**KONERU LAKSMAIAH EDUCATION FOUNDATION (KLEF)**
**Department of Mathematics**
**M. Sc.(Computational Mathematics)**
**A.Y.:2023-2024**

**STUDENT HANDBOOK**

**Applicable for Students Admitted into**

**M.Sc.( Computational Mathematics) Program**

**A.Y.: 2023-2024**

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**ACRONYMS**

| Sl No | Acronyms | Full Form |
|---|---|---|
| 1. | KLEF | Koneru Lakshmaiah Education Foundation |
| 2. | CET | Common Entrance Test |
| 3. | KLEEE | KLEF Engineering Entrance Examination |
| 4. | CGPA | Cumulative Grade Point Average |
| 5. | SGPA | Semester Grade Point Average |
| 6. | LTPS | Lecture Tutorial Practical Skill |
| 7. | SEE | Semester-End Examinations |
| 8. | SIE | Semester-In Examinations |
| 9. | IRP | Industrial Relations and Placements |
| 10. | OPAC | Online Public Access Catalogue |
| 11. | QCM | Quality Circle Meeting |
| 12. | MOOC | Massive Open Online Course |
| 13. | MOU | Memorandum of  Understanding |
| 14. | OD | On Duty |
| 15. | (A,B) | Between A and B excluding value A and including value B |
| 16. | COE | Controller of Examinations |

# VISION AND MISSION

## University Vision

To be a globally renowned university.

## 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.

## Department Vision

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

## Department Mission

**M1**. To create an ambience of Mathematical thinking and applying the same to solve complex engineering problems.

**M2**. To Develop Mathematical model to solve problems at global level.

**M3**. To collaborate with other campus entities, individuals, professional associations and local community organizations.

# PROGRAM OBJECTIVES AND OUTCOMES

## PROGRAME EDUCATIONAL OBJECTIVES (PEO):

The Program Educational Objectives (PEOs) are as follows:

**PEO-1:** Apply mathematics and technology tools (MATLAB) to solve modelling problems.

**PEO-2:** Understand the use of mathematical tools and concepts in other fields.

**PEO-3:** Communicate, and work with people of diverse backgrounds in individual and group settings, in an ethical and professional manner.

**PEO-4:** Critically analyze information and concepts to adapt to advances in knowledge and technology in the workplace.

## PROGRAMME OUT COMES: (PO)

**PO1:** To identify, formulate, abstract and analyze complex, real life or engineering problems using the principles of mathematical techniques.

**PO2:** To apply the mathematical concepts in the fields of high end research and recognize their need and prepare for lifelong learning.

**PO3:** To apply mathematics tools (MATLAB, R, and MINITAB) for a better decision making in complex situations.

**PO4: To** maintain the core of mathematical and technical knowledge this is adaptable for solid foundation for lifelong learning.

**PO5: To** apply ethical principles of mathematical techniques for the commitment of professional ethics, responsibilities and socio-economic needs of the society.

**PO6: Ability** to do interdisciplinary research among allied subjects related to applied mathematics.

**P07: Use** symbolic and numerical software as part of practical computation.

**MAPPING OF POs/PSOs with PEOs:**

| S No. | Key Components of POs and PSOs | Description of PEO | | | |
|---|---|---|---|---|---|
| | | Apply mathematics and technology tools (MATLAB) to solve problems. | Understand the use ofmathematical tools and concepts in other fields. | Communicate, and work, with people of diverse backgrounds in individual and group settings, in an ethical and professional manner. | Critically analyze information and concepts to adapt to advances in knowledge and technology in the workplace |
| | | **PEO 1** | **PEO 2** | **PEO 3** | **PEO 4** |
| PO1 | To identify, formulate, abstract and analyze complex, real life or engineering problems using | ✓ | ✓ | | ✓ |
| PO2 | To apply the mathematical concepts in the fields of high end research and recognize their need and prepare for life long learning. | ✓ | ✓ | ✓ | ✓ |
| PO3 | To apply mathematics tools (MATLAB, R, and MINITAB) for a better decision making in complex | ✓ | ✓ | ✓ | ✓ |

| PO4 | To maintain the core of mathematical and technical knowledge which is adaptable for solid foundation for | ✓ | ✓ | | ✓ |
|---|---|---|---|---|---|
| PO5 | To apply ethical principles of mathematical techniques for the commitment of professional ethics, responsibilities and socio- | | ✓ | ✓ | |
| PO6 | Ability to do interdisciplinary research among allied subjects related to applied mathematics | | ✓ | | ✓ |
| PO7 | Use symbolic and numerical software as part of practical computation. | ✓ | | | ✓ |

# DEPARTMENT OF MATHEMATICS

## 2023-2024  M.Sc. (Computational Mathematics) BATCH Course Outcomes vs Program Outcomes

### Course Articulation Matrix

| S No | Course Code | Course Title | LTPS | Credits | CO NO | Description of the Course Outcome | Program Outcomes | | | | | | | | Course Rationale |
|------|-------------|--------------|------|---------|-------|-----------------------------------|---|---|---|---|---|---|---|---|-----------------|
| | | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| 1 | 23UC1101 | Professional Communication Skills | 0-0-4-0 | 2 | CO1 | Understand the concepts of grammar to improve communication, reading, and writing skills. | | | | | 5 | | | | For the students to develop Professional Communication Skills. |
| | | | | | CO2 | Demonstrate required knowledge over 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 | | | | | 5 | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | memos. | | | | | | | | | | |
| 2 | | Linear Algebra | 2-2-0-0 | 4 | **CO1** | Describe group, subgroup and quotient groups and their applications. | 2 | | | | | | | | | This course intends to highlight basic concepts, principles and procedure of Linear algebra to analyze practical problems and as such it lays down foundation for the understanding group, subgroup and quotient groups and their applications. Our emphasis is on principles rather than routine calculations and our approach is a compromise between diversity and depth. The students acquire the knowledge on usage of algebra. |
| | | | | | **CO2** | Demonstrate the concepts of homomorphism and automorphisim of groups. | 2 | | | | | | | | | |
| | | | | | **CO3** | Illustrate the theory of rings and its applications. | 2 | | | | | | | | | |
| | | | | | **CO4** | Illustrate the concept of fields and Polynomial Rings. | 2 | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23CT1101 | | | | | | | | | | | | | | | | |
| 3 | 23CT1102 | Relational Algebra and Database Management System | 2-0-2-4 | 4 | CO1 | Illustrate the functional components of DBMS, importance of data modelling in design of a database. | | | | | 5 | | | | | For the students to develop a strong foundation in Relational Algebra and Database Management Systems. |
| | | | | | CO2 | Build queries using SQL and concepts of PL/SQL | | | | | 5 | | | | | |
| | | | | | 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 | | | | | |

