**MADAN BHANDARI
UNIVERSITY OF
SCIENCE AND TECHNOLOGY**

**Chitlang, Thaha Municipality Ward 9, Bagmati Province, Nepal**

# Curriculum

# Graduate Programs in

# Data Science

**September 2024**

# 1. Program Description

The program in Data Science is a research-based graduate program that aims to provide students with advanced knowledge and research skills in the field of data science. In this program, students will embark on a journey to explore data science, from foundational concepts to cutting-edge research. Through a blend of core courses, electives, and research, students will engage in deep learning and application of data science principles, culminating in the completion of an original research thesis. This program is structured to nurture critical thinking, problem-solving, and ethical research practices in data science.

## 1.1. Aims
1. **Knowledge Advancement:** To provide students with a comprehensive understanding of data science principles, methodologies and emerging trends, which enables them to become experts in the field.
2. **Research Excellence:** To foster an innovative and research-oriented culture that enables students to carry out independent studies and contribute to the data science field.
3. **Interdisciplinary Learning:** Through multidisciplinary study and collaboration, an integrated perspective of data science's applications and impact on society is established.
4. **Professional and Academic Development:** To prepare students for both research and industry roles in data science, equipping them with expertise in diverse career paths of data science.

## 1.2. Objectives
1. Implement machine learning algorithms to solve real-world data science problems.
2. Evaluate and compare the performance of machine learning models and choose appropriate techniques for specific tasks.
3. Conduct advanced statistical analysis to derive insights from data.
4. Critically assess and apply ethical guidelines and research methods to ensure the validity of data science research.
5. Create novel research contributions in the field of data science through the Master's thesis.

# 2. Eligibility and Selection Criteria

Student selection will be based on academic credentials, research statement, personal statement, referee's feedback, interview etc.

### A. Master of Applied Sciences

- 4-year Bachelor's degree in science/engineering/technology fields from recognized universities with CGPA of 2.75 out of 4.0 (or international equivalent)
- Applicants with demonstrable good programming skills, a strong mathematical background, and knowledge of algorithms is preferable.
- List of publication if applicable.

## B. PhD

- Master's in Engineering/Technology/Science fields from recognized universities with CGPA of 3.0 out of 4.0 (or international equivalent)
- Applicants with demonstrable good programming skills, a strong mathematical background, and knowledge of algorithms is preferable.
- List of publication if applicable.

3. **Courses**
    ### A. Core courses

| S. No. | Course code | Course title | Credit |
|--------|-------------|--------------|--------|
| 1 | DS-CR-501 | Programming for Data Science | 2 |
| 2 | DS-CR-502 | Data Analytics and Visualization | 3 |
| 3 | DS-CR-503 | Machine Learning for Data Science | 3 |
| 4 | DS-CR-504 | Research Methods for Data Science | 1 |
| 5 | DS-CR-550 | Data Engineering and Architecture | 2 |
| 6 | DS-CR-551 | Deep Learning | 3 |
| 1 | GC-CR-501 | Development Policy | 3 |

### B. Non-Credit Compulsory Courses

| S.N. | Course code | Course title | Credit |
|------|-------------|--------------|--------|
| 2 | GC-NC-550 | Entrepreneurship, Scientific Communication and Leadership (4 hours) | 0 |

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## C. Technical Elective Courses

| S. No. | Course Code | Course Title | Credit |
|--------|-------------|--------------|--------|
| 1 | DS-EL-561 | Generative AI and Applications | 2 |
| 2 | DS-EL-562 | Text Mining and Information Retrieval | 2 |
| 3 | DS-EL-563 | Human-Computer Interaction | 2 |
| 4 | DS-EL-564 | AI in IoT | 2 |
| 5 | DS-EL-565 | AI in Agriculture | 2 |
| 6 | DS-EL-566 | AI in Climate | 2 |
| 7 | DS-EL-567 | AI in Tourism | 2 |
| 8 | DS-EL-568 | Social Network Analysis | 2 |
| 9 | DS-EL-569 | Healthcare Analysis | 2 |
| 10 | AI-EL-570 | Signal processing for music information retrieval | 2 |

## 4. Course Framework

**Master of Applied Sciences in Data Science**
Duration of the course: 2 years

| Semester I | | | Semester II | | |
|------------|--------------|--------|-------------|--------------|--------|
| Course Code | Course Title | Credit | Course Code | Course Title | Credit |
| DS-CR-501 | Programming for Data Science | 2 | DS-CR-550 | Data Engineering and Architecture | 2 |
| DS-CR-502 | Data Analytics and Visualization | 3 | DS-CR-551 | Deep Learning | 3 |
| DS-CR-503 | Machine Learning for Data Science | 3 | DS-EL-561~570 | Elective I | 2 |

| Course Code | Course Title | Credit | Course Code | Course Title | Credit |
|---|---|---|---|---|---|
| DS-CR-504 | Research Methods for Data Science | 1 | DS-EL-561~570 | Elective II | 2 |
| GC-NC-550 | Entrepreneurship, Scientific Communication and Leadership (4 hours) | 0 | GC-CR-501 | Development Policy | 3 |
| | | | DS-TH-699 | Thesis | 4 |

| Semester III | | | Semester IV | | |
|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Credit** | **Course Code** | **Course Title** | **Credit** |
| DS-TH-699 | Thesis | 13 | DS-TH-699 | Thesis | 13 |

Total credit hours for thesis = 30; total credit hours for core and elective courses not less than 20.

**PhD in Data Science**
Duration of the course: 3 years

| Semester I | | | Semester II | | |
|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Credit** | **Course Code** | **Course Title** | **Credit** |
| DS-CR-501 | Programming for Data Science | 2 | DS-CR-550 | Data Engineering and Architecture | 2 |
| DS-CR-502 | Data Analytics and Visualization | 3 | DS-CR-551 | Deep Learning | 3 |

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| Course Code | Course Title | Credit | Course Code | Course Title | Credit |
|---|---|---|---|---|---|
| DS-CR-503 | Machine Learning for Data Science | 3 | DS-EL-561~570 | Elective I | 3 |
| DS-CR-504 | Research Methods for Data Science | 1 | DS-EL-561~570 | Elective II | 3 |
| GC-NC-550 | Entrepreneurship, Scientific Communication and Leadership (4 hours) | 0 | GC-CR-501 | Development Policy | 3 |
| | | | DS-TH-699 | Thesis | 4 |

| Semester III | | | Semester IV | | |
|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Credit** | **Course Code** | **Course Title** | **Credit** |
| DS-EL-561~570 | Elective III | 2 | DS-EL-561~570 | Elective IV | 2 |
| DS-TH-699 | Thesis | 12 | DS-TH-699 | Thesis | 12 |

| Semester V | | | Semester VI | | |
|---|---|---|---|---|---|
| DS-TH-699 | Thesis | 11 | DS-TH-699 | Thesis | 11 |

Total credit hours for thesis = 50; total credit hours for core and elective courses not less than 25.

## 5. Timeline
**Master of Applied Science in Data Science**

| Semester I | Semester II | Semester III | Semester IV |
|---|---|---|---|
| • 4 Core Course<br>• 1 Non-Credit Course | • 3 Core Course<br>• 2 Technical Elective<br>• Thesis proposal submission and research initiation | • Thesis work<br>• Thesis Progress Presentation | • Thesis work<br>• Thesis Defense |

## PhD in Data Science

| Semester I | Semester II | Semester III | Semester IV | Semester V | Semester VI |
|---|---|---|---|---|---|
| • 4 