algebra	Core	2	2	0	0	4		2						
3	23CT5102	Relational Algebra and Database Management System	Core	2	0	2	4	4		2	3		5	6	7	
4	23CT5103	Applied Discrete structures	Core	2	2	0	0	4	1						8	
5	23CT5104	Mathematical Modelling & Numerical Methods using MATLAB	Core	2	0	2	0	3	1	2	3					
6	23CT5105	Computational Thinking for Structured Design THROUGH C++	Core	2	0	2	4	4				4			7	
7	23UC5102	Essentials of Research Design	Core	2	0	2	0	3			3					
8	23CT5201	Data Structures and Design of Algorithms	Core	2	0	2	4	4			3					
9	23CT5202	Probability and Statistics	Core	2	0	2	4	4			3					
10	23CT5203	Matrix Computation	Core	2	0	2	4	4			3				7	
11	23CT6101	Minor Project	Core	0	0	4	4	3							7	

12	23CT6102	Mathematical Programming	Core	2	2	0	0	4			3				7	
13	23CT6103	Transform Techniques for Engineering	Core	2	2	0	0	4			3					
14		FLEXI-CORE COURSE	Core	2	1	0	0	3			3					
15	23UC6103	VAC	Core	2	0	0	0	0								
16		OPEN ELECTIVE - 1	Core	2	0	0	0	2	1							
17	23CT5205	Essentials of Machine Learning	PE	2	0	2	0	3			3				7	
18	23CT5206	Cryptography & Security	PE	2	0	2	0	3			3				7	
19	23CT5204	Data Science & Visualization	PE	2	0	2	0	3			3				7	
20	23CT5205	Essentials of Machine Learning	PE	2	0	2	0	3			3				7	
21	23CT5206	Cryptography & Security	PE	2	0	2	0	3			3				7	
22	23CT6104	Data Warehousing & Data Mining	PE	2	0	2	0	3			3				7	
23	23CT6105	Deep Learning Concepts	PE	2	0	2	0	3			3				7	
24	23CT6106	Crypt Analysis & Cyber Defence	PE	2	0	2	0	3			3				7	
25	23CT6107	Introduction to Big Data Analytics	PE	2	0	2	0	3			3				7	
26	23CT6108	Cognitive Computing	PE	2	0	2	0	3			3				7	
27	23CT6109	Introduction to Block chain & Cryptocurrencies	PE	2	0	2	0	3			3				7	

Course Articulation Matrix

S No	Course Code	Course Title	LTPS	Credits	CO NO	Description of the Course Outcome	Program Outcomes							
							1	2	3	4	5	6	7	8
1	23UC5201	Professional Communication Skills	0-0-4-0	*2*	CO1	Understand the concepts of grammar to improve communication, reading, and writing skills.					5			
					CO2	Demonstrate required knowledge over Dos and Don'ts of speaking in the corporate context. Demonstrate ability to face formal situations / interactions. Dos and Don'ts of speaking in the corporate context. Demonstrate ability to face formal situations / interactions.					5			
					CO3	Understand the varieties of reading and comprehend the tone and style of the author, Skim and scan effectively and appreciate rhetorical devices.					5			
					CO4	Apply the concepts of writing to draft corporate letters, emails, and memos.					5			
2	23CT5101	Linear Algebra	2-2-0-0	*4*	CO1	Describe group, subgroup and quotient groups and their applications.		2						
					CO2	Demonstrate the concepts of homomorphism and automorphism of groups.		2						
					CO3	Illustrate the theory of rings and its applications.		2						
					CO4	Illustrate the concept of fields and Polynomial Rings.		2						
3	23CT5102	Relational Algebra and Database Management	2-0-2-4	*4*	CO1	Illustrate the functional components of DBMS, importance of data modelling in design of a database.					5			
					CO2	Build queries using SQL and concepts of PL/SQL					5			

		System			CO3	Apply normalization techniques and indexing to construct and access decent Database.					5			
					CO4	Identify the importance of transaction processing, concurrency control and recovery techniques					5			
					CO5	Develop a good database and define SQL queries for data analysis.		3						
4	23CT5103	Applied Discrete Structures	2-2-0-0	*4*	CO1	Describe the rules of Propositional logic to the arguments of the statements.					6			
					CO2	Illustrate the concept of discrete structures to represent Boolean functions.					6			
					CO3	Construct recurrence relations and solve them.					6			
					CO4	Apply concepts of graph theory for real life problems.					6			
5	23CT5104	Mathematical Modelling & Numerical Methods using MATLAB	2-0-2-0	*3*	CO1	Identify the difference between solutions of system linear and roots of non-linear equations by direct, bisection methods.		2						
					CO2	Construct the interpolation forward and backward tables and find the Eigen values and vectors by using mat lab also.		2						
					CO3	Apply Numerical differentiation and integration problems for different methods and find the values and compare the values by using mat lab also.		2						
					CO4	Construct numerical solutions of first and second order ordinary differential equations		2						

						and compare the numerical values with mat lab also.								
					CO5	Verify the solution of the N.M. through MATLAB.			3					
6	23CT5105	Computational Thinking for Structured Design THROUGH C++	2-0-2-0	*3*	CO 1	Describe the basic computer organization and concepts of computer language fundamentals.							7	
					CO 2	Apply the concept of user define functions in C++ for modular programming.							7	
					CO 3	Illustrate user defined C++ functions and different operations on list of data.							7	
					CO 4	Demonstrate the Object Oriented Concepts and implement linear data structures.							7	
					CO 5	Develop the code for the algorithms in C++							7	
8	23IE5102	Essentials of Research Design Data Structures and Design of Algorithms	2-0-2-4	*4*	CO 1	Demonstrate the way of writing thesis and dissertation, Research article, Reviews, Monographs, Bibliography, Literature search, Significance of research, Research methods versus methodology, Research and Scientific methods, Defining the research Problem and Research design.		2						
					CO 2	Illustrate on various methods for Problem Solving through the statistical modelling and Analysis.		2						
					CO 3	Illustrate the Sampling Fundamentals with applications.		2						

					CO 4	Illustrate the concept of Interpretation and Report Writing		2						
9	23CT5201	Data Structures and Design of Algorithms	2-0-2-4	*4*	CO 1	Analyze and compare stack ADT and queue ADT implementations using linked list and applications.							7	
					CO 2	Analyze the linked lists and types of Binary trees and their representations.							7	
					CO 3	Analyze different Sorting Algorithms, linked implementation of Binary, Balanced Trees and different Hashing techniques.							7	
					CO4	Analyze different representations, traversals, applications of Graphs and Heap organization.							7	
					CO5	Analyze and compare stack ADT and queue ADT implementations using linked list and applications.							7	
10	23CT5202	Probability and Statistics	2-0-2-4	*4*	**CO 1**	Understand the basic functions in R programming and identify the operators using in it.	1							
					CO 2	Simulating data using R		2						
					CO 3	Apply various probability distributions to the real world problems using R	1							
					CO4	Analyze the data using various linear and nonlinear lines using R		2						
					CO5	Develop and Evaluate common practical applications for linear and non-linear data structures.			3					