| | | | | | CO | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | CO5 | Develop a good database and define SQL queries for data analysis. | | | | | | 3 | | | | |
| 4 | | 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 | | | For the students to develop a strong foundation in Discrete structures |
| | | | | | **CO3** | Construct recurrence relations and solve them. | | | | | | | 6 | | | |
| | | | | | **CO4** | Apply concepts of graph theory for real life problems. | | | | | | | 6 | | | |

| | 23CT1103 | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 23CT1104 | Mathematical Modeling & Numerical Methods | 2-0-2-0 | 3 | CO 1 | Identify the difference between solutions of system linear and roots of non-linear equations by direct, bisection methods. | | 2 | | | | | | | | | To apply mathematical modeling & numerical methods to various problems arise in sciences. |
| | | | | | CO 2 | Construct the interpolation forward and backward tables and find the Eigen values and vectors by using mat lab also. | | 2 | | | | | | | | | | |
| | | | | | CO 3 | Apply Numerical differentiation and integration problems for different methods and find the values and compare the values by using mat lab also. | | 2 | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | CO 4 | Construct numerical solutions of first and second order ordinary differential equations and compare the numerical values with mat lab also. | 2 | | | | | | |
| | | | | | CO 5 | Verify the solution of the N.M. through MATLAB. | | 3 | | | | | |
| 6 | 23CT1105 | Computational Thinking for Structured Design | 2-0-2-4 | *4* | **CO 1** | Describe the basic computer organization and concepts of computer language fundamentals. | | | | 7 | | For the students to develop a strong foundation in Computational Thinking for Structured Design to solve problems. |
| | | | | | **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 | | |

| 7 | | | Essentials of Research Design | **2-0-2-0** | *3* | CO1 | 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 | | | | | | | This course intends to highlight basic concepts, principles and procedure of Research. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CO2 | Illustrate on various methods for Problem Solving through the statistical modelling and Analysis. | 2 | | | | | | | |
| | | | | | | CO3 | Illustrate the Sampling Fundamentals with applications. | 2 | | | | | | | |
| | | | | | | CO4 | Illustrate the concept of Interpretation and Report Writing | 2 | | | | | | | |
| | | | | | | | | | | | | | | | |

| | 23UC1102 | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 23CT1201 | Data Structures and Design of Algorithms | 2-0-2-4 | 4 | CO1 | Analyze and compare stack ADT and queue ADT implementations using linked list and applications. | | | | | | | | 7 | | | For the students to develop a strong foundation in various types of data structures and establish algorithms. |
| | | | | | CO2 | Analyze the linked lists and types of Binary trees and their representations. | | | | | | | | 7 | | | |
| | | | | | CO3 | 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 | Develop and Evaluate common practical applications for linear and non-linear data structures. | | | | | | | | 7 | | | |
| 9 | 23CT1202 | Probability and Statistics | 2-0-2-4 | 4 | CO1 | Understand the basic functions in R programming and identify the operators using in it. | 1 | | | | | | | | | | For the students to develop a strong foundation in the concepts of probability including distributions and statistics. |

| | | | | | CO2 | Simulating data using R | | 2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | CO3 | 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 | | | | | | | | |
| 10 | | 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 | | | | | | | | This course intends to highlight basic concepts, principles and procedure of Matrix Computation. | | |
| | | | | | 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 | | | | | | | | |

| S.No | Code | Course | L-T-P-O | C | CO | Course Outcome | | | | | | | | | | | Course Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 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 | | | | | | |
| 11 | 23CT1203 | Data Science & Visualization | 2-0-2-0 | 3 | CO 1 | Understand the modelling of various types of data. | | | 3 | | | | | | | | This course intends to highlight basic concepts, principles and procedure of Data Science and its Visualization. |
| | | | | | CO 2 | Understand the Visualization fundamentals. | 2 | | | | | | | | | | |
| | | | | | CO 3 | Apply methods and tools for Non-Spatial Data Visualization | | | | | 5 | | | | | | |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | CO 4 | Apply methods for Scientific / Spatial Data Visualization and Web data visualization. | | | | 5 | | | | | | | |
| | | | | | CO 5 | Evaluate data visualization through Python &Tableau. | | | | 5 | | | | | | | |
| 12 | 23CT1204 | Machine Learning | 2-0-2-0 | 3 | CO 1 | Understand the basic terminology and measurementsof Machine Learning and Apply Machine Learning techniques using Tree and Bayesian models. | | 3 | | | | | | | This course intends to highlight basic concepts, principles with procedure and applications of Machine Learning. | | | |

| | CO | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | CO 2 | Apply and analyze Neural Network and SVM Modelsfor solving Classification and Prediction problems | | | | 4 | | | |
| | CO 3 | Apply Dimensionality reduction methods, Evolutionary learning and Ensemble methods to solve classificationproblems | | 3 | | | | | |
| | CO 4 | Illustrate different unsupervised models, Analytical,Explanation-Based and reinforcement learning methods. | 2 | | | | | | |
| 23CT1205 | CO 5 | Implement Machine Learning Techniques using Python Language. | 2 | | | | | | |

| 13 | | Information Security & Cryptography | 2-0-2-0 | 3 | CO 1 | Apply error detection and correction mechanisms to compute code words for the source code and outline the working of OSI & TCP/IP reference models. | | 2 | | | | | | | | | | This course intends to highlight basic concepts, principles and procedure of Information Security & Cryptography. |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | CO 2 | Infer Channel allocation problem and algorithms to avoid it and compute the optimal path in a network using various static and dynamic routing algorithms. | 1 | | | | | | | | | | | |
| | | | | | CO 3 | Identify the IP addresses of a network using IPV4 classful & classless addressing schemes and outline the functionalities of the transport layer like TCP Connection management and congestion control. | | 2 | | | | | | | | | | |
| | | | | | CO 4 | Apply different symmetric and asymmetric encryption algorithms to compute cipher text and identify the functionality of application layer protocols. | | 2 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |

| 14 | 23CT1206 | Minor Project | 0-0-4-4 | 3 | | | | | | | | | | |

| 15 | 23CT2101 | 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 | | | | | | | This course intends to highlight basic concepts, principles and procedure of Mathematical Programming . |
|----|----------|--------------------------|---------|---|------|----------------------|---|---|---|---|---|---|---|---|---|---|
| | | | | | CO 2 | Different methods to find the optimal solution of Transportation and Assignment problems. | | | 3 | | | | | | | |
| | | | | | 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 | | | | | | | |

