**Computational Data Enabled Science and Engineering (CDSE)**

Doctor of Philosophy (Ph.D.) in Computational and Data Enabled Science and Engineering (CDSE):

The doctoral program in CDSE is a research-oriented program that requires a minimum of 72 credit hours beyond the Bachelor’s degree or a minimum of 48 credit hours beyond the Master's degree. The program shares resources with the departments and schools offering concentrations in CDSE and operates under the College of Science, Engineering, and Technology (CSET)– coordinated and directed by the Chair, Department of Mathematics and Statistical Science, Tor A. Kwembe, PhD.

CDSE Ph.D. program at JSU serves as a model PhD program, long in demand by industry, government and private labs and coming into its own as increasing demanded by the nation’s need to create knowledge from the overwhelming world of data thrust upon us in today’s global world of sensors and its permeation in all disciplines. The CDSE program seeks to improve our ability to extract knowledge from large and complex digital data as we meet the national imperative to accelerate discoveries in science, engineering, business, strengthen our national security and transform teaching and learning. Transdisciplinary, multidisciplinary and interdisciplinary research is at the core of the CDSE program and hence JSU’s CDSE meets these challenges by:

1. Providing core courses that allow transitioning students from all disciplines to be successful.
2. Integrating and adapting the Affinity Research Group Model- a cooperative learning approach involving students with diverse backgrounds and emphasizing the conscious development of students’ domain knowledge, research abilities, team skills and professional identity.

The educational objectives of the CDSE Ph.D. program are met by:

* Providing students with advanced theoretical, analytical, and applied interdisciplinary research training of high quality at the Ph.D. level.
* Providing the necessary structures, learning opportunities, and experiences beyond the traditional university curriculum required for diversity and interdisciplinary collaborations in areas of Computational Biology and Bioinformatics, Computational Mathematics and Statistical Sciences, Computational Physical Sciences, and Computational Computer Science and Engineering.
* Producing high quality graduates with terminal degrees in CDSE capable of joining the workforce in industry, academia and state or federal agencies and of becoming the future leaders in computing Data-centric and Big Data fields.

**Admissions:**

For graduate admissions applications, please contact the [JSU Graduate Studies](https://www.jsums.edu/admissions/) website.

**Curriculum**

**Requirements for students with a Bachelor’s Degree**

| Common Core | 12 course credit hours |
| --- | --- |
| Track Requirements | 12 course credit hours |
| Track Electives (Internships, CDS&E Seminars) | 24 course credit hours |
| Comprehensive Qualifying Examination | 0 credit hours |
| Graduate Area Comprehensive Examination | 0 credit hours |
| Dissertation | 24 credit hours |
| Total | 72 credits hours\* |

\**Minimum requirements; additional requirements may be recommended by the Doctoral Committee*

**Requirements for students who hold a Master’s Degree (in Mathematics/Statistics/ Computer Science/ Engineering) – A minimum of 48 credit hours**

Students in this category will consult with an adviser within their chosen track to develop a degree plan for a minimum of 48 credit hours. The Common Core Course work covering 12 credit hours is required. Students who pass the Admission to the CDSE Ph.D. Candidacy Exam (The Comprehensive Qualifying Examination) before completing the common core courses can transfer those courses into the developed degree plan.

A student with a Master’s degree in a CDSE or data science discipline can transfer at most 24 credit hours of coursework from their Master’s degree transcript to the categories of Common Core, Track Requirements and Track electives (as applicable, decided in consultation with the adviser). This implies, for the PhD degree, a student who already has a Master’s degree in a CDSE disciplines should do a minimum of 24 credit hours of additional coursework (to satisfy the overall 12, 12 and 24 credit hour requirements for Common Core, Track Requirements and Track Electives respectively) and at most 24 credit hours of dissertation as well as pass the Comprehensive Qualifying Examination and the Graduate Area Comprehensive Examination.