11	23CT5203	Matrix Computation	2-0-2-4	*4*	CO 1	Use sophisticated scientific computing and visualization environments to solve application problems involving matrix computation algorithms and Explain the effects of errors in computation and how such errors affect solutions.	1							
					CO 2	Analyze numerical algorithms, and understand the relationships between the computational effort and the accuracy of these algorithms.		2						
					CO 3	Interpret the results produced by computer implementations of numerical algorithms.			3					
					CO 4	Apply Rayleigh quotient iterations and Explicit and implicit QR algorithms.					5			
					CO5	Demonstrate the necessary analytical background for further studies leading to research in Machine Learning.					5			
13	23CT6101	Minor Project												
14	23CT6102	Mathematical Programming	2-2-0-0	*4*	CO 1	Apply different methods to find the optimal solution of linear programming problems and analyze the sensitivity of the solution.			3					
					CO 2	Different methods to find the optimal solution of Transportation and Assignment			3					

						problems.								
					CO 3	Apply non-linear optimization methods to solve non- linear programming problems.			3					
					CO 4	Apply Search methods to solve non-linear programming problems.			3					
15	23CT6103	Transform Techniques for Engineering	2-2-0-0	*4*	**CO 1**	Apply Laplace transform techniques to solve linear differential equations in system analysis where initial conditions can be easily included to give system response.	1							
					CO 2	Applying z- transform and Mellin transform to the analysis and characterization of Discrete Time systems.	1							
					CO 3	Apply Fourier series to analyze various signals.		2						
					CO 4	Apply Fourier transforms to analyze various signals.		2						
					CO 5	Verify the solution of the Transform techniques through MATLAB.			3					
16	23UC6103	VAC												

18	23CT6201	Major Project													
19	23CT6110	Stochastic Processes & Optimization	2-2-0-0	*4*	CO 1	Describe the concept of Markov process and Poisson Process.	1								
					CO 2	Illustrate Queuing models and Demonstrate the concepts of Brownian motions and applications						6			
					CO 3	Formulate LPP and solve LPP. Model and solve Transportation and Assignment problems.						6			
					CO 4	Apply Geometric programming and Ant-colony Optimization and PSO. Solve decision making techniques to solve real life problems.						6			
20	23CT6111	Quantum Computing	2-2-0-0	*4*	CO 1	To introduce basics of quantum computing		2							
					CO 2	Implementing Quantum computing algorithms			3						

					CO 3	Applying concepts of Quantum computing using QISKIT			3					
					CO 4	Analyze and Discuss Quantum Machine learning and deep learning concepts with applications				4				
					CO 5	Practicals on all algorithms discussed above			3					
21	23CT6112	Applied Geometry & Computer Graphics	3-0-2-0	*4*	CO 1	To understand Basics of Augmented Reality and Interactions. Fundamentals of Augmented , Mixed Reality and its features P	1							
					CO 2	To understand Basics of Virtual Reality and Interactions. Fundamental Concept and Components of Virtual Reality					5			
					CO 3	To understand Graphics Pipelines, Creating a sample augmented reality apps in android					5			
					CO 4	To apply Unity development Environment, IDE Basics, Sprites,User Interfaces, Simple 3D animation Creation.					5			
					CO 5	Develop applications through Lab experiments.					5			
22	23CT5204	Data Science & Visualization	2-0-2-0	*3*	CO 1	Understand the modelling of various types of data.			3					
					CO 2	Understand the Visualization fundamentals.		2						
					CO 3	Apply methods and tools for Non-Spatial DataVisualization					5			

					CO 4	Apply methods for Scientific / Spatial Data Visualization and Web data visualization.					5			
					CO 5	Evaluate data visualization through Python &Tableau.					5			
23	23CT5205	Essentials of Machine Learning	2-0-2-0	*3*	CO 1	Understand the basic terminology and measurements of Machine Learning and Apply Machine Learning techniques using Tree and Bayesian models.								
					CO 2	Apply and analyze Neural Network and SVM Models for solving Classification and Prediction problems								
					CO 3	Apply Dimensionality reduction methods, Evolutionary learning and Ensemble methods to solve classificationproblems								
					CO 4	Illustrate different unsupervised models, Analytical, Explanation-Based and reinforcement learning methods.								
					CO 5	Implement Machine Learning Techniques using PythonLanguage.								
24	23CT5206	Cryptography & Security	2-0-2-0	*3*	CO1	Understand the principles of cryptography by analyzing various attacks and apply different classic encryption techniques.								
					CO2	Understand the principles of block cipher and apply algorithmslike DES, AES.								
					5CO3	Understand and apply different algorithms of public key cryptosystem for ensuring secured communication and authentication.								
					5CO4	Understand the concept of elliptic curve and its applications to cryptography. Apply hash algorithms for security.								

					CO5	Implement various cryptographic algorithms so as to analyze the achievability of security goals like Confidentiality, integrity, authentication and also Justify the possibility of cryptanalysis attack with each algorithm.								
25	23CT6104	Data Warehousing & Data Mining	2-0-2-0	*3*	CO 1	Understand Data Warehousing Techniques and apply different data processing techniques.		2						
					CO 2	Implementation of Data Pre-Processing Techniques.		2						
					CO 3	Apply mining Algorithms for classifying data into differentclasses using labelled data.		2						
					CO 4	Applying unsupervised learning algorithm for datacategorization.		2						
					CO 5	Implement mining algorithms using modern tolls andtechniques for data processing.					5			
26	23CT6105	Deep Learning Concepts	2-0-2-0	*3*	CO 1	Able to understand Deep learning and remember the concepts ofPerception, Back Propagation,		2						
					CO 2	Able to understand auto encoders- and apply Regularization, andCNN techniques to generate Deep learning models		2						
					CO 3	Apply Long Short Term Memory			3					
					CO 4	Build Markov models, Markov networks, Markov chains.			3					
					CO 5	Implement basic Neural Networks, optimization algorithms.			3					

27	23CT6106	Crypt Analysis & Cyber Defence	2-0-2-0	*3*	CO1	Understand the principles of cryptography by analyzing various attacks and apply different classic encryption techniques.	1							
					CO2	Understand the principles of block cipher and apply algorithmslike DES, AES.					5			
					CO3	Understand and apply different algorithms of public key cryptosystem for ensuring secured communication and authentication.					5			
					CO4	Understand the concept of elliptic curve and its applications to cryptography. Apply hash algorithms for security.					5			
					CO5	Implement various cryptographic algorithms so as to analyze the achievability of security goals like Confidentiality, integrity, authentication and also Justify the possibility of cryptanalysis attack with each algorithm.					5			
28	23CT6107	Introduction to Big Data Analytics	2-0-2-0	*3*	CO 1	Understand the concepts of big data, Initial exploration of analysis of data and Data visualization	1							
					CO 2	Understand Initial exploration of data and advanced data analytics by using R		2						
					CO 3	Apply advanced algorithms & Statistical modeling for big data using HDFS, HIVE, and PIG.		2						
					CO 4	Apply advanced SQL functions for in-database analytics by MADlib, Greenplum along with common deliverables of analytics life cycle project		2						
					CO 5	Build and Evaluate the Big Data Analytical problem using R, Hadoop, HIVE Programming concepts.				4				

29	23CT6108	Cognitive Computing		*3*	CO1	Understand cognitive computing is, and how it differs from traditional approaches	1							
					CO2	Applying the primary tools associated with cognitive Computing	1							
					CO3	Develop a project that leverages cognitive computing		2						
					CO4	Analyse and discuss the business implications of cognitive computing		2						
					CO5	Able to implement cognitive computing programs using IBM Watson			3					
30	23CT6109	Introduction to Blockchain & Cryptocurrencies	2-0-2-0	*3*	CO 1	To apply the concepts of number theory and its applications incryptography	1							
					CO 2	To understand the basics of block chain		2						
					CO 3	To apply different types of block chain and consensusalgorithms for contract transaction			3					
					CO 4	To apply the different types of crypto currencies to cryptoapplications		3						
					CO 5	To analyse basic number theory, cryptography concepts and smart contracts applications using soft wallet.						6		

CHAPTER 13

SYLLABUS

PROFESSIONAL COMMUNICATION SKILLS (PCS)