23CT2102

| 16 | | 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. | | 3 | | | | | | | This course intends to highlight basic concepts, principles and work procedure of Transform Techniques. |
| | | | | | CO 2 | Applying z- transform and Mellin transform to the analysis and characterization of Discrete Time systems. | | 3 | | | | | | | |
| | | | | | CO 3 | Apply Fourier series to analyze various signals. | | | 4 | | | | | | |
| | | | | | CO 4 | Apply Fourier transforms to analyze various signals. | | | | | 6 | | | | |
| | | | | | CO 5 | Verify the solution of the Transform techniques through MATLAB. | | 3 | | | | | | | |

| 17 | 23CT2103 | Data Warehousing & Mining | 2-0-2-0 | 3 | CO 1 | Understand Data Warehousing Techniques and apply different data processing techniques. | 2 | | | | | | This course intends to highlight basic concepts, principles and handling procedure of Data Warehousing & Mining. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | CO 2 | Implementation of Data Pre-Processing Techniques. | 2 | | | | | | |
| | | | | | CO 3 | Apply mining Algorithms for classifying data into different classes using labelled data. | 2 | | | | | | |
| | | | | | CO 4 | Applying unsupervised learning algorithm for data categorization. | 2 | | | | | | |
| | | | | | CO 5 | Implement mining algorithms using modern tolls and techniques for data processing. | | | | 5 | | | |

| | 23CT2104 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | | Deep Learning | 2-0-2-0 | 3 | CO 1 | Able to understand Deep learning and remember the concepts ofPerception, Back Propagation, | 2 | | | This course intends to highlight basic concepts, principles and algorithms of Deep Learning concepts. |
| | | | | | CO 2 | Able to understand auto encoders- and apply Regularization, andCNN techniques to generate Deep learning models | 2 | | | |
| | | | | | CO 3 | Apply Long Short Term | | 3 | | |
| | | | | | CO 4 | Build Markov models, Markov networks, Markov chains. | | 3 | | |

| | | | | | | CO 5 | Implement basic Neural Networks, optimization algorithms. | | | | 3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23CT2105 | | | | | | | | | | | | | | | | | | |
| 19 | | Cryptanalysis & Cyber Defense | 2-0-2-0 | 3 | | CO1 | Understand the principles of cryptography by analyzing various attacks and apply different classic encryption techniques. | 1 | | | | | | | | | | This course intends to highlight basic concepts, principles and algorithms of Cryptanalysis & Cyber Defense concepts. |
| | | | | | | CO2 | Understand the principles of block cipher and apply algorithms like DES, AES. | | | | | | 5 | | | | | | |

| | | | | | CO3 | Understand and apply different algorithms of public key crypto system 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 | | | | |
| 23CT2106 | | | | | 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 | | | | |

| 20 | | 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 | | | | | | | | This course intends to highlight basic concepts, principles and algorithms of Big Data Analytics. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 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 | | | | | |

23CT
2107

| 21 | | Cognitive Computing | 2-0-2-0 | 3 | CO 1 | Understand cognitive computing is, and how it differs from traditional approaches | 1 | | | | | | | | | This course intends to highlight basic concepts, principles and algorithms of Cognitive Computing. |
| | | | | | CO 2 | Applying the primary tools associated with cognitive Computing | 1 | | | | | | | | | |
| | | | | | CO 3 | Develop a project that leverages cognitive computing | | 2 | | | | | | | | |
| | | | | | CO 4 | Analyse and discuss the business implications of cognitive computing | | 2 | | | | | | | | |
| | | | | | CO 5 | able to implement cognitive computing programs using IBM Watson | | | 3 | | | | | | | |

23CT2108

| No | | Course | L-T-P-C | Cr | CO | Course Outcome | | | | | | | | Description |
|----|---|--------|---------|----|----|----------------|---|---|---|---|---|---|---|-------------|
| 22 | | Block chain and Crypto currencies | 2-0-2-0 | *3* | CO 1 | To apply the concepts of number theory and its applications in cryptography | 1 | | | | | | | This course intends to highlight basic concepts, principles and algorithms of Block chain and Crypto currencies. |
| | | | | | CO 2 | To understand the basics of block chain | | 2 | | | | | | |
| | | | | | CO 3 | To apply different types of block chain and consensus algorithms for contract transaction | | | 3 | | | | | |
| | | | | | CO 4 | To apply the different types of crypto currencies to cryptoapplications | | 2 | | | | | | |
| | | | | | CO 5 | To analyse basic number theory, cryptography concepts andsmart contracts applications using soft wallet. | | | | | | 6 | | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23CT2109 | | | | | | | | | | | | | | | | |
| 23 | | Stochastic Processes & Optimization | 2-2-0-0 | *4* | CO 1 | Describe the concept of Markov process and Poisson Process. | 1 | | | | | | | | | | This course intends to highlight basic concepts, principles and algorithms of Block chain and Crypto currencies. |
| | | | | | 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 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23CT2110 | | | | | | | | | | | | | | |

| 24 | | Quantum Computing | 2-2-0-0 | 4 | CO 1 | To introduce basics of quantum computing | | 2 | | | | | | This course intends to highlight basic concepts, principles and algorithms of Quantum Computing. |
| | | | | | 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 | | | | | |

23CT2111

| 25 | | 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 | | | | | | | This course intends to highlight basic concepts, principles of Applied Geometry & Computer Graphics. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 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 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23CT2112 | | | | | CO 5 | Develop applications through Lab experiments. | | | | | 5 | | | |

<div align="center">**PROGRAMMES OFFERED**</div>

Degree with Specialization

M.Sc. (Computational Mathematics) with Specialization:
Artificial Intelligence Specialization

Duration: 2 Years (4 Semesters)

**Eligibility:**

Candidates should have passed B.Sc. / B.Sc. Honours from recognized Indian or foreign universities/institutions in respective discipline with minimum of 55% marks or equivalent CGPA. Furthermore, the candidates should have secured a qualifying rank in the PG entrance Examination i.e., KLEF Entrance /any other equivalent examination.