**Progress Towards Earning the CDS&E Ph.D.**

To become a candidate for the Doctor of Philosophy Degree in CDS&E, the student must have:

1. Completed the formal coursework with a GPA of 3.0 or better.
2. During the first two semesters of study, students are required to attend CDSE 700 –Seminar in CDSE (focus on collaborative learning and research and understanding of the CDSE profession).
3. Passed a comprehensive qualifying examination. A good performance (or average of 80% scores) on the Common Core and Concentration track exams will be required for passing. The student entering the program with a bachelor’s degree will be required to take the comprehensive qualifying examination, for the first time, no sooner than in their second semester (when the common core and concentration tracks course work has been completed), and within the first 2 years of admission into the program. The student will be required to pass within five (5) semesters of admission, and will have two (2) opportunities for passing.
4. Students who pass the Comprehensive Qualifying examination must immediately meet the **IRB/IACUC** regulations compliance and apply for Graduate Degree Candidacy-And form a doctoral advisory committee in consultation with their chosen faculty advisor or mentor and enroll in CDSE 899 (CDSE Research Seminar- continuation of the collaborative model implementation engaging student weekly presentations and their faculty advisors.
5. Complete all the required course work with at most 3 credit hours of internship or research experience in CDSE at organizations with data and Big Data centered operations, or as on campus training with IT. Obtain the **IRB approval or exemption**, if applicable.
6. Form a dissertation committee and submit a dissertation proposal.
7. Complete the Graduate Area Comprehensive Examination.
8. Follow the guidelines for preparing a Doctoral Dissertation from the Division of Graduate Studies.
9. Submit preliminary copies of the dissertation to the committee.
10. Schedule the Dissertation Defense.
11. Public announcement of Dissertation Defense.
12. Submit Committee Report of Dissertation Defense to Graduate Studies- Follow Graduate Studies Deadlines.
13. Submit Final Draft of the dissertation to the Chairperson of the committee and committee members.
14. Final Submission of Corrected (or proofed) Dissertation before final graduation clearance deadline.
15. Removal of “Incomplete” or “In-Progress” Grades.
16. Apply for Online Graduation Clearance- Follow the University Deadlines-Registrar.
17. Participate in the Commencement Exercises- Optional.

**Course Work**

| **Common Core Courses (12 hrs)**  **Course Title** | | **Semester Hours** |
| --- | --- | --- |
| CSC 552 | Applied Programming | 3 |
| CSC 601 | Computing Algorithms | 3 |
| CSC 620 | Database Management Systems | 3 |
| STAT 672 | Computational Statistics | 3 |

**or**

| STAT 661 | Advanced Probability and Statistics | 3 |
| --- | --- | --- |

**Concentration Tracks Required Courses and Electives**

Please consult with the most current issue of the [Graduate Catalog](https://www.jsums.edu/university-catalogs/) for course listing in the tracks and electives.

**Transfer of Credits**

A course for which transfer credit is sought must have been completed with a grade of "B" or better. Holders of at least the Master’s degree can transfer up to 24 credit hours. Please refer to the [Division of Graduate Studies guidelines.](https://www.jsums.edu/graduateschool/areas-of-study/)

**Time Limit**

Students with adequate computational sciences and concentration area subject disciplines preparation at the undergraduate level can take at least five years and three years at the master’s level to complete the CDSE Ph.D. program. However, all students must complete their programs within five years of becoming a candidate for the CDSE Ph.D. degree.

**CDSE Ph.D. Examination Procedures**

1. Comprehensive Qualifying Examination
2. Graduate Area Comprehensive Examination
3. The Dissertation
4. Peer Reviewed Publications
5. Final Defense of Dissertation

**Comprehensive Qualifying Examinations**

In order to ensure that the skills and basic knowledge have been acquired to carry out the research necessary for the dissertation, the student must demonstrate competence in the common core and concentration track areas. Competence will be demonstrated by a comprehensive qualifying examinations which shall consists of written examinations over each of these two areas. The two-part comprehensive qualifying examination will consist of 3 of the 4 common core courses (CSC 601, CSC 620, STAT 661 or STAT 672 and recommended CDSE courses) as Part I and all the 4 required courses for the chosen track as Part II. A good performance (or average of 80% scores) on both Part I and Part II exams will be required for passing. Knowledge of the content of the courses listed in the common core and specialized concentration tracks, such as the typical course sequence listed under each area, should be adequate preparation for the comprehensive qualifying examination. Study guides for each of the examination areas will also be available.

The Comprehensive qualifying examination is typically scheduled for the spring semester and once during the summer. To show satisfactory progress in his/her graduate studies, a student is expected to complete his/her comprehensive qualifying examinations by the end of the second full academic year of Ph.D. work or equivalently, completing the common core and concentration track course work. A student will be allowed to repeat an examination only once or at the recommendation of the examining committee.