COURSE CODE	22UC1101L	MODE	R	LTPS	1040	PRE-REQUISITE	NIL

Course Outcomes

CO#	CO Description	BTL	PO Mapping
CO1	To develop and demonstrate principles of listening, speaking, reading and writing in various functional contexts	3	PO 5
CO2	To demonstrate different types of personal and professional skills and apply them for growth in professional zone.	3	PO 5
CO3	Apply the concepts of Mathematical Principles to solve problems on Arithmetic, Algebra & Geometry to improve problem solving ability.	3	PO5
CO4	Apply the concepts and using Logical thinking to solve problems on verbal & Non-Verbal Reasoning to develop Logical thinking skills.	3	PO5

Syllabus

Module 1	A) Vocabulary: Synonyms, Antonyms and One-word substitutes, (B)Reading comprehension, Critical reading, (C) Writing skills: Email writing, report writing and paragraph writing (D) Listening/Speaking Skills: listen & speak, Functional grammar
Module 2	(A) Personal Skills: Intra & Interpersonal skills (B) Assertiveness (C) Group Discussion (D) Resume writing (E) Video resumes (F) Interview skills
Module 3	Simple Equations, Ratio & Partnership, Averages, Percentages, Profit & Loss, Simple & Compound Interest, Numbers, Quadratic Equations & Inequalities, Time & Work, Time, Speed & Distance, Permutations & Combinations, Probability, Mensuration, Data Interpretation.
Module 4	Syllogism, Logical Venn Diagrams, Cubes & Dice, Number& letter series, Number, letter & word Analogy, Odd Man Out, Coding & Decoding, Blood Relations, Directions, clocks, calendars, Number, ranking & Time sequence test, Seating Arrangements, Data Sufficiency.

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	The Business Student's Handbook: Skills for Study and Employment	Fisher, Julie and Bailey, Peter	Cengage Learning	2017
2	The Complete Guide to mastering soft skills for workplace success	Adams, John	Adams media	2019
3	Writing Tools: 55 Essential Strategies for Every Writer	Roy Peter Clark	Little, Brown and Company	2006
4	Quantitative Aptitude	R. S. Agarwal	SCHAND	
5	A Modern Approach to Verbal Reasoning	R. S. Agarwal	SCHAND	

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification Provider	Proctored (Y/N)	Format of the Exam	Exam Provider	URL of the Certification
1	Lingua Skills	Cambridge University	Yes	Online	Cambridge	https://www.cambridgeenglish.org/exams-and-tests/qualifications/business/
2						

Tools used in Practical / Skill:

Sl No	Tool Name	Parent Industry	Open Source/ Commercial
1			
2			

Evaluation Components:

Evaluation	Component	Weightage	Total
In-Sem Formative			
In-Sem Summative			

End-Sem Summative			

< **Linear Algebra**> <(**LA)>**

COURSE CODE	23CT5101	MODE	**Regular**	LTPS	**2-2-0-0**	PRE-REQUISITE	Nil

Course Outcomes

CO#	CO Description	BTL	PO/PSO Mapping
CO1	Describe vector space, subspaces and quotient spaces and their applications.	3	PO2
CO2	Demonstrate the concepts of Linear transformations and Algebra of Linear Operators, range, and null space of linear transformation.	3	PO2
CO3	Illustrate the concepts of Eigen vectors invariant subspaces and Grahm–Smith Orthogonalization process and its applications.	3	PO2
CO4	Demonstrate the concepts of Groups, homomorphism and automorphism of groups and their applications.	3	PO2

Syllabus

Module 1	**Vector Spaces:** General properties of vector spaces, n-dimensional Vectors, Null space, Vector subspaces, Algebra of subspaces, Linear Sum of two subspaces, linear combination of Vectors, Linear span Linear independence and Linear dependence of Vectors. Basis of Vector space, Finite dimensional Vector spaces, basis extension, co-ordinates, Dimension of a Vector space, Dimension of a subspace, Quotient space and Dimension of Quotient space.
Module 2	**Linear transformations**; Linear transformations, linear operators, Properties of L.T, sum and product of LTs, Algebra of Linear Operators, Range and null space of linear transformation, Rank and Nullity of linear transformations –Rank – Nullity Theorem.
Module 3	**Linear Equations**: Linear equations Characteristic Roots, Characteristic Values & Vectors of square Matrix, Cayley – Hamilton Theorem. invariant subspaces and triangular form, simultaneous triangularization and diagonalization, direct sum decompositions, invariant direct sums, primary decompostion theorem. Inner product spaces**,** Schewarz inequality, Grahm–Smith Orthogonalization process adjoints, unitary and normal transformations, spectral Theorem, Jordan canonical form.
Module 4	**Group theory**: Definition and some examples of groups, some preliminary lemmas, subgroups. Homeomorphisms, auto morphisms, Cayley's theorem, permutation groups, Solow's theorems.

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification Provider	Proctored (Y/N)	Format of the Exam	Exam Provider	URL of the Certification
1	Coursera	Imperial	Yes	online		

		college London			https://www.coursera.org/learn/linear-algebra-machine-learning
2	Udemy	Tech of Udemy	Yes	online	https://www.udemy.com/course/linear-algebra-for-data-science-machine-learning-ai/

Tools used in Practical / Skill:

Sl No	Tool Name	Parent Industry	Open Source/ Commercial
1	MATLAB	Maths works	Open source

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	Linear Algebra	K. Hoffman and R. Kunze:	Prentice Hall of India	2005
2	: Linear Algebra Done Right	. Axler	Springer UTM,	1997.
3	Topics in Algebra	Herstein, I. N	John Wiley & Sons	2004
4	Finite dimensional vectors paces	P. Halmos	Springer	1974
5	Linear Algebra	J.N. Sharma and A.R. Vasishta	Publisher: Krishna Prakashan Media (P) Ltd.	2019
6	Linear Algebra	Kenneth Hoffman and Ray Kunze	Pearson Education. (low priced edition), New Delhi	2018
7	Linear algebra	Peter D. Lax	Wiley student edition	1997.
8	Linear algebra	M. Thamban Nair and Arindama singh	Springer	2018.

Evaluation Components:

EVALUATION COMPONENTS					REGULAR		ADVANCED		PEER MENTOR	
Sl NO	TIME	CATEGORY	EVALUATION COMPONENT	MODE OF ASSESSMENT (Select Appropriate)	WEIGHTAGE	TOTAL	WEIGHTAGE	TOTAL	WEIGHTAGE	TOTAL
1			Active Learning	LMS	8					
2	IN-SEM	FORMATIVE	Tutorial	Paper Based	8	24				
3			Home Assignments	LMS / Paper Based	8					
		SUMMATIVE	In-Sem 1	Paper Based	18	36				
4				Closed Book Exam						
			In-Sem 2	Paper Based	18					
5				Closed Book Exam						
6	END - SEM	SUMMATIVE	End-Sem Exam (Paper Based)	ERP / Paper Based Open/Closed Book Exam	40	40				

Relational Algebra and Database Management System (RADMS)

COURSE CODE	23CT5102	MODE	Regular	LTPS	**2-0-2-4**	PRE-REQUISITE	Nil

Course Outcomes

CO#	CO Description	BTL	PO/PSO Mapping
CO1	Choose the functional components of DBMS and Design an ER Model for a database.	3	PO1,PO2,PO3, registration proc1
CO2	Utilize a relational model for a database & Implement SQL concepts and relational algebra.	3	PO1,PO2,PO3, PSO1
CO3	Examine the PL/SQL programs, normalization techniques, indexing to construct and access database	3	PO1,PO3,PO8,PSO1
CO4	List the importance of transaction Processing, concurrency control and recovery techniques.	3	PO1,PO3, PO8,PSO1
CO5	Categorize the MangoDB to perform CURD, Indexing, Aggregation, Replication, Sharding, Performance analysis for distributed Databases	3	PO1,PO3, PO5,PSO1
CO6	Assume the MongoDB and implement SQL queries and PL/SQL programs to do various operations on data.	3	PO1,PO3, PO5,PSO1