For foreign students who wish to study at the University, please refer to the "Foreign Student Admission Procedures" stated separately and comply with the study requirements of the Ministry of HRD, Govt. of India.

## ACADEMIC REGULATIONS

This document supplements the KLEF rules and regulations to provide assistance to all M.Sc. (Computational Mathematics) students. It is required that every individual must abide by these regulations.

**Note**: 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 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. 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 Year:** It is the period necessary to complete an actual course of study within a year. It comprises of two consecutive semesters i.e., Even and Odd semester.

**Audited Course:** It is a course of study which has zero credits and has a "Satisfactory" or a "Unsatisfactory" grade.

**Backlog Course:** A course is considered to be a backlog course 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.

**Compulsory Course:** Course required to be undertaken for the award of the degree as per the program.

**Course:** A course is a subject offered by the University for learning in a particular semester.

**Course Handout:** Course Handout is a document, which gives 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.

**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.

**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.

**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 up to two decimal places.

**Curriculum:** Curriculum incorporates the planned interaction of students with instructional content, materials, resources, and processes for evaluating the attainment of Program Educational Objectives.

**Degree:** A student who fulfils all the Program requirements is eligible to receive a degree.

**Degree with Specialization:** A student who fulfils all the Program requirements of her/his discipline and successfully completes a specified set of Professional elective courses in a specialized area is eligible to receive a degree with specialization.

**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 marks in continuous in-semester evaluation and /or minimum prescribed attendance in a course shall be detained in that particular course.

**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 is Professional Elective.

**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:** It is an index of the performance of the students in a said course. Grades are denoted by alphabets.

**Grade Point:** It is a numerical weight allotted to each letter grade on a 10 - point scale.

**In-Semester Evaluation:** Summative assessments used to evaluate student learning, acquired skills, and academic attainment during a course.

**Professional Core:** The courses that are essential constituents of each engineering discipline are categorized as Professional Core courses for that discipline.

**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:** 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.

**Program Educational Objectives:** The broad career, professional, personal goals that every student will achieve through a strategic and sequential action plan.

**Project:** Course that a student has to undergo during his/her final year which involves the student to undertake a research or design, which is carefully planned to achieve a particular aim. It is a credit-based course.

**Project based laboratory:** Project Based Laboratory is a student-centric learning methodology that involve students in design, problem-solving, decision making, and investigative activities; gives students the opportunity to work in teams, over extended periods of time; and culminate in realistic products or presentations.

**Re-Appearing**: A student can reappear only in the semester end examination for the Theory component of a course, subject to the regulations contained herein.

**Registration**: Process of enrolling into a set of courses in a semester/ term of the Program.

**Re-Registering:** A student desiring to repeat a course is permitted to do so, subject to the regulations contained herein.

**Semester:** It is a period of study consisting of 15 to 18 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.

**Semester End Examinations:** It is an examination conducted at the end of a course of study.

**Single Section Course:** Course taught for a single section.

**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 behavioural.

**Summer Term:** The term during those courses which are offered from May to July. Summer term is not a student right and will be offered at the discretion of the University.

**Dissertation:** Dissertation is a course that a student has to undergo during his/her second year which involves the student to undertake a research or design, which is carefully planned to achieve a particular aim. It is a credit-based course.

# ACADEMIC INSTRUCTIONS

GENERALBEHAVIOUR

a. Students should speak in English only while on campus with the faculty or among themselves.

b. Students are expected to wish / greet all senior officials of the KLEF with due respect.

c. Students should be courteous and polite in dealing with all faculty & staff.

d. Students should maintain silence and/or speak in a soft voice 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.

e. Students should not loiter during the free time in the university ampus.

f. 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.

g. 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.

h. Students must always adhere to a prescribed/decent dress code befitting the dignity of a technical/professional student within the campus.

i. 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.

j. Students must not be involved in quarrelling 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.

k. 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.

## KLEF WORKING HOURS

KLEF operates between 09:00 AM to 5:00 PM on all weekdays.

## LECTURE 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, laboratories. KLEF expects students to conduct themselves in an orderly and cooperative manner by adhering to UniversityRules & Regulations.

## LABORATORY ENVIRONMENT

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

l. Always listen carefully to the faculty especially for the safety precautions to take in the laboratories. Accidents resulting in injuries may occur if precautions are not taken.

m. Eating in laboratories is strictly prohibited.

n. Proper dress code is to be followed as prescribed by faculty in each lab.

o. Students should familiarize themselves with the location of all safety equipment which may be available.

p. Follow evacuation procedures quickly and quietly, if needed.

q. Students should always conduct themselves in a responsible and cautious manner. Risky behaviours such as pushing, running, jumping etc., are unwarranted.

r. Only materials required to complete and record the experiment instructions, (e.g. pencils or graph paper, etc.) should be brought into the laboratory.

s. Equipment must be carefully handled to prevent breakage or damage, otherwise appropriate penalties/disciplinary action may be levied/imposed.

t. Lab station must be cleaned prior to leaving a lab.

u. 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;

v. Registration into a course will be permitted only for such courses, which are offered by KLEF in that semester.

w. A student must clear the pre-requisite(s) if any, to register in to a course.

x. KLEF reserves the right to register.

y. Registration for add/drop/change of a course will be permitted only within one week from the scheduled date of commencement of classes.

z. Students can register upto a maximum of 26 credits of their choice in a semester to meet their program requirements.

aa. 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.

bb.    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.

cc. 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.

