

COMPUTATIONAL DATA-ENABLED SCIENCES AND ENGINEERING (PH.D.)

The doctoral program in computational and data enabled science & engineering (CDS&E) 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 CDS&E and operates under the College of Science, Engineering, and Technology (CSET). The CDS&E Ph.D. program at JSU serves as a model Ph.D. program to the traditional computational and computer science fields Ph.D. programs embodying high performance computing with data science and big data analytics, long in demand by industry, government and private labs and coming into its own as 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 CDS&E program seeks to improve our ability to extract knowledge from large and complex digital data as we endeavor to meet the national imperative to accelerate discoveries in science and engineering, strengthen our national security and transform teaching and learning. ¹Transdisciplinary, multidisciplinary and interdisciplinary research is at the core of the CDS&E and hence JSU's CDS&E meets the challenges by:

1. Providing core courses that allow transitioning students from all disciplines
2. Integrating and adapting the Affinity Research Group (ARG) 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 [Such as been demonstrated as an effective means of ensuring student engagement²]

¹ <https://obamawhitehouse.archives.gov/blog/2012/03/29/big-data-big-deal> (<https://obamawhitehouse.archives.gov/blog/2012/03/29/big-data-big-deal/>)

² <https://www.computer.org/web/cspress/arg> (<https://www.computer.org/web/cspress/arg/>)

The educational objectives of the CDS&E 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, Computational Public Health Science, and Computational Science and Engineering.
- Producing high quality graduates with terminal degrees in CDS&E capable of joining the workforce in industry, academia and state or federal agencies and of becoming the future leaders in computing-centric and Big Data fields.

Specialized Tracks in CDS&E

The following Specialized Tracks are being offered:

- Computational Biology and Bioinformatics
- Computational Mathematics and Statistical Sciences
- Computational Physical Sciences
- Computational Science and Engineering
- Computational Public Health Science

Admission Requirements

To be considered for admission, the following requirements should be met:

1. Applicants must have completed the Graduate Application for Admission.
2. Applicants must have provided official copies of transcripts from all colleges/universities attended.
 - a. The applicant must have a Bachelor's or Master's degree from an accredited college or university in a STEM or Public Health Sciences, and
 - b. A minimum GPA of 3.00 (on a 4.00 scale) on the highest degree earned.
3. A satisfactory TOEFL score for international students whose native language is not English.
4. Three letters of recommendation from three professors or professionals knowledgeable of the applicant's professional academic ability, job experiences, and leadership potential.
5. A statement of purpose.

The above listed are the minimal requirements, and do not guarantee acceptance into the program.

Degree Requirements

The requirements for the Doctor of Philosophy Degree in Computational and Data-Enabled Science and Engineering are:

- A minimum of 72 credit hours beyond the Bachelor's Degree or
- A minimum of 48 credit hours beyond the Master's Degree.

These requirements are distributed as follows:

- Common Core = 12 credit hours
- Track Requirement = 12 credit hours
- Track electives = 24 credit hours
- Dissertation = Not more than 24 credit hours

For an applicant with at least a Master's Degree, the course and Dissertation credit hour requirements shall be decided by the Graduate Admissions Committee of the Ph.D. program after evaluating the applicant's transcripts and academic records.

Additional requirements include:

1. Satisfactory performance on the Comprehensive Qualifying Examination (GNST 700 APPS FOR GRAD DEG CAND DOCTORA); and
2. Satisfactory performance on the Graduate Area Comprehensive Examinations (GNST 888 GRAD COMP EXAM(DOCTORAL LEVEL)) and Successful defense of the dissertation research. The final basis for granting the degree shall be the candidate's grasp of the subject matter in a specialized track of CDS&E, and a demonstrated ability to

express thoughts clearly and forcefully in both written and oral presentations and publications in peer reviewed journals.