**Graduate Area Comprehensive Examinations (GACE)**

When the comprehensive qualifying examination has been passed, the Graduate Advisory Committee is formed, the Doctoral Committee and mentor are selected with a dissertation research topic chosen, and when all course work on the program of study has been completed, the student may request the Graduate Area Comprehensive Examination (GACE) to be scheduled. The GACE will be an examination in the candidate’s draft dissertation presented to the candidate’s dissertation committee, as well as an in-depth examination in the concentration. It will be administered by the Director of the CDSE program and must contain an oral component. Pass or fail will be determined by majority vote of the committee.

**The Dissertation**

Once admitted to the Degree candidacy doctoral, the student together with his/her advisor will select the student's dissertation committee, subject to the approval of the CDSE Ph.D. Advisory Committee. The dissertation committee will consist of at least five [graduate faculty](http://math.msstate.edu/people/order_research.php) members, including a major professor and at least three additional graduate faculty members from the other concentration tracks, including an external member. Each member of the committee must have graduate faculty status. The primary responsibility of the committee will be to supervise the student's research and writing of the dissertation in the chosen concentration track, and its members should be chosen with this mission in mind.

In the early stages of the research effort, the student will make a formal dissertation proposal to the dissertation committee. The dissertation will be an original data driven discovery work that makes a significant contribution of Big Data analytics or data science analytics (using machine learning and artificial intelligence methods) to the student's area of specialization.The dissertations should involve but not limited to the development of fundamental theories, techniques, methodologies, and technologies with broad applications to big data problems motivated by specific domain data challenges and requirements or employ new big data techniques, methodologies, and technologies to address and solve problems in specific application domains. An external person who has expertise in the dissertation area will be enlisted by the student and his/her committee to serve as an external member of the dissertation committee.

**Final Defense Examination**

After all other examinations and the dissertation have been completed, the student's committee will schedule the final defense examination for the student. This examination will consist of an oral defense of the dissertation and will be open to the public. **The student is expected to publish versions of the dissertation findings in peer reviewed publications before defense (definitely before graduation process is cleared).** After consultation with the CDSE Ph.D. program Coordinator, the major professor will publicize the time and place that the examination will be held. This announcement should be at least one week prior to the scheduled date of the examination. A pass or fail on this examination will be determined by a majority vote of the student's committee.

**Financial Suport**

There are sources of faculty research driven competitive financial support that may be available to students in the CDSE Ph.D. Program at Jackson State University. All such sources of financial support endavor to include a combination of tuition costs in addition to stipends that mirroed the cost of living in Jackson, Mississippi. Costs of living in **Jackson metro and the surrounding neighborhoods** are generally below the national average and the benefits of living in the **largest city in Mississppi** also add to the quality of the CDSE Ph.D. program. Details about graduate funding can found on the JSU [Admissions and Aids](https://www.jsums.edu/admissions/) website.

Masters of Science

COMPUTATIONAL AND DATA-ENABLED SCIENCE AND ENGINEERING (CDSE)

**M.S. in CDSE Program – Overview**

The Masters of Science (M.S.) in CDSE program is an interdisciplinary program, which includes the disciplines of Biology, Chemistry, Computer Science, Engineering, Physical Sciences, and Mathematics & Statistical Sciences. The M.S. program in CDSE requires a minimum of 36 credit hours beyond the Bachelor’s degree. The M.S. program in CDSE serves as a feeder program for the PhD program in CDSE and will provide a foundation for students to successfully pursue the doctoral program and employment outside of the academy. The program shares resources with the existing STEM programs and operates under the College of Science, Engineering, and Technology (CSET). The M.S. in CDSE can be completed with a thesis or project.