# PROGRAM CURRICULUM

**Program Structure**

a) Each Academic Year is divided into two semesters, each of, approximately, 18 weeks duration:

- Odd Semester (July – December).
- Even Semester (January – May)

b) All courses are categorized into three streams even, odd and dual semester courses.

c) 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.

d) A 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.

e) 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 work**

a. Every course has a Lecture-Tutorial-Practice-Skill (L-T-P-S) component attached to it.

b. Based upon the L-T-P-S structure the credits are allotted to a course using the following criteria:

- Every Lecture / Tutorial hour is equivalent to one credit.
- Every Practical hour is equivalent to half credit.
- Every Skill-based practice hour is equivalent to quarter credit.
- If the calculated value of credit is a fraction, it is rounded to the next integer.

| S. No. | SEM | Code | COURSE NAME | Type | L | T | P | S | CR | CH | Pre requis ites |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 23UC1101 | Professional Communication Skills | AUC | 0 | 0 | 4 | 0 | 0 | 4 | NIL |
| 2 | 1 | 23CT1101 | Linear Algebra | PCC | 2 | 2 | 0 | 0 | 4 | 4 | NIL |
| 3 | 1 | 23CT1102 | Relational Algebra and Database Management System | PCC | 2 | 0 | 2 | 4 | 4 | 8 | NIL |
| 4 | 1 | 23CT1103 | Discrete structures | PCC | 2 | 2 | 0 | 0 | 4 | 4 | NIL |
| 5 | 1 | 23CT1104 | Mathematical Modeling & Numerical Methods | PCC | 2 | 0 | 2 | 0 | 3 | 4 | NIL |
| 6 | 1 | 23CT1105 | Computational Thinking for Structured Design | PCC | 2 | 0 | 2 | 4 | 4 | 8 | NIL |
| 7 | 1 | 23CT1106 | Colloquium-1 | HSS | 2 | 0 | 0 | 0 | 0 | 2 | NIL |
| 8 | 2 | 23UC1102 | Essentials of Research Design | PRI | 2 | 0 | 2 | 0 | 3 | 4 | NIL |
| 9 | 2 | 23CT1201 | Data Structures and Design of Algorithms | PCC | 2 | 0 | 2 | 4 | 4 | 8 | CTSD |
| 10 | 2 | 23CT1202 | Probability and Statistics | PCC | 2 | 0 | 2 | 4 | 4 | 8 | NIL |
| 11 | 2 | 23CT1203 | Matrix Computation | PCC | 2 | 0 | 2 | 4 | 4 | 8 | LA |
| 12 | 2 | | **PE-1** | | | | | | | | |
| 13 | 2 | 23CT1204 | Colloquium-2 | HSS | 2 | 0 | 0 | 0 | 0 | 2 | NIL |
| 14 | 3 | 23CT2101 | Minor Project | PRI | 0 | 0 | 4 | 4 | 3 | 8 | ERD, MM NM |
| 15 | 3 | 23CT2102 | Mathematical Programming | PCC | 2 | 2 | 0 | 0 | 4 | 4 | DS |
| 16 | 3 | 23CT2103 | Transform Techniques for Engineering | PCC | 2 | 2 | 0 | 0 | 4 | 4 | LA |
| 17 | 3 | | FLEXI-CORE COURSE | PCC | 2 | 2 | 0 | 0 | 4 | 4 | Relev ant |

| | | | | | | L | T | P | S | Cr | CH | Course |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 3 | 23UC1103 | VAC | VAC | 2 | 0 | 0 | 0 | 0 | 0 | 0 | NIL |
| 19 | ANY | | OPEN ELECTIVE - 1 | OEC | 3 | 0 | 0 | 0 | 0 | 3 | 3 | NIL |
| 20 | 3 | | PE-2 | | | | | | | | | |
| 21 | 3 | | PE-3 | | | | | | | | | |
| 22 | | 23CT2104 | Colloquium-3 | HSS | 2 | 0 | 0 | 0 | 0 | 0 | 2 | NIL |
| 23 | ANY | | OPEN ELECTIVE - 2 | OEC | 2 | 0 | 0 | 0 | 0 | 2 | 2 | NIL |
| 24 | 4 | 23CT2201 | Major Project | PRI | 0 | 0 | 24 | 16 | 16 | 40 | | SPO, TTE, MIP, CTSD |

| | | | | | L | T | P | S | Cr | CH | PRE-REQUISITE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Flexi Core Courses** | | | | | | | | |
| 1 | 3 | 23CT2110 | Stochastic Processes & Optimization | | 2 | 2 | 0 | 0 | 4 | 4 | P&S |
| 2 | 3 | 23CT2111 | Quantum Computing | | 2 | 2 | 0 | 0 | 4 | 4 | MM NM |
| 3 | 3 | 23CT2112 | Applied Geometry & Computer Graphics | | 3 | 0 | 2 | 0 | 4 | 5 | DS |

| | | | **Professional Electives** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **PE-1** | | | | | | | | |
| 1 | 2 | 23CT1204 | Data Science & Visualization | PE | 2 | 0 | 2 | 0 | 3 | 4 | RAD MS |
| 2 | 2 | 23CT1205 | Machine Learning | PE | 2 | 0 | 2 | 0 | 3 | 4 | LA, DS |
| 3 | 2 | 23CT1206 | Information Security & | PE | 2 | 0 | 2 | 0 | 3 | 4 | LA |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cryptography | | | | | | | | |
| | | | **PE-2** | | | | | | | | |
| 1 | 3 | 23CT2104 | Data Warehousing & Mining | PE | 2 | 0 | 2 | 0 | 3 | 4 | DSV |
| 2 | 3 | 23CT2105 | Deep Learning | PE | 2 | 0 | 2 | 0 | 3 | 4 | ML |
| 3 | 3 | 23CT2106 | Crypt Analysis & Cyber Defence | PE | 2 | 0 | 2 | 0 | 3 | 4 | ISC |
| | | | **PE-3** | | | | | | | | |
| 1 | 3 | 23CT2107 | Big Data Analytics | PE | 2 | 0 | 2 | 0 | 3 | 4 | DSV |
| 2 | 3 | 23CT2108 | Cognitive Computing | PE | 2 | 0 | 2 | 0 | 3 | 4 | ML |
| 3 | 3 | 23CT2109 | Block chain & Crypto currencies | PE | 2 | 0 | 2 | 0 | 3 | 4 | ISC |

| Computational Mathematics with Data Science | | | |
|---|---|---|---|
| 1 | 2 | 23CT1204 | Data Science & Visualization |
| 2 | 3 | 23CT2104 | Data Warehousing & Mining |
| 3 | 3 | 23CT2107 | Big Data Analytics |

| Computational Mathematics with  AI | | | |
|---|---|---|---|
| 1 | 2 | 23CT1205 | Machine Learning |
| 2 | 3 | 23CT2105 | Deep Learning |
| 3 | 3 | 23CT2108 | Cognitive  Computing |

| Computational Mathematics with  Cyber Security | | | |
|---|---|---|---|
| 1 | 2 | 23CT1206 | Information Security & Cryptography |
| 2 | 3 | 23CT2106 | Crypt Analysis & Cyber Defence |
| 3 | 3 | 23CT2109 | Block chain & Crypto currencies |

| List of Minor Degree Courses | | | |
|---|---|---|---|
| 1 | 2 | | Computational Fluid Dynamics |
| 2 | 3 | | AI Ethics & Governance |
| 3 | 3 | | Natural Language Processing |