Comprehensive Qualifying Examination

(GNST 700 APPS FOR GRAD DEG CAND DOCTORA)

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 examination which shall consist of written examinations in each of these two areas. The two parts comprehensive qualifying examination will consist of 3 of the 4 common core courses (CSC 601 COMPUTER ALGORITHMS, CSC 620 DATABASE MANAGEMENT SYSTEMS, and STAT 661 PROBABILITY AND STATISTICS or STAT 672 COMPUTATIONAL STATISTICS) as Part I, and all the 4 required courses for the chosen track as Part II. A good performance 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.

A Comprehensive qualifying examination will normally be scheduled at the beginning of the spring semester and once during the summer. To show satisfactory progress in his/her graduate studies, a student is normally 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 as recommended by the faculty advisory committee.

Graduate Area Comprehensive Examination (GACE)

When the comprehensive qualifying examination has been passed, the Graduate Advisory Committee is formed. The Doctoral Committee and mentor are selected with the 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 core courses as well as an in-depth examination in the track. It will be administered by the student's doctoral committee and must contain an oral component. Pass or fail will be determined by majority vote of the committee. The oral component of the examination is open to members of the faculty.

The Dissertation

After the GACE has been passed, the student's doctoral committee will be reconstituted to form the dissertation committee. The student and the major professor of the doctoral committee will select the student's dissertation committee, subject to the approval of the CDS&E Ph.D. Advisory Committee. The dissertation committee will consist of at least five graduate faculty members, including a major professor and at least three additional graduate faculty members from the other concentration tracks, including an external member. 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 work that makes a significant contribution to the student's area of specialization. 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 examiner for the dissertation. This person will read the dissertation and submit written comments regarding its quality and significance to the student's committee. It is highly recommended that at least two publications in professionally refereed journals be resulted from the dissertation.

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.

After consultation with the CDS & E 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. In making its decision, the committee will give due consideration to the external examiner's assessment of the dissertation and the refereed publications that resulted from the dissertation.

Requirements for Students Who Hold a Master's Degree (in Mathematics/Computer Science/Engineering) – A Minimum of 48 Credit Hours

These students 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 CDS & E 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 CDS&E 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 CDS&E discipline 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:

- Completed the formal coursework with a GPA of 3.0 or better.
- During the first two semesters of study, students are required to attend CDSE 700 SEM N COMP DATA SCI & ENG (focus on ARG and understanding of the profession)
- 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 third 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.
- 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 DISSERTATION RESEARCH-continuation of the ARG model implementation engaging student weekly presentations and their faculty advisors.
- Complete all the required course work with at least 6 credit hours of internship or research experience at a High-Performance Computing Facility or Laboratory, or as on campus training with IT. Obtain the **IRB approval or exemption**, if applicable.
- Form a dissertation committee and submit a dissertation proposal.
- Complete the Graduate Area Comprehensive Examination.
- Follow the guidelines for preparing a Doctoral Dissertation from the Division of Graduate Studies.
- Submit preliminary copies of the dissertation to the committee.
- Schedule the Dissertation Defense.
- Public announcement of Dissertation Defense.
- Submit Committee Report of Dissertation Defense to Graduate Studies-(Follow Graduate Studies Deadlines).
- Submit Final Draft of the dissertation to the Chairperson of the committee and committee members.
- Final Submission of Corrected (or proofed) Dissertation before final graduation clearance deadline.
- Removal of "Incomplete" or "In-Progress" Grades.
- Apply for Online Graduation Clearance- Follow the University Deadlines-Registrar.
- Participate in the Commencement Exercises-Optional.

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.

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 CDS & E Ph.D. program. However, all students must complete their programs within five years of becoming a candidate for the CDS&E Ph.D. degree.

Curriculum

Requirements for Students with a Bachelor's Degree

Code	Title	Hours
Common Core		12
Track Requirements		12
Track Electives		24
Dissertation ¹		24
Total Hours		72

¹ At most 24 credit hours.