Syllabus:

Module 1	Database Fundamentals: DBMS Characteristics & Advantages, Database Environment, Database Users, Database Architecture, Data Independence, Languages, Tools and Interface in DBMS, DBMS types. Data Modeling: ER Model, Notation used in ER Diagram, Constraint, Types, Relationships in ER Model and other considerations in designing ER diagram. Enhanced, ER data Model, EER Diagram,
Module 2	Relational Model: concepts, constraints, schemas, ER to Relational Model. SQL & Relational Algebra: Data Definition and other languages in SQL, Creating tables and Data types, Constraints, DML statements, Functions and writing SQL statements using nested sub queries, complex queries, joining relations, views, compound statements, user defined functions, user defined procedures, cursors, Triggers, Relational Algebra :Operators in relational algebra, Database Design: Guidelines for good database design,
Module 3	Normalization- Normal Forms, First, Second, Third Normal Forms, BCNF, Multi value and join dependencies, 4th and 5th normal forms. Decomposition algorithms for normalization. File and Storage Structures: File storage, Index structures, Indexing and hashing, Query processing and optimization.
Module 4	Transaction Management: Transaction processing issues, Transaction states, problems during multiple transactions processing, ACID properties, system log and concurrency control Techniques: Lock based techniques, and Timestamp based techniques, Multiversion based Techniques. Recovery Techniques: Recovery concepts, shadow paging, ARIES

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	Database System Concepts	Abraham Silberschatz, Yale University Henry, F. Korth Lehigh University, S. Sudarshan Indian Institute of Technology, Bombay.	Tata McGraw Hill	6th Edition, 2019
2	Fundamentals of Database Systems	RamezElmasri, University of Texas at Arlington, Shamkant B. Navathe, University of Texas at Arlington.	Pearson	7 th Edition,1989
3	An Introduction to Database Systems	Bipin C. Desai	Galgotia Publications Pvt Ltd	1st Edition,2010
4	Principles of Database Systems	Jeffrey D. Ullman	Galgotia Publications	1st Edition,1982

5	Database Management Systems	Raghu RamaKrishnan, Johannes Gehrke	Tata McGraw Hill	3rd Edition, 2014

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification Provider	Proctored (Y/N)	Format of the Exam	Exam Provider	URL of the Certification
1	MongoDB	MongoDB University	Yes	online	https://learn.mongodb.com/pages/certification-program	
2	Azure Database Administrator Associate - Global Certification	Microsoft	Yes	online	https://learn.microsoft.com/en-us/certifications/azure-database-administrator-associate/	

Tools used in Practical / Skill:

Sl No	Tool Name	Parent Industry	Open Source/ Commercial
1	PL/SQL	IBM Corporation, Inc.,	Open source
2	My SQL	IBM Corporation, Inc.,	Open source

Evaluation Components:

Evaluation	Component	Weightage	Total
In-Sem Formative	ALM (LTC, in - class Quiz etc.)	7	24
	Home Assignment and Book. (Min. 4 Assignments etc.)	7	
	Lab Weekly exercise	5	
	Skill Continuous Evaluation	5	
In-Sem Summative	In-Sem Exam-I	12	36
	In-Sem Exam-II	12	
	Lab In Semester Exam	8	
	Skill In Semester Exam	8	
End-Sem Summative	End Semester Exam (Paper Based)	24	40
	Lab End Exam	8	
	Skill End Exam	8	

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<Applied Discrete Structures> <(DS)>

COURSE CODE	23CT5103	MODE	Regular	LTPS	2-2-0-0	PRE-REQUISITE	Nill

Course Outcomes

CO#	CO Description	BTL	PO/PSO Mapping
CO1	Describe the rules of Propositional logic to the arguments of the statements.	2	PO6
CO2	Illustrate the concept of discrete structures to represent Boolean functions.	3	PO6
CO3	Construct recurrence relations and solve them.	3	PO6
CO4	Apply concepts of graph theory for real life problems.	3	PO6

Syllabus

Module 1	Basic Discrete Structures: Proposition, predicate logic, logic connectives, methods of proofs. Mathematical induction. Relation and Function: Definitions and properties, pigeonhole principle, extended pigeonhole principle, equivalence relations and equivalence classes. Representation of relations by binary matrices and digraphs; operations on relations. Closure, Warshall's algorithm, discrete numeric functions, growth of functions, big O, big hash function. Partial Order. Partially ordered sets, lattices, isomorphism of lattices
Module 2	Boolean algebra and Boolean functions, different representations of Boolean functions, application of Boolean functions to synthesis of circuits, circuit minimization and simplification, Karnaugh map.
Module 3	Recurrence Relation: Linear recurrence relations with constant coefficients, homogeneous and non-homogeneous relations, discussion of several special cases to obtain particular solutions. Generating functions, solution of linear recurrence relations using generating functions. Some recursive algorithms
Module 4	GRAPH THEOREY Definition of Graphs, Finite & infinite graphs, Incidence & degree, Walks, paths and circuits, trees, their properties and fundamental circuits, cut-sets and cut-vertices, Euler, Hamiltonian path & circuit, planar graphs, colouring theorems, isomorphism of graphs. Relations: Relations and their Properties, n-array relations and their applications, representing relations, Closure of relations, equivalence of relations, partial orderings.

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	Discrete mathematics and its applications,	Kenneth H. Rosen,	McGraw Hill Publication, 2022.	2022

2	Discrete Mathematical Structures, Sixth Edition Pearson Publications, 2015	Bernard Kolman, Robert Busby, Sharon C. Ross,	Oxford University Press, New Delhi	2022
3	Discrete Mathematics for Computer Scientists and Mathematicians	Joe L Mott, Abraham Kandel, Theodore P Baker	Printice Hall of India	
4	Discrete Mathematical Structures with Applications to Computer Science,	Tremblay J P and Manohar R	Tata McGraw Hill publishers,	2022
5	Discrete mathematics and its applications,	Kenneth H. Rosen,	McGraw Hill Publication, 2022.	2022

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification Provider	Proctored (Y/N)	Format of the Exam	Exam Provider	URL of the Certification
1	Introduction to Discrete Mathematics for Computer Science Specialization	Coursera	Y	Online Objective	Coursera	https://www.coursera.org/specializations/discrete-mathematics
2	Discrete Mathematics	| IIT Ropar	y	Online Objective	NPTEL	https://onlinecourses.nptel.ac.in/noc23_cs109/preview

Tools used in Practical / Skill:

Sl No	Tool Name	Parent Industry	Open Source/ Commercial
1	--	--	--
2	--	--	--

Evaluation Components:

Evaluation	Component	Weightage	Total
In-Sem Formative	**ALM**	8	24
	Tutorial	8	
	Home Assignment andTextbook	8	
In-Sem Summative	**Semester in Exam-I**	18	36
	Semester in Exam-II	18	
End-Sem Summative	**End Semester Exam**	40	40

< **Mathematical Modelling & Numerical Methods using MATLAB**> <(MMNM)>

COURSE CODE	23CT5104	MODE	R	LTPS	2-0-2-0	PRE-REQUISITE	NIL

Course Outcomes

CO#	CO Description	BTL	PO Mapping

CO1	Apply Numerical methods for obtaining the unknown value from the given data points.	3	PO1
CO2	Apply numerical techniques to solve the ordinary differential equations.	3	PO1
CO3	Apply Lagrange's and Charpit's method and solve first order partial differential equations.	3	PO1
CO4	Apply method of separation of variables and finite difference method to solve one dimensional wave and heat equations and two dimensional Laplace equations.	3	PO1
CO5	Verify the solution of the N.M. through MATLAB.	3	PO1

