**MORGAN STATE UNIVERSITY**

**\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_Computer Science Department\_\_\_\_\_\_\_\_\_\_\_\_**

*Name of academic unit*

**Curriculum Committee**

PROPOSAL FOR A COURSE

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| 1. **Course Number, Title and Number of Credits:**   **Course Number: COSC xxx**  **Course Title: I**ntroduction to Quantum Computing  **Number of Credit Hours: 3** |

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| **2. Number of Contact Hours:**  **Lecture: \_\_\_\_\_3\_\_\_\_\_\_\_ Laboratory \_\_\_\_\_\_0\_\_\_\_\_\_\_** |

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| 1. **Catalog Description:**   **COSC xxx Introduction to Quantum Computing** – *Three hours of lecture, 3 credits*.  Quantum computation involves highly parallel systems devoted toward solving problems considered to be computationally difficult for classical computers. This course introduces basic mathematical and programming structures necessary for understanding and implementing basic quantum circuits. Key concepts such as quantum measurement, projections, reversible computation, unitary operators, entanglement, quantum gates, gate equivalences, density matrix and the no-cloning theorem will be emphasized within the course.  **Prerequisite:** COSC 241 or equivalent, Quantum Mechanics for Computing Scientists |

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| 1. **Course Objectives (Broad Objectives of the Course):**   Upon completion of this course, students will be able to do the following:   * **Describe** the computational complexity of quantum circuits for implementing various quantum algorithms. * **Analyze** quantum circuits employing quantum operators. * **Demonstrate** skills by implementing and coding quantum algorithms. |

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| 1. **Course Content (Statement of Subject Matter):**   **Unit 0:** Review of complex numbers and quantum concepts  **Unit 1:** Complex vector spaces and quantum operators  **Unit 2:** Introduction to Qiskit and single qubit circuits  **Unit 3:** Multiple qubit circuits and entanglement  **Unit 4:** Random number generation  **Unit 5:** Addition on a quantum computer  **Unit 6:** Deutsch-Jozsa algorithm  **Unit 7:** Quantum Fourier transform  **Unit 8:** Addition using the QFT  **Unit 9:** Phase estimation  **Unit 10:** Quantum computation project |

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| 1. **Relationship to Curriculum Sequence (Elective or Required; Need):**   This is an elective course for the BS in Computer Science program. |

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| 1. **Relationship to Similar Course Offerings in Other Departments:**   None. |

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| 1. **Bibliography:**   Course deliverables: lectures, notes, tutorials will be provided according to the topics covered.   * Introduction to Quantum Computing. Ray LaPierre. Springer. ISBN-13: 978-3030693176, 2021. * Quantum Computation and Quantum Information, M.A. Nielsen and I.L.Chuang, 10th Anniversary Edition. Cambridge. ISBN-13 ‏ : ‎ 978-1107002173, 2011. |

**Note: A course outline and course syllabus must be submitted with this form.**

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| **Approved by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  *Department Curriculum Chairperson Date*  **Approved by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  *Department Chairperson Date*  **Approved by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  *Chairperson, School Curriculum Committee Date*  **Approved by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  *Dean/Director Date*  **Approved by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  *Office of the Vice President for Academic Affairs Date* |