**Curriculum**

| **Project Option** | | **Thesis Option** | |
| --- | --- | --- | --- |
| **Core Courses** | **12 Credit hrs** | **Core Courses** | **12 Credit hrs** |
| **Required Courses** | **9 Credit hrs** | **Required Courses** | **9 Credit hrs** |
| **Elective Courses** | **12 Credit hrs** | **Elective Courses** | **9 Credit hrs** |
| **Project** | **3 Credit hrs** | **Thesis** | **6 Credit hrs** |

**Core Courses (12 hrs)**

CSC 520 Database Management Systems (3 hrs)

CSC 552 Applied Programming (3 hrs)

CSC 601 Computing Algorithms (3 hrs)

STAT 661 Probability and Statistics (3 hrs) or

STAT 672 Computational Statistics

**Required Courses (9 hrs)**

**A student will choose a particular track for the required courses after consultation with the graduate** **advisor.**

**Track 1: Computational Biology and Bioinformatics**

BIO 605 Mathematical Modeling of Biological Systems

BIO 619 Advanced Genetics

BIO 679 Statistics for Bioinformatics

**Track 2: Computational Mathematics and Statistical Sciences**

MATH 670 Computational Methods in Mathematics I

STAT 672 Computational Statistics

MATH 673 Quantitative Exploration of Data

**Track 3: Computational Physical Science**

PHY 522 Quantum Theory

PHY 533 Solid State Theory

PHY 561 Computational Methods in Physics

**Track 4: Computational Science and Engineering**

CSC 551 Parallel and Distributed Computing or CPE 610 Parallel Computing and Programming

CSC 571 Programming for Big Data

CSC 621 Machine Learning

**Elective Courses (9-12 hrs)**

Elective Courses will be approved by the student's graduate committee. A list of elective courses is given below (the elective courses can be taken from one or more tracks):

BIO 623 Systems Biology and Signaling Networks

BIO 635 Cancer Biology

BIO 689 Advanced Topics in Computational Biology

MATH 543 Numerical Analysis

MATH 628 Advanced Partial Differential Equations I

MATH 629 Advanced Partial Differential Equations II

MATH 671 Computational Methods in Mathematics II

MATH 700 Topics in Mathematical and Statistical Applications in CDS&E

STAT 661 Probability and Statistics

STAT 680 Computational Data Analysis and Visualization I

STAT 681 Computational Data Analysis and Visualization II

CDSE 700- Seminar in CDS&E

CDSE 701- Internship in CDS&E

CDSE 702- Current Trends in CDS&E

CSC 511 Object-Oriented Programming

CSC 534 Data Mining

CSC 537 Cloud Computing

CSC 562 Artificial Neural Networks

CSC 573 Modeling & Simulation of Complex Systems

CSC 582 Social Network Analysis

CSC 630 Computability and Complexity

CSC 634 Big Data Mining

CSC 635 Big Data for Cyber Security

CSC 641 Network Science

CSC 653 Large Scale Computing

CSC 661 Software Engineering for Computational Applications

CSC 663 High Performance Scientific Computing

CPE 505 Analysis of Algorithms

CPE 547 Modeling and Analysis of Computer and Communication Systems

**Project (3 hrs)**

Students can enroll in the project courses from one of these disciplines until further notice:

CDSE 589 Masters Project (1-3 hrs)

**Thesis (6 hrs)**

Students can enroll in the thesis courses from one of these disciplines until further notice:

CDSE 599 Thesis (1-6 hrs)

**Special Requirements:**

To become a candidate for the Master of Science in Computational and Data Enabled Sciences and Engineering, student will have to:

1. Take and pass the Graduate Area Comprehensive Examination (GACE) on the 4 core courses (This requirement is waived for CDSE Ph.D. students who have passed the Comprehensive Qualifying Examinations). A student will have two chances of passing the GACE exam on the 4 core courses or complete 12 credit hours in the core and concentration track (This requirement is for students seeking only the Master’s degree in CDSE).
2. Additionally, the student will need to present and defend his/her Masters Project or Thesis to a committee comprised of the student advisor and committee members.

**GRADUATE DEGREE PROGRAMS IN MATHEMATICS**

The Department of Mathematics offers graduate programs leading to the Master of Science (M.S.) degree in mathematics.

**Program Objectives**

1. To provide quality mathematics training at the master’s degree level

2. To help increase the number of mathematicians qualified to undertake further studies leading to the doctoral degree in the mathematical sciences.

3. To increase the pool of mathematicians seeking to obtain employment in industry, government and academic institutions.

**Degree Programs**

The M.S. degree in mathematics can be obtained through coursework, and a Thesis or Project of original work in mathematics, or only coursework only. It is essentially a transitional degree program to a doctoral degree program in the mathematical sciences. However, it is designed to meet academic requirements for students who are interested in seeking professional degrees beyond the master’s degree level.