## M. Sc.(Computational Mathematics)  Weighatge Distribution

| Semester | Sum of CR | Sum of CH |
|----------|-----------|-----------|
| 1 | 19 | 32 |
| 2 | 18 | 32 |
| 3 | 22 | 31 |
| 4 | 16 | 40 |
| Any | 5 | 5 |
| Grand Total | 80 | 140 |

| Type | Sum of CR | No. of Courses |
|------|-----------|----------------|
| AUC | 0 | 1 |
| OEC | 5 | 2 |
| PCC | 64 | 11 |
| PEC | 15 | 3 |
| PRI | 52 | 3 |
| FCC | 0 | 0 |
| VAC | 0 | 0 |
| HSS | 6 | 3 |
| SKILL | 0 | 0 |
| Grand Total | 142 | 23 |

**Legend: PCC - Professional Core Courses related to Major area, PEC - Professional Elective Courses related to Specialization, PRI - Project, Research or Internship Courses, AUC - Audit Courses, VAC - Value Added Courses, OEC - Open Electives, FCC- Flexi Core Courses which leads to specialization, SKILL-Skill Based Courses, HSS-Humanities and Social Sciences.**

**Graduation Requirements: Successful attainment of 92 credits, obtain all PEC credits from courses of specific specialization domain, complete One Scopus Publication and obtain Satisfactory in all 0 credit courses (AUC, VAC and PRI categories)**

## SUMMER TERM COURSES

KLEF offers summer term courses during May and June. The following are the guidelines to register into courses offered in Summer Semester.

    c.   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 timetable.

    d.   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.

e. In any case, a student can register only for a maximum of 12 credits during summer term.

f. 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.

## ELIGIBILITY FOR ADMISSIONS

Candidates should have passed B.Sc. / B.Sc. Honours from recognized Indian or foreign universities/institutions in respective discipline with minimum of 55% marks or equivalent CGPA. Furthermore, the candidates should have secured a qualifying rank in the PG entrance Examination i.e., KLEF Entrance /any other equivalent examination.

For foreign students who wish to study at the University, please refer to the "Foreign StudentAdmission Procedures" stated separately and comply with the study requirements of the Ministry of HRD, Govt. of India.

# REGISTRATION PROCESS & ATTENDANCE RULES

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

a. Registration into a course will be permitted only for such courses, which are offered by KLEF in that semester.

b. A student must clear the pre-requisite(s) if any, to register in to a course.

c. KLEF reserves the right to register.

d. Registration for add/drop/change of a course will be permitted only within one week from the scheduled date of commencement of classes.

e. Students can register upto a maximum of 26 credits of their choice in a semester to meet their program requirements.

f. 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.

g. 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.

h. 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.

## ATTENDANCEPOLICY

Students must maintain a minimum attendance of 85% in every course. In case of medical exigencies, the student/parent should inform the Head of the Department within a week by submitting necessary proofs and in such cases the attendance can be condoned up to an extent of 10% by Principal concerned on the recommendation of the Head of the Department.

1. 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 a 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 75% condition after going through case by case.

2. Attendance in a course shall be counted from the date of commencement of the class work.

3. Attendance for the students who are transferred from other institutes and for new admissions, attendance must be considered from the date of her/his admission.

## 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 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 principal 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 extra-curricular 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 9 instructional days per semester, and in Entrepreneurship related activities a maximum of 18 instructional days per semester. This condonation is not applicable for summer term.

## ELIGIBILITY FOR APPEARING IN SEM-END EXAMINATION

A student registered for a course is eligible to write the Semester-End Examination for that course unless found ineligible due to one or more of the following reasons:

a. Shortfall of attendance

b. Acts of indiscipline

c. Withdrawal from a course

## ABSENCE IN ASSESSMENT & 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 assessmentcriteria based on the approval from the principal on the basis of recommendations made by the concerned Head of the Department.

If a student fails to write Sem-In Exam-I or obtained less than 50% marks in Sem-In Exam-I, he has to attend remedial classes and score 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 all the Laboratory exams.

1. A student is in genuine absence for a Sem-In Exam only under the following circumstances:

   a. Pre-approved participation in University/State/National/International co-curricular and extra-curricular activities.

   b. 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.

   c. Death of immediate family member.

**Remedial Classes**

The following category of students is recommended to attend Remedial classes:

- Students who did not attend or obtain a minimum of 50% marks in the Sem-In exam 1.

- Students those for whom CO1/CO2 is(are) not attained in Semester-In Exam 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 which are scheduled to be conducted usually one or two weeks post conclusion of Sem-In exam 1.
- The number of remedial classes to be conducted shall be 50% of regular classes held till the Semester-In exam 1.
- Remedial classes MUST NOT be scheduled during regular class work hours.
- The following ALMs are recommended for slow learners:
  - One minute paper
  - Think/Plan/Share
  - Role play
  - Focussed listening and listening for specifics
  - Just-in time teaching

Course coordinators may also include alternate Active Learning Methods based on the course being taught.

# REQUIREMENTS FOR THE AWARD OF DEGREE

| Name of the program | PC | PE | HSS | BS | ES | FC | OE | ME | FL | Skill | Studio | Certificate on domain | Certificate on Sports | ITR/PS/PR/ter mPaer | Total Credits | Minimum CGPA req |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M.Sc. (Computational Mathematics) | 65 | 12 | 2 | - | - | - | - | - | 1 | - | - | - | 12 | 92 | 5.5 |

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

    a. $5.5 \leq$ CGPA $< 5.75$ will be awarded Pass class.

    b. $5.75 \leq$ CGPA $< 6.75$ will be awarded Second class.

    c. $6.75 \leq$ CGPA $< 7.75$ will be awarded First class.

    d. CGPA $\geq 7.75$ 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.