Syllabus

Module 1	Newton- Raphson method for solution of a pair of non-linear equations. Eigen values and Eigen vectors: Dominant and smallest Eigen values/Eigen vectors by power method. Interpolation: Finite difference operator and their relationships, difference tables, Newton, Bessel and Stirling's interpolation formulae, Divided differences, Lagrange interpolation and Newton's divided difference interpolation.	
Module 2	Numerical differentiation: First and second order derivatives by various interpolation formulae. Numerical integration: Trapezoidal, Simpsons $1/3^{rd}$ and $3/8^{th}$ rules with errors and their combinations, Gauss Legendre 2-points and 3-points formulae. Numerical solution of first and second order ordinary differential equations: Picard's method, Taylor's series method, Euler, Modified Euler, Runge-Kutta methods, Predictor-Corrector ,Method's- Milne's method.	
Module 3	Modeling with Differential Equation: Population Growth, Graphical Solutions of Autonomous Differential Equations, Drawing a Phase Line and Sketching Solution Curves, Logistic Growth, Numerical Approximation Methods, Using Euler's Method.	
Module 4	A Savings Certificate Revisited, Separation of Variables, Newton's Law of Cooling, Population Growth with Limited Resources, Graphical Solutions of Autonomous Systems of First-Order Differential Equations, A Competitive Hunter Model, A Predator--Prey Model.	
Module 5	Verify the solution of the Numerical Methods and solution of ordinary differential equations through MATLAB.	
Module 6		

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	Applied Numerical Analysis	Gerald, C. F. and Wheatly, P. O	6^{th} Ed., Wesley	2002
2	Numerical Methods for Scientific and Engineering Computation	Jain, M. K., Iyengar, S. R. K. and Jain, R. K.	New Age Pvt. Pub, New Delhi.	2000
3	Elementary Numerical Analysis	Conte, S. D. and DeBoor, C	McGraw- Hill	1982

			Publisher	
4	Mathematical Modelling Models, Analysis and Applications	Banerjee Sandip	CRC Press, Taylor & Francis Group.	2014
5	Mathematical Modelling.	Kapur J. N.,	New Age International Publishers.	2007

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification Provider	Proctored (Y/N)	Format of the Exam	Exam Provider	URL of the Certification
1	Mathematical modelling: Analysis and Applications	NPTEL	YES	ONLINE	NPTEL	https://archive.nptel.ac.in/courses/111/107/111107113/
2	Numerical Methods for Engineers	COURSERA	YES	ONLIVE	COURSERA	https://www.coursera.org/learn/numerical-methods-engineers

Tools used in Practical / Skill:

Sl No	Tool Name	Parent Industry	Open Source/ Commercial
1	MATLAB		

Evaluation Components:

Evaluation	Component	Weightage	Total
In-Sem Formative	ALMs	8	100
	Home Assignment and Book.	7	40
In-Sem Summative	In-Sem Exam-I	15	50
	In-Sem Exam-II	15	50
	In Semester Exam (Lab)	8	50
	Lab Weekly exercise / Continuous Skill evaluation	7	50
End sem lab	END SEM EXAM	16	50
End-Sem Summative	END SEM EXAM	24	100

< **Computational Thinking for Structured Design THROUGH C++**> <(CTSD)>

COURSE CODE	23CT5105	MODE	REGULAR	LTPS	2-0-2-4	PRE-REQUISITE	MMNM

Course Outcomes

CO#	CO Description	BTL	PO/PSO Mapping
CO1	Develop and apply logical building blocks to solve real world problems	3	PO1,PSO2
CO2	Apply computational thinking for designing solutions	3	PO1,PSO2
CO3	Develop and apply the CRUD operations on arrays	3	PO1,PSO2
CO4	Apply CRUD operations on Linear Data Structures	3	PO4
CO5	Apply the structured programming paradigm with logic building skills on Basic and Linear Data Structures for solving real world problems.	3	PO1,PSO2,PO4
CO6	Skill the students in such a way that students will be able to develop logic that help them to create programs as well as applications in C	5	PO1,PSO2,PO4

Syllabus

Module 1	Structured Programming Paradigm: Problem Solving Approach, Algorithms and Algorithm Analysis, Program Development Steps, Structure of C Program, Pre-Processor Directives, Design of Building Blocks for solving real world problems : Modularization: Functions, Scope of Variables and Storage classes ,Data Types: Primitive, Extended and Derived Including Pointers, Operators: Types of operators, Precedence, Associativity , Formatted I/O, Decision Making using conditional statements
Module 2	Definite and indefinite Iterative statements. Recursion, logic building using complex building blocks, Bitwise operators, Redirecting I/O :Files and File Operations
Module 3	Command line arguments, CRUD operations on Basic Data Structures: Basic Data Structure: Arrays, 2-D Arrays, Dynamic Memory Allocation Searching: Linear Search and Binary Search Sorting: Bubble Sort
Module 4	CRUD operations on Linear Data Structures: Stacks, Queues, Single Linked List, Introduction to nonlinear data structures

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	The C Programming Language	Brian W. Kernighan, Dennis M. Ritchie	Prentice-Hall/Pearson Education	2005
2	Programming in ANSI C	E. Balagurusamy	Tata McGraw-Hill Education	2008
3	Data Structures	R. F. Gilberg, B. A. Forouzan	Thomson India Edition	2005

Essentials of Research Design (ERD)

COURSE CODE	23UC5102	MODE		LTPS	1-1-0-0	PRE-REQUISITE	Nil

Course Outcomes

CO#	CO Description	BTL	PO Mapping
CO1	Illustrate Research objects, steps involved in research and articulate appropriate Research Questions	3	PO1
CO2	Perform Literature Review in a Scholarly style and apply appropriate methods for Data collection	3	PO2
CO3	Represent the data in tabular/Graphical form and prepare data for analysis	3	PO2
CO4	Perform statistical modelling and analysis to optimize the data, prepare the data for publishing.	4	PO2

Syllabus

Module 1	Definition and objectives of Research-Types of research, Various Steps in Research process, Applied Mathematical tools for analysis, developing a research question-Choice of a problem, Literature review, Surveying, Synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.
Module 2	Literature Review (LR)-Meaning and its Types-Narrative and Systematic, LR using Web of Science, Google and Google Scholar, Citations-Types, referencing in academic writing, Citation vs Referencing Vs Bibliography, Citation tools- Zotero, Qualitative Research and its methods, Quantitative Research, and its Methods. Data Collection-Primary data collection using Questionnaire, Google forms, survey monkey, Testing the validity and Reliability of Questionnaire using Factor Analysis and Cronbach's Alpha respectively, Secondary data-sources.
Module 3	Diagrammatic and graphical presentation of data: Diagrams and Graphs of frequency data of one variable- histogram, barcharts-simple, sub-divided and multiple; line charts, Diagrams and Graphs of frequency data of two variables -scatter plot, preparing data for analysis. Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Error Analysis.
Module 4	Analyzing data using one-dimensional statistics, two-dimensional statistics and multidimensional statistics. Technical Writing and Publishing, Conference presentations, Poster Presentations, Plagiarism-check and tools, Self-Plagiarism. Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, Design Thinking for Contextualized Problem-Solving and Empathetic Research

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	Research Methods for Engineers	C.R. Kothari		

2	Engineering Research Methodology	y Krishnan Nallaperumal		
3	Engineering Research Methodology -A Practical Insight for Researchers	Dipankar Deb and Balas		

