INDIAN INSTITUTE OF INFORMATION TECHNOLOGY
DESIGN AND MANUFACTURING (IIITDM) KANCHEEPURAM

COURSE FORMAT

<table>
<tr><td>Course Code</td><td>(to be filled by Office of Acad.)</td><td>Course Title</td><td colspan="4">Quantum Computing and Technology</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE/Dr. Tejendra Dixit</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">M.Tech/PhD</td><td>Type</td><td colspan="2">Core ☐</td><td colspan="2">Elective ▬</td></tr>
<tr><td>Status</td><td colspan="2">New ▬</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>Introductory Quantum Science, Linear Algebra</td><td colspan="3">Submitted for approval</td><td colspan="2">Mention Senate Number</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• Understand key quantum concepts such as superposition and entanglement.
• Build and simulate quantum circuits and algorithms using Qiskit and QuTiP.
• Understand quantum computing architecture, gates, and hardware design.
• Explore applications in quantum machine learning and emerging quantum technologies.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will be able to
• Understand and apply foundational quantum principles to quantum circuits, algorithms, and architecture.
• Use quantum programming tools to simulate algorithms and explore applications in quantum machine learning and technology.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">• Quantum Terminology: Hilbert Space, Uncertainty, Hamiltonian, Schrodinger's equation, Quantum states, Dirac notations, Entanglement and Superposition, (6L+2T)
• Quantum Architecture: Qubits, Bloch Sphere, Quantum Gates and Quantum Circuits (6L+2T)
• Introduction to Qiskit and QuTiP tools (3L+3T)
• Quantum Algorithms with applications: Deutsch's algorithms, Grover's algorithm, Bernstein-Vazirani algorithm, Shor's algorithm, Simon's algorithm (6L+2T)
• Quantum Hardware and Design of Quantum Computer (6L+2T)
• Quantum Neural Networks and Quantum Machine Learning (6L+1T)
• Quantum Technology and Applications: Superconducting Quantum Circuits, Semiconductor-Superconductor Devices for Quantum Technologies (9L+2T)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Chuck Easttom, Quantum Computing Fundamentals, 2nd Edition, Pearson, ISBN: 978-93-560-6259-7, 2024
2. Alto Osada, Rekishu Yamazaki, Atsushi Noguchi, Introduction to Quantum Technologies, 1st Edition, Springer Singapore, ISBN: 978-981-19-4641-7, 2022</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Michael A. Nielsen & Isaac L. Chuang, Quantum Computation and Quantum Information, 10th Edition, Cambridge University Press, UK, ISBN: 978-1-107-00217-3, 2010.
2. Robert Loredo, Learn Quantum Computing with Python and IBM Quantum Experience, 1st Edition, Packt Publishing Ltd., ISBN 978-1-83898-100-6, 2020
3. Eleanor G. Rieffel and Wolfgang H. Polak, Quantum Computing: A Gentle Introduction, 8th Edition, MIT Press, USA, ISBN-13: 978-0262526678, 2011.
4. David J. Griffiths, Introduction to Quantum Mechanics, 3rd edition, Cambridge University Press, 2024.</td></tr>
</table>

Details to be submitted by the HoD to the Office of Academics for proposing a course to the Senate