Total = 72 credit hours: *Minimum requirements; additional requirements may be recommended by the Doctoral Committee*

Computational Biology and Bioinformatics Track

Code	Title	Hours
Common Core Courses		
CSC 552	APPLIED PROGRAMMING	3
CSC 601	COMPUTER ALGORITHMS	3
CSC 620	DATABASE MANAGEMENT SYSTEMS	3
STAT 672	COMPUTATIONAL STATISTICS	3
or STAT 661	PROBABILITY AND STATISTICS	
Track Requirements		
CSC 651	FNDS OF PROGRAMMING & COMP SYS	3
BIO 509	GENERAL GENETICS	3
BIO 540	CELL BIOLOGY	3
BIO 679		3
Elective Courses		
Select 24 hours of electives. A sample list is as follows: ¹		24
BIO 615	PRINCIPLES OF BIOREMEDIATION	
BIO 623	SYMS BIO & SIGNALING NETWORKS	
BIO 689	ADVD TPCS IN COMPUTATIONAL BIO	
CDSE 700	SEM N COMP DATA SCI & ENG	
CDSE 701	INT N COMP DATA SCI & ENG	
CDSE 702	CURRENT TRENDS IN CDS&E	
Dissertation		
Select a total of 24 hours of the following:		24
CDSE 899	DISSERTATION RESEARCH	
Total Hours		72

¹ Elective Courses will be approved by the students graduate committee. A sample list of elective courses for this track is as follows.

Computational Mathematics and Statistical Sciences Track

Code	Title	Hours
Common Core Courses		
CSC 552	APPLIED PROGRAMMING	3
CSC 601	COMPUTER ALGORITHMS	3
CSC 620	DATABASE MANAGEMENT SYSTEMS	3

STAT 672	COMPUTATIONAL STATISTICS	3
or STAT 661	PROBABILITY AND STATISTICS	

Track Requirements

MATH 670	COMPUTATIONAL METHODS N MATH I	3
MATH 671	COMPUTATNL METHODS IN MATH II	3
STAT 661	PROBABILITY AND STATISTICS	3
MATH 673	QUANTITATIVE EXPLORATN OF DATA	3

Track Electives

Select 24 hours of the following. A sample list of elective courses are as follows: ¹ 24

CSC 511	OBJECT-ORIENTED PROGRAMMING	
MATH 700	TPCS N MATH & STATS A N CDS&E	
MATH 543	NUMERICAL ANALYSIS	
MATH 571	NUMERICAL ANALYSIS I	
MATH 577	ORDINARY DIF EQUATIONS I	
MATH 578	ORDINARY DIF EQUATION II	
MATH 628	ADVD PARTIAL DIFF EQUATIONS I	
MATH 629	ADVND PARTIAL DIF EQUATIONS II	
STAT 680	CMPTNL DATA ANLYSIS & VISUAL I	
CDSE 700	SEM N COMP DATA SCI & ENG	
CDSE 701	INT N COMP DATA SCI & ENG	
CDSE 702	CURRENT TRENDS IN CDS&E	

Dissertation

Select a total of 24 hours of the following: 24

CDSE 899	DISSERTATION RESEARCH	
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Total Hours 72

¹ Elective Courses will be approved by the student's graduate committee. A sample list of elective courses for this track are as follows.

Computational Physical Sciences Track

Code	Title	Hours
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Common Core Courses

CSC 552	APPLIED PROGRAMMING	3
CSC 601	COMPUTER ALGORITHMS	3
CSC 620	DATABASE MANAGEMENT SYSTEMS	3
STAT 672	COMPUTATIONAL STATISTICS	3
or STAT 661	PROBABILITY AND STATISTICS	