# ASSESSMENT AND EVALUATION PROCESS

The assessment in each theory subject consists of two Sem-In Exams (Sem-in Exam-I and Sem-In Exam -II), in-class quizzes/tutorials/home-assignments/Active Learning Methods (continues assessment), and the Semester-End Exanimation (SEE). The distribution of weightage for each assessment step is listed below. The distribution of internal marks in the table below is only a guideline. Instructors at their discretion may apportion some marks for attendance beyond 75%. In such cases, the marks shown for quizzes and assignments will accordingly be adjusted. Students are advised to consult the course handout to get more detailed information on assessment.

a. The Sem-In tests and the Semester-End Examinations will be conducted as per the Academic Calendar.

b. As per the necessity, the Supplementary examinations will be conducted at the discretion of Dean Academics with the approval of the Vice-Chancellor.

c. Students may have to take more than one examination in a day either during Sem-In exams, Semester-End Examinations /Supplementary examinations.

## SEMESTER-IN EVALUATION

The following guidelines are followed for the Semester-In evaluation.

a. The process of evaluation is continuous throughout the semester.

b. The distribution of marks for Semester-In evaluation is 60% of aggregate marks of thecourse.

c. The distribution of weightage for various evaluation components 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.

d. In order 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 tore-evaluate.

e. 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.

f. 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 suchstudents.

g. In case a student has missed any of the two semesters in evaluations, He/she is eligible for and will be provided with an opportunity of appearing for re-examination. However, such a facility is applicable for only one semester in evaluation tests.

## SEMESTER END EXAMINATION

The following guidelines are followed for the Semester-In evaluation.

h. The weightage for Semester End Examination is 40% of the aggregatemarks and the student should secure minimum 40% in Semester End Examination.

i. The pattern and duration of such examination are decided and notified by the Course Coordinator through the Course handout, after approval from the DeanAcademic.

j. 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.

k. 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 one fortnight of the declaration of the results.

## EVALUATION FOR THEORYCOURSES

The table below gives details about the evaluation components in courses which contain only the lecture components:

| Type of Evaluation | Maximum Marks for which the Evaluation is Conducted | Duration | Weighatge |
|---|---|---|---|
| Sem-In Exam-I | 50 Marks | Refer course handout (Annexure A) | Refer course handout (Annexure A) |
| Sem-In Exam -II | 50 Marks | Refer course handout (Annexure A) | Refer course handout (Annexure A) |
| Quizzes / ALM / Tutorial | Each quiz/ALM/ Tutorial will be conducted for a minimum of 10 marks | Refer course handout (Annexure A) | Refer course handout (Annexure A) |
| Assignment | In the form of a report, seminar, presentation, quiz, experiment, GD, etc. as defined in the course syllabus/ course plan | Refer course handout (Annexure A) | Refer course handout (Annexure A) |
| Sem-End Exam | 100 marks | 3 hours | Refer course handout (Annexure A) |

**ASSESSMENT OF LABORATORY BASED COURSES**

The continuous assessments in laboratory courses will be based on supervision of the students' work, their performance in viva-voce examinations and the quality of their work. The Sem-End Exam for the laboratory courses are conducted by a panel of examiners including experts from outside KLEF as approved by the Dean Academics.

| Type of Evaluation | Evaluation Component | Marks | Remarks | Weighatge out of 100 |
|---|---|---|---|---|
| Internal | Sem-In Lab Exam -1 | 30 | Sem-In lab exam will have questions framed from the experiments conducted in the lab. | Refer to course Handout (Annexure A) |
| | Sem-In Lab Exam -2 | 30 | Sem-In lab exam will have questions framed from the experiments conducted in the lab. | |
| | Continuous Assessment | 20 per Lab | Assessment includes marks for record, observation, execution of experiment and viva-voce | |
| | Mini Project | 20 | Project evaluation includes weekly reviews, project completion, process management | |
| External | Report | | Refer course. Handout (Annexure A) | 50 |
| | Lab Experiment | | | |
| | Viva-voce | | | |
| | External Review | Refer course handout (Annexure A) | | |

**NOTE:** Check for specific courses or as specified by the Course Coordinator.

**ASSESSMENT OF THEORY COURSES WITH EMBEDDED LABORATORY**

The following table briefs the evaluation components of a theory course with embedded lab:

| Type of Evaluation | Evaluation Component | Marks | Remarks | Weightage out of 100 |
|---|---|---|---|---|
| Internal | Sem-In Exam-1 | 50 | refer course handout (Annexure A) | Refer to course Handout (Annexure A) |
| | Sem-In Exam-1 | 50 | refer course handout (Annexure A) | |
| | Quizzes / ALM / Tutorial | Each quiz/ALM/ Tutorial will be conducted for a minimum of 10marks | refer course handout (Annexure A) | |
| | Lab Continuous Assessment | 20 per Lab | Assessment includes marks for record, observation, execution of experiment and viva- voce | |
| External | Lab Experiment | Refer course Handout (Annexure A) | | Refer Course Handout (Annexure A) |
| | Viva-Voce | Refer course handout (Annexure A) | | |
| | Semester End Exam | 100 | | |

**ASSESSMENT OF PROJECT/RESEARCH-BASED SUBJECTS**

All project or research-based subjects must have a defined time-limit for completion. The specific time limits for completion and schedule for monitoring and evaluation of performance of students will be announced by the school each term. The final project report, after getting the plagiarism certificate only will be considered and evaluated by a panel of examiners including external experts. Student project reports must be as prescribed by the office of Dean Academics. Students conducting their projects outside the campus can participate in project reviews through an online video conferencing tool.

**GRADING PROCESS**

At the end of all evaluation components based on the performance of the student, each student is awarded 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:

| Letter Grade | Grade Point | Percentage of marks |
|---|---|---|
| O | 10 | 90 - 100 |
| A+ | 9 | 80 - 89 |
| A | 8 | 70 - 79 |
| B+ | 7 | 60 - 69 |
| B | 6 | 50 - 59 |
| C | 5 | 46 - 49 |
| P | 4 | 40 - 45 |
| F | 0 | 0 – 39 |
| Ab | 0 | Absent |

**RELATIVE GRADING**

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

| Letter Grade | Grade Point | Grade Calculation |
|---|---|---|
| O | 10 | total marks >= 90% and total marks >= mean + $1.50\sigma$ |
| A$^+$ | 9 | $\mu+0.50\sigma \le$ total marks $< \mu+1.50\sigma$ |
| A | 8 | $\mu \le$ total marks $< \mu+0.50\sigma$ |
| B$^+$ | 7 | $\mu-0.50\sigma \le$ total marks $< \mu$ |
| B | 6 | $\mu-1.00\sigma \le$ total marks $< \mu-0.50\sigma$ |
| C | 5 | $\mu-1.25\sigma \le$ total marks $< \mu-1.00\sigma$ |
| P | 4 | $\mu-1.50\sigma \le$ total marks $< \mu-1.25\sigma$ or $\ge 40$ |
| F | 0 | total marks $< \mu-1.50\sigma$ 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 from the μ.*

**SGPA & 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.

$$SGPA(S_i) = \frac{\sum C_i * G_i}{\sum C_i},$$

where '$C_i$' is the number of credits of the i$^{th}$ course and '$G_i$' is the grade point scored by the student in the i$^{th}$ course.

The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a program,

$$CGPA(S_i) = \frac{\sum C_i * S_i}{\sum C_i},$$

where 'S'$_i$ is the SGPA of the i$^{th}$ semester and '$C_i$' is the total number of credits in that semester.

a. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

b. CGPA can be converted to percentage of marks: 10 X CGPA -7.5

c. A student appearing for a course having lab integrated with theory and in case obtains less than 40% in either of lab or theory component of semester end examination, and in such case the student has to 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.

d. Audit/Certificate courses are graded as satisfactory (S) or non-satisfactory (NS) only.

e. At the end of each semester, the KLEF issues grade sheet indicating the SGPA and CGPA of the student. However, grade sheet will not be issued to the student if he/she has any outstandingdues.

**ILLUSTRAION OF COMPUTATION OF SGPA AND CGPA**

Computation of SGPA and CGPA illustration for SGPA:

| COURSE | CREDITS | GRADE LETTER | GRADE POINT | CREDITPOINT (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

Illustration for CGPA:

| 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 $\leq 6.75$ and the grade in the respective course to be equal to or lower than "C". In the case of reappearing, the better of the two grades is 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 accord of academic regulations.

A student cannot reappear for semester end examination in courses like Industrial Training, courses with their L-T-P-S Structure like 0-0-X-X, Project, Practice School and Term Paper.

**COURSE BASED DETENTIONPOLICY**

In any course, a student must maintain a minimum attendance as per the attendance policy referred in Chapter 5.1 and 5.4, to be eligible for appearing in the Sem-End examination, failing to fulfil this condition, will deem such student to be detained in that course. He/she is thereby ineligible to take semester end exam.

**PROMOTION**

**CREDIT TRANSFER**

**CREDIT TRANSFER BETWEEN KLEF AND OTHERINSTITUTION**

a. Credit transfer from other institutions to KLEF or vice versa is permitted only for undergraduateprogram.

b. Credit transfer from KLEF to other institutions: Studentstudyingin KLEF can take transfer to another institution under the followingconditions:

- KLEF has signed MOU with theinstitution.
- 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.

c. Credit transfer from another institution to KLEF: A student studying in another institution can take transfer to KLEF under the followingconditions:

- When a student seeks transfer, equivalent credits will be assigned to the student based on the courses studied by the student.
- The student, when transferred from other institutions, has to stick to the rules and regulations of KLEF.
- 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 aHonours 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/Honours degree must be approved by Dean Academics prior to enrolment in the respective MOOCs.

Students acquiring additional credits for Honours/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 CGPAof 7.5 till that semester.

## COURSE 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 one tutorial hour per week or two hours per week of practical/ field work or four hours per week of skilling during a semester.

## RE-EVALUATION

Students desirous of seeing their Semester-End Examination answer scripts have to apply online to the COE for the same within the timeframe as declared by the COE by paying the prescribed fee. Student applications must be forwarded by the Head of the Department and the Principal of the School and then re-evaluation fees are to be paid. The application along with the attached fee receipt must be submitted to the office of the COE.

There is no provision for re-evaluation in case of Lab/Practical/skilling exams, student project, viva-voce exam or seminar/ design/ mini-project courses.

The final grades awarded to each course shall be announced by the COE and the same will be made available to students through the website/notice boards.

## ACADEMIC COUNSELING BOARD (ACB)

Academic Counselling Board is constituted by the Dean Academics, for each program separately. This board shall comprise of the respective Chairmen, Board of Studies, two Professors and two Associate Professors of the program.

A student will be put under Academic Counselling Board in the following circumstances:

- Secured a CGPA of less than6.00.
- Secured 'F' grade in 3 or more courses.

The students under Academic Counselling Board may not be allowed to register for all regular courses in the semester, based on the recommendation of Academic Counselling Board and decision of Dean Academics.

**BACKLOG COURSES**

A course is considered to be a backlog if the student has obtained 'F' grade in the course.

**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 (2) students based on CGPA. However,

    a. The grade obtained by betterment, will not be considered for thisaward.
    b. He/ She must have obtained first class with distinction for the award of gold or silvermedal.

# COUNSELLING & FEEDBACK

Guidelines for effective counselling for students on academic and non-academic activities Student counselling ensures that every student gets to know the academic structure of the University and utilize maximum opportunities that the institute offers to fulfil their career and personal life goals. The objective of "Student Counselling / Mentoring Service" is to provide friendly support to the students for their well-being during their stay in the campus and for their holistic development. Student counselling promotes the development of students in the following aspects:

**Academic**: It disseminates information about different academic programs of the Institute and provides efficient time management and learning skills. It also addresses academic issues of students, e. g. inadequate academic performance, fall of attendance, lack of basic IT skills and language skills of students, particularly from non-English background. Besides, counselling helps students to take proper direction as they leave the campus, viz. higher education in a specialized field (both in India and abroad), job (different types of career options), entrepreneurship etc.

**Co-Curricular & Extra-Curricular**: It strives to develop talents in students and encourages them to discover their extra-curricular interests/hobbies, viz. sports, fine arts, etc.

**Personal**: It provides a cushion against homesickness and assists in adjusting to the new environment by providing personalized guidance. The following Orientation/training programs could be organized:

   a.   Counselling for Academic Excellence - Closely monitoring the Academic
         Progress of the students.

   b.   Orientation Program for new students to acquaint them with the Institute.

   c.   Awareness on Anti-ragging, gender sensitization,etc.

   d.   Stress and timemanagement

   e.   Health care andhygiene

   f.   Careercounselling

   g.   Motivational lectures by eminentspeakers.


Every student should approach her/his counsellor only, for any of his/ her requirements. One slot of 50 minutes duration per week is provided in the timetable for counselling.


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