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification Provider	Proctored (Y/N)	Format of the Exam	Exam Provider	URL of the Certification
1			N.A.			
2						

Tools used in Practical / Skill:

Sl No	Tool Name	Parent Industry	Open Source/ Commercial
1			
2			

Evaluation Components:

Evaluation	Component	Weightage	Total
In-Sem Formative	Active Learning	8	8
	Home Assignments	8	8
	Tutorial Continuous Evaluation	8	8
In-Sem Summative	In-Sem 1	18	18
	In-Sem 2	18	18
End-Sem Summative		40	40

Probability and Statistics><(23CT5202)>

COURSE CODE	23CT5202	MODE	Regular	LTPS	2-0-2-4	PRE-REQUISITE	NIL

Course Outcomes

CO#	CO Description	BTL	PO Mapping
CO1	Understand the basic functions in R programming and identify the operators using in it.	2	PO1

CO2	Simulating data using R	2	PO2
CO3	Apply various probability distributions to the real world problems using R	2	PO1
CO4	Analyze the data using various linear and nonlinear lines using R	2	PO2
CO5	Apply R-Programming to various data sets	3	PO3
CO6	Analyze statistics data by R - Programming	3	PO3

Syllabus

Module 1	Introduction, How to run R, R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes. R Programming Structures, Control Statements, Loops, - Looping Over Non vector Sets,- If-Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return- Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quick sort Implementation- Extended Example: A Binary Search Tree.
Module 2	Doing Math and Simulation in R, Math Function, Extended Example Calculating Probability- Cumulative Sums and Products-Minima and Maxima- Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product- Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /output, Accessing the Keyboard and Monitor, Reading and writer Files, Graphics, Creating Graphs, The Workhorse of R Base Graphics, the plot () Function Customizing Graphs, Saving Graphs to Files.
Module 3	Probability Distributions, Normal Distribution- Binomial Distribution- Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests,- ANOVA. Linear Models
Module 4	Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, - Poisson Regression- other Generalized Linear Models-Survival Analysis, Nonlinear Models, Splines- Decision- Random Forests

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	The Art of R Programming	Norman Matloff	Cengage Learning	2011
2	R for Everyone	Lander	Pearson	2014
3	R Cook book	Paul Teetor	Oreilly	2019
4	R in Action	Rob Kabacoff	Manning	2011

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification Provider	Proctored (Y/N)	Format of the Exam	Exam Provider	URL of the Certification
1	**Introduction to**	Coursera	Y	Quiz	Coursera	https://www.coursera.org/learn

	Probability and Data with R					/probability-intro
2	Statistics and R	edX	Y	Quiz	Hardvard University	https://pll.harvard.edu/course/statistics-and-r

Tools used in Practical / Skill:

Sl No	Tool Name	Parent Industry	Open Source/ Commercial
1	R Programming	R Programming	Open Source

Evaluation Components:

Evaluation	Component	Weightage	Total
In-Sem Formative	ALM	6	40
	Tutorial	6	100
	Home Assignment and Text Book Reading	6	40
In-Sem Summative	In Sem Examination-I	10	50
	In Sem Examination-II	10	50
	Lab In Sem Examination	5	50
	Lab Weekly Exercise Evaluation	5	50
	Continuous Skill Evaluation	6	50
	Skilling In Sem Examination	6	50
End-Sem Summative	End Semester Examination	24	100
	Lab End Semester Examination	8	100
	Skill End Semester Examination	8	100

< Matrix Computation> <(MC)>

COURSE CODE	23AM5203	MODE	Regular	LTPS	2-0-2-4	PRE-REQUISITE	Nill

Course Outcomes

CO#	CO Description	BTL	PO/PSO Mapping
CO1	Use sophisticated scientific computing and visualization environments to solve application problems involving matrix computation algorithms and Explain the effects of errors in computation and how such errors affect solutions.	1	PO1, PO2
CO2	Build numerical algorithms, and understand the relationships between the computational effort and the accuracy of these algorithms.	3	PO2, PO3
CO3	Organize the results produced by computer implementations of numerical algorithms.	3	PO3, PO4
CO4	Apply Rayleigh quotient iterations and Explicit and implicit QR algorithms.	3	PO5, PO6
CO-5	Categorize the Floating points, banded and, positive definite systems to perform Databases. Cholesky decomposition -, Householder transformation, Rayleigh quotient iterations QR factorization Verify with python programme.	3	PO5, PO6

CO-6	Assume the necessary analytical background for further studies leading to research in Machine Learning.	4	PO5, PO6

Syllabus

Module 1	Floating point computations, IEEE floating point arithmetic, analysis of roundoff errors; Sensitivity analysis and condition numbers; Linear systems, LU decompositions, Gaussian elimination with partial pivoting; Banded systems, positive definite systems.
Module 2	Cholesky decomposition - sensitivity analysis; Gram-Schmidt orthonormal process, Householder transformation, Givens rotations; QR factorization, stability of QR factorization. Solution of linear least squares problems, normal equations, singular value decomposition (SVD), polar decomposition
Module 3	Moore-Penrose inverse Rank deficient least-squares problems; Sensitivity analysis of least-squares problems; Review of canonical forms of matrices; Sensitivity of eigenvalues and eigenvectors.
Module 4	Reduction to Hessenberg and tridiagonal forms; Power, inverse power and Rayleigh quotient iterations; Explicit and implicit QR algorithms for symmetric and nonsymmetric matrices; Reduction to bidiagonal form; Golub- Kahan algorithm for computing SVD.

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	Fundamentals of Matrix Computations	D. S. Watkins,	John Wiley, 2002.	2002
2	Numerical Linear Algebra	L. N. Trefethen and D. Bau.	SIAM, 1997.	1997
3	Matrix Computations	G. H. Golub and C. F. Van Loan,	John Hopkins University Press, 1996.	1996
4	Applied Numerical Linear Algebra	J. W. Demmel	SIAM, 1997.	1997

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification Provider	Proctored (Y/N)	Format of the Exam	Exam Provider	URL of the Certification
1	coursera	THE HONG CONG University science and technology	Yes	online	https://www.coursera.org/learn/matrix-algebra-engineers	
2	Matrix computers	Matrix computers	Yes	online	http://www.matrixcomputers.in/courses	

Tools used in Practical / Skill:

Sl No	Tool Name	Parent Industry	Open Source/ Commercial
1	AIHR	AIR	Open source
2	My SQL •	IBM Corporation, Inc.,	Open source

Evaluation Components:

Evaluation	Component	Weightage	Total
In-Sem Formative	ALM (LTC, in - class Quiz etc.)	7	24
	Home Assignment and Book. (Min. 4 Assignments etc.)	7	
	Lab Weekly exercise	5	
	Skill Continuous Evaluation	5	
In-Sem Summative	In-Sem Exam-I	12	36
	In-Sem Exam-II	12	
	Lab In Semester Exam	8	
	Skill In Semester Exam	8	
End-Sem Summative	End Semester Exam (Paper Based)	24	40
	Lab End Exam	8	
	Skill End Exam	8	

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Mathematical Programming (MP)

COURSE CODE	23CT6102	MODE	**Regular**	LTPS	**2-2-0-0**	PRE-REQUISITE	**Nil**

Course Outcomes

CO#	CO Description	BTL	PO/PSO Mapping
CO1	Apply different methods to find the optimal solution of linear programming problems and analyze the sensitivity of the solution	3	PO3, PSO1
CO2	Different methods to find the optimal solution of Transportation and Assignment problems	3	PO3, PSO1
CO3	Apply non-linear optimization methods to solve non- linear programming problems	3	PO3, PSO1
CO4	Apply Search methods to solve non-linear programming problems	3	PO3, PSO1

Syllabus:

Module 1	Introduction to linear programming: Convex Sets, Graphical Method, Simplex Method, Big – M Method, Two Phase Method, Revised Simplex Method.
Module 2	Duality Theory, Dual Simplex Method, Sensitivity Analysis, Parametric Linear Programming -Transportation Problems and Assignment Problems.