Track Requirements

CSC 651	FNDS OF PROGRAMMING & COMP SYS	3
CHEM 768	MOLECULAR QUANTUM MECHANICS	3
PHY 522		3
PHY 533		3

Track Electives

Select 24 hours from the following: 24

CHEM 734	PHYSICAL BIOCHEMISTRY	
CHEM 752	ATOMIC & MOLECULAR SPECTROSCRO	
CHEM 758	QUANTUM CHEMISTRY	
CHEM 787	NANOSCIENCE AND NANOTECHNOLOGY	
CDSE 700	SEM N COMP DATA SCI & ENG	
CDSE 701	INT N COMP DATA SCI & ENG	
CDSE 702	CURRENT TRENDS IN CDS&E	

Dissertation

Select at most 24 hours of the following: 24

CDSE 899	DISSERTATION RESEARCH	
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Total Hours 72

Computational Science and Engineering Track

Code	Title	Hours
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Common Core Courses

CSC 552	APPLIED PROGRAMMING	3
CSC 601	COMPUTER ALGORITHMS	3
CSC 620	DATABASE MANAGEMENT SYSTEMS	3
STAT 672	COMPUTATIONAL STATISTICS	3
or STAT 661	PROBABILITY AND STATISTICS	

Track Requirements

CSC 511	OBJECT-ORIENTED PROGRAMMING	3
CSC 571	PROGRAMMING FOR BIG DATA	3
CSC 621	MACHINE LEARNING	3
CSC 641	NETWORK SCIENCE	3

Track Electives

Select 24 hours of electives. A sample list of elective courses are as follows: ¹ 24

CSC 537	CLOUD COMPUTING	
CSC 582	SOCIAL NETWORK ANALYSIS	
CSC 634	BIG DATA MINING	
CDSE 701	INT N COMP DATA SCI & ENG	
CDSE 702	CURRENT TRENDS IN CDS&E	

Dissertation

Select at most 24 hours of the following: 24

CDSE 899	DISSERTATION RESEARCH	
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Total Hours 72

¹ Elective Courses will be approved by the student's graduate committee. A sample list of elective courses for this track are as follows.

Computational Public Health Science Track

Code	Title	Hours
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Common Core Courses

CSC 552	APPLIED PROGRAMMING	3
CSC 601	COMPUTER ALGORITHMS	3
CSC 620	DATABASE MANAGEMENT SYSTEMS	3
STAT 672	COMPUTATIONAL STATISTICS	3
or STAT 661	PROBABILITY AND STATISTICS	

Track Requirements

CSC 751		3
PHS 701	ADV BIostatISTICS & COMPTR SCI	3
PHS 707	LEADERSHIP FOR PHS PROFESSNLS	3
PHEP 711	BEHAVIORAL & PSYCHOSOC EPIDEM	3

Elective Courses

Select 24 hours of electives. A sample list of elective courses are as follows:¹ 24

PHS 505	PRINCIPLES OF EPIDEMIOLOGY
PHS 506	RESEARCH & QUANTITATIVE MTHDS
PHS 531	HEALTH BEHAVIOR,PROMOTION & ED
PHS 703	DESGNG RES STUD ON MIN&SPEC PO
PHS 705	ADVOCACY AND PUBLIC HLTH POLIC
PHS 706	PRIN OF ENVMNTAL & OCCU HLTH
ENV 702	ENVIRONMENTAL HEALTH
ENV 720	ENVNMNTL & OCCUPATION HEALTH
ENV 717	INTRO TO REMOTE SENSING
ENV 718	REMOTE SENSING APPLIED
ENV 751	WATERQUALITY MANAGEMENT
ENV 755	AIR QUALITY MANAGEMENT
ENV 800	ENVIRONMENTAL TOXICOLOGY
ENV 801	RISK ASSESSMENT&MANAGMNT
CDSE 700	SEM N COMP DATA SCI & ENG
CDSE 701	INT N COMP DATA SCI & ENG
CDSE 702	CURRENT TRENDS IN CDS&E

Dissertation

Select at most 24 hours of the following: 24

CDSE 899	DISSERTATION RESEARCH
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Total Hours 72

¹ Elective Courses will be approved by the student's graduate committee. A sample list of elective courses for this track are as follows.