**Admissions Requirements**

Admission to a graduate program in mathematics requires at least 15 semester hours of undergraduate mathematics above the regular calculus sequence and the fulfillment of the admission requirement into graduate studies at Jackson State University, which is an earned Bachelor’s degree with a cumulative GPA of at least 3.0 on the 4.0 scale in all undergraduate courses taken at a regional accredited degree granting institution. GRE is not required for admission into any of the Master’s degree programs. However, students who are seeking to pursue the doctoral degree are encouraged to take the GRE exams, general and subject area, to increase their chances for competitive admission and financial assistance. These exams can be taken while students are taking courses or after they have completed all coursework.

**Transfer of Credits**

A course for which transfer credit is sought must have been completed with a grade of “B” or better. The approval of the Department is required.

**Time Limit**

Students with adequate mathematics preparation at the undergraduate level will normally take two years to complete any of the Master’s degree programs. However, all students must complete their programs within eight years of starting coursework at Jackson State University or elsewhere.

**Master of Science in Mathematics Curriculum**

The department offers programs leading to the M.S. degree in Pure or Applied Mathematics for students who plan on pursuing the doctoral degree or wish to seek careers in college or university teaching, government, industry and the business sector. The programs are designed for persons with adequate background in undergraduate mathematics beyond the calculus sequence.

To receive the M.S. degree a student must be in residence at Jackson State University for at least one semester, complete all degree requirements. If a student’s GPA upon completion of all coursework is below 3.33, then such a student is required to take and score at least 70% on a comprehensive exit exam given by the Department. This requirement is waived for students completing the degree with a Thesis or project.

**The requirements for the M.S. degree are:**   
1. Thirty-six (36) hours are required with a thesis or project, i.e. ten (10) courses plus six (6) hours for a thesis, or eleven (11) courses plus three (3) hours of a project, or only 36 hours of coursework.  
2. A “B” average with no more than one “C” grade is required for graduation.

**Required Courses**

**Course Title Hours**

Math 513 Linear Algebra I 3

Math 511 Abstract Algebra I 3

Math 531 Real Analysis I 3

Math 541 Complex Analysis I 3

Math 551 General Topology I 3

Math 561 Probability & Statistics 3

Math 599 Thesis 6

*Total Hours 24*

The student will fulfill the remaining 12 hours from mathematics electives drawn from a list of pure or applied mathematics courses to match his/her area of concentration. Courses are offered each semester to match each enrolled student’s interest. In consultation with an advisor and the department chairperson, a student must develop a study plan and select sufficient electives from departmental courses to complete degree requirements with a concentration in either pure or applied mathematics. See the list of departmental courses below. A typical study plan for a student with a concentration in applied mathematics who is seeking to pursue a doctoral degree would look like this:

**Coursework for Year One**

Fall Semester

Math 511 – Abstract Algebra I

Math 513 – Linear Algebra I

Math 531 – Real Analysis I

Spring Semester

Math 577- Ordinary Differential Equations with Applications

Math 579- Partial Differential Equations with Applications

Math 541 – Complex Analysis I

Summer Sessions

Math 599-Thesis

**Coursework for Year Two**

Fall Semester

Math 551 – General Topology I

Math 542 – Complex Analysis II

Math 535 – Real Analysis II

Math 580 – Partial Differential Equations II or Math 599 -Thesis

**Extra Coursework and Thesis Defense**

Spring Semester

Math 537 – Introduction to Functional Analysis

Math 514 – Linear Algebra II

Take the GRE both General and Subject area tests

Math 599-Thesis

**May – Receive the M.S. degree from JSU**

Recommended Elective Courses

| Math 512 Abstract Algebra II  Math 513 Linear Algebra I  Math 514 Linear Algebra II  Math 532 Real Analysis II  Math 535 Intro to Measure & Integration I  Math 536 Intro to Measure & Integration II  Math 541 Complex Analysis I  Math 542 Complex Analysis II  Math 547 Integral Equations I  Math 548 Integral Equations II  Math 561 Probability and Statistics I  Math 562 Probability and Statistics II  Math 551 General Topology I  Math 552 General Topology II  Math 581 Number Theory I  Math 582 Number Theory I | CSC 515 Data Structures and File Management  CSC 518 Principles of Operating Systems  CSC 531 Computer Simulation Methods and Models |
| --- | --- |