Module 3	Non-linear optimization: Unconstrained and constrained optimization of several variables, Lagrange's multipliers, Khun-Tucker theory, Quadratic Programming – Wolfe's Method.
Module 4	Search Methods- Unconstrained search: Fibonacci Search Method, Constrained search: Penalty function method (Interior and exterior search).

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	Applied Mathematical Programming	Bradley, Hax, and Magnanti	Addison-Wesley	1977
2	Nonlinear Programming Theory and Algorithms	MOKHTAR S. BAZARAA, HANIF D. SHERALI and M. SHETTY	Wiley-Interscience	2006
3	An Introduction to Computational Leaning Theory	Michael Kearns and Umesh Vazirani.	MIT Press	1994
4	An introduction to optimization	Chong, Edwin KP, and Stanislaw H. Zak	John Wiley & Sons	2013
5	Evolutionary Optimization Algorithms	Dan Simon	Wiley	2013

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification Provider	Proctored (Y/N)	Format of the Exam	Exam Provider	URL of the Certification
1	**Operations research**	NPTEL	YES	Online	https://onlinecourses.nptel.ac.in/noc22_ma48/preview	

Evaluation Components:

Evaluation	Component	Weightage	Total
In-Sem Formative	Active Learning (LMS)	8	24
	Tutorial (Paper Based)	8	
	Home Assignment (LMS/Paper based)	8	
In-Sem Summative	In-Sem Exam-I	18	36
	In-Sem Exam-II	18	
End-Sem Summative	End Semester Exam (Paper Based)	40	40

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Transform Techniques for Engineers (TTE)

COURSE CODE	23CT6103	MODE	Regular	LTPS	2-2-0-0	PRE-REQUISITE	NIL

Course Outcomes

CO#	CO Description	BTL	PO Mapping
CO1	Apply Laplace transforms to obtain the solution of differential equation.	3	PO1
CO2	Apply Z-transforms to analyse discrete time systems.	3	PO1
CO3	Apply Fourier series to analyse the signals	3	PO1
CO4	Apply Fourier transforms to analyse the signals.	3	PO1
CO5	Apply Laplace transforms to obtain the solution of differential equation.	3	PO1
CO6			

Syllabus

Module 1	Apply Laplace transform techniques to solve linear differential equations in system analysis where initial conditions can be easily included to give system response.	
Module 2	Applying z- transform and Mellin transform to the analysis and characterization of Discrete Time systems.	
Module 3	Apply Fourier series to analyze various signals	
Module 4	Apply Fourier transforms to analyze various signals	

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	Advanced Engineering Mathematics.	Erwin Kreyszig.	John Wiley & Sons	2020
2	Numerical methods for scientific and engineering computation	M.K.Jain, S.R.K.Iyengar and R.K.Jain	New age international publishers, New Delhi.	2003
3	Higher Engineering Mathematics, BS Grewal. Publisher: Khanna, New Delhi.	B S Grewal	Khanna Publishers	2015

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification	Proctored	Format	Exam Provider	URL of the Certification

		Provider	(Y/N)	the Exam		
1	Transform Techniques for Engineers	NPTEL	YES	ONLINE	NPTEL	https://archive.nptel.ac.in/courses/111/106/111106111/
2	Transform Techniques for Engineers	COURSERA	YES	ONLIVE	COURSERA	https://www.classcentral.com/course/swayam-transform-techniques-for-engineers-119561

Tools used in Practical / Skill:

Sl No	Tool Name	Parent Industry	Open Source/ Commercial

Evaluation Components:

Evaluation	Component	Weightage	Total
In-Sem Formative	ALMs	8	100
	Tutorial	8	40
	Home Assignment and Book.	8	40
In-Sem Summative	In-Sem Exam-I	18	50
	In-Sem Exam-II	18	50
End-Sem Summative	END SEM EXAM	40	100

Stochastic Proesses & Optimization (SPO)

COURSE CODE	23CT6110	MODE	**Regular**	LTPS	**2-2-0-0**	PRE-REQUISITE	**Nil**

Course Outcomes

CO#	CO Description	BTL	PO/PSO Mapping
CO1	Describe the concept of Markov process and Poisson Process	3	PO1
CO2	Illustrate Queueing models and demonstrate the concepts of Brownian motions and applications	3	PO6
CO3	Formulate LPP and solve LPP. Model and solve Transportation and Assignment problems.	3	PO6
CO4	Apply Geometric programming and Ant-colony Optimization and PSO. Solve decision making techniques to solve real life problems.	3	PO6

Syllabus:

Module 1	**Discrete-Time Markov Models:** Discrete-Time Markov Chains, Transient Distributions, Occupancy Times, Limiting Behavior, First-Passage Times.

	Poisson Processes: Poisson Processes, Superposition of Poisson Processes, Thinning of a Poisson Process, Compound Poisson Processes. **Continuous-Time Markov Models:** Continuous-Time Markov Chains, Transient Analysis: Uniformization, Occupancy Times, Limiting Behavior, First -Passage Times. **Generalized Markov Models:** Renewal Processes, Cumulative Processes, Semi -Markov Processes.
Module 2	**Queueing Models:** Queuing Systems, Single-Station Queues, Birth and Death Queues. **Brownian Motion:** Standard Brownian Motion, Brownian Motion, First-Passage Times, Martingales and Semi martingales, Black Scholes Formula.
Module 3	Introduction to LPP: Formulation of LP models, Graphical procedure of solution, Convex functions and their properties, Basic feasible solution, Optimal solution. Simplex method, Transportation Problems: VAM Method, Optimality Test, Degeneracy, Unbalanced Transportation problem, Assignment problems, Travelling salesman problem. Integer LPP - Branch and Bound Algorithm, Cutting Plane Algorithm.
Module 4	Geometric Programming: Problems with one-degree of difficulty with positive coefficients, Geometric programming with constraints, Problems with positive and negative coefficients. Heuristic and Meta heuristics, Single solution vs. population-based, Parallel meta heuristics, Evolutionary algorithms, Nature-inspired meta heuristics, Genetic Algorithm, Ant-colony optimization, Particle swarm optimization, Simulated annealing.

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	Operations Research: An Introduction	Taha, H.A.,	MacMillan Pub Co., NY	2013
2	Optimization	Rao, S. S	Wiley Eastern India	4Th Edition
3	Linear Programming	Hadley G	Addison-Wesley	1963
4	Operations Research: Principles and Practice	Ravindran, A., Phillips, D.T. and Solberg, J.J	John Wiley and Sons, NY	2nd Ed. (Reprint).
5	Hillier F.S. and Lieberman G.J	Hillier F.S. and Lieberman G.J.	McGraw Hill.,	9th Edition.

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification Provider	Proctored (Y/N)	Format of the Exam	Exam Provider	URL of the Certification
1	Optimization and control	Cornell university	YES		https://arxiv.org/abs/2003.09867	

Evaluation Components:

Evaluation	Component	Weightage	Total
In-Sem Formative	Active Learning (LMS)	8	24
	Tutorial (Paper Based)	8	
	Home Assignment (LMS/Paper based)	8	
In-Sem Summative	In-Sem Exam-I	18	36
	In-Sem Exam-II	18	
End-Sem	End Semester Exam (Paper Based)	40	40

Summative			

<Quantum Computing>< (QC)>

COURSE CODE	23CT6111	MODE	REGULAR	LTPS	2-2-0-0	PRE-REQUISITE	MMNM

Course Outcomes

CO#	CO Description	BTL	PO/PSO Mapping
CO1	To introduce basics of quantum computing	2	PO2,PSO2
CO2	Implementing Quantum computing algorithms	3	PO3,PSO2
CO3	Applying concepts of Quantum computing using QISKIT	3	PO3,PSO2
CO4	Analyze and Discuss Quantum Machine learning and deep learning concepts with applications	3	PO4,PSO2

Syllabus

Module 1	Introduction and Basics of Quantum computing Overview of classical mechanics, Drawbacks of classical mechanics, Quantum mechanics origin, Building blocks of quantum mechanics, Introduction to quantum computing, Quantum states and qubits, Single qubit gates, Multiple qubits and entanglement, Quantum circuits, Applications.
Module 2	Quantum computing algorithms Deutsch Jozsa algorithm, Bernstein Vazirani algorithm, Simons algorithm, Quantum fourier transform, Shors algorithm, Grovers algorithm, Superdense coding
Module 3	IBM QISKIT Implementation Setting up environment, Python and Jupiter notebooks configuring, Quantum circuits implementation, Quantum measurement, Quantum phase estimation, Scalable shor's algorithm, Grover's algorithm
Module 4	Quantum Machine learning Unsupervised learning, Pattern recognition and neural networks, Supervised learning, Support vector machines, Regression analysis and boosting, Quantum clustering and classification, Adiabatic quantum computing, Quantum teleportation and game theory, Applications, Quantum Deep learning

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	Quantum Machine learning	Peter Wittek	Elsevier Publisher	2014
2	Quantum computing for everyone	Chris Bernhardt	MIT	2020
3	Quantum Computing for Computer Scientists	Yanofsky and Mannucci	Cambridge University Press	2008

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification Provider	Proctored (Y/N)	Format of the Exam	Exam Provider	URL of the Certification
1	Introduction to Quantum Information	Coursera	y	online	Coursera	https://www.coursera.org/learn/introduction-to-quantum-information
2	Introduction to Quantum Computing for Everyone	Edx	y	online	Edx	https://www.edx.org/course/quantum-computing?index=product&objectID=course-e08ab5d6-00e1-4cab-8e00-12d05299e906&webview=false&campaign=Introduction+to+Quantum+Computing+for+Everyone&source=edX&product_category=course&placement_url=https%3A%2F%2Fwww.edx.org%2Flearn%2Fquantum-computing

Tools used in Practical / Skill: NIL

Sl No	Tool Name	Parent Industry	Open Source/ Commercial
	nil		

Evaluation Components:

Evaluation	Component	Weightage	Total
In-Sem Formative	Active Learning	8	
	Tutorial	8	24
	Home Assignments	8	
In-Sem Summative	In-Sem Exam-I	18	
	In-Sem Exam-II	18	36
End-Sem Summative	END SEM EXAM	40	40

> Applied Geometry & Computer Graphics <(AGCG)>

COURSE CODE	23CT6112	MODE	R	LTPS	3-0-2-0	PRE-REQUISITE	DS

Course Outcomes

CO#	CO Description	BTL	PO/PSO Mapping
CO1	To understand Basics of Augmented Reality and Interactions. Fundamentals of Augmented, Mixed Reality and its features P	3	PSO1,PO1
CO2	To understand Basics of Virtual Reality and Interactions. Fundamental Concept and Components of Virtual Reality	3	PO1,PO5,PSO2
CO3	To understand Graphics Pipelines, Creating a sample augmented reality apps in android	3	PSO2,PO1,PO5
CO4	To apply Unity development Environment, IDE Basics, Sprites, User Interfaces, Simple 3D animation Creation	3	PSO2,PO5
CO5	Develop applications through Lab experiments	3	PO1,PO5,PSO2

Syllabus

Module 1	Introduction to Augmented Reality -Augmented Reality Interactions, Monitor Based Displays, Headmounted Displays, Ar Interaction, ArTracking, Augmented and Mixed Reality, Technology and features of augmented reality, Typical AR Experiences, Difference between AR, VR and MR, Challenges with AR, AR systems, Simultaneously Localize and Map Environment, Optical Tracking, AR Tracking and registration, Markers, Holography and Photography, AR System Evaluation.
Module 2	Introduction to Virtual Reality- Historical development of VR Fundamental Concept and Components of Virtual Reality, Architecture of Virtual Reality, Primary Features and Present Development on Virtual Reality, Typical VR System, The three l's of virtual reality, commercial VR technology and the five classic components of a VR system, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement ,VR Content, Factors in Virtual Reality, Benefits of virtual reality, Typical System Delays, VR Graphics Architecture.
Module 3	The Graphics Pipeline VR– Panorama, Stereo Movie, Stereo Panorama, Mono Panoramas, Comparison: Mono and Stereo Panoramas, Spatial Audio for VR, Ambisonics, Motion Sickness–Spherical Harmonics, Engines& Unity, VR Engines – Audio ,3D Audio, Physics, User Interface (UI), VR Engines – Content Creation, Latency, Post-rendering Warp, Eye Tracking
Module 4	Introduction to Game Development – Unity Development Environment, IDE Basics, Sprites, User Interfaces, Prefabs, Simple 3D animation Creation, Vuforia Engine, Finitudes, ARCore, ARKit, Vumarks Designer, Marker based AR with Vuforia and Unity, User Defined Target, Avengers on table using Umar's, Multiple Image Targets and Umar's with Vuforia and unity, adding shadowto Scene.

Reference Books:

Sl No	Title	Author(s)	Publisher	Year
1	Understanding Augmented Reality Concepts and Applications	Alan B. Craig	Nunes.	

2	Understanding Virtua/Reality	William R. Sherman and Alan B. Craig	Morgan Kaufmann Publishers	
3	Android Application development for java programmers,	James C Shensi	Cengage Learning	
4	Mike McCaffery and David Graham	Game Coding Complete	Cengage Learning	2012
5	Virtual Reality	Brett S. Martin	Norwood House Press	2017
6	Virtual Reality Systems	John Vince	Pearson Education	
7	Android apps for absolute Beginners	Wallace Jackson	Apress.	
8	Fundamentals of Game Design	Ernest Adams and Andrew Rolling	2nd Edition Prentice Hall / New Riders,	2009

Global Certifications:

Mapped Global Certifications:						
Sl No	Title	Certification Provider	Proctored (Y/N)	Format of the Exam	Exam Provider	URL of the Certification
1	Interactive Computer Graphics	NPTEL	YES	ONLINE	NPTEL	https://www.coursera.org/learn/interactive-computer-graphics?action=enroll#about
2	EITCA/CG COMPUTER GRAPHICS ACADEMY	EITCA	YES	ONLINE	EITCA Academy	https://www.coursera.org/specializations/graphic-design#courses

Tools used in Practical / Skill: NIL

Sl No	Tool Name	Parent Industry	Open Source/ Commercial
1			
2			

EVALUATION COMPONENTS					REGULAR	
Sl NO	TIME	CATEGORY	EVALUATION COMPONENT	MODE OF ASSESSMENT (Select Appropriate)	WEIGHTAGE	TOTAL
1	IN-SEM	FORMATIVE	Active Learning	LMS	8	22
			Home Assignments	Paper Based	7	
			continuous evaluation lab	lab based	7	
2						
		SUMMATIVE	In-Sem 1	Paper Based	15	38
				Closed Book Exam		
			In-Sem 2	Paper Based	15	
				Closed Book Exam		

			In sem lab	lab based	8	
	END-SEM	SUMMATIVE	End-Sem Exam (Paper Based)	ERP / Paper Based Open/Closed Book Exam	24	40
			End-Sem Lab Exam	lab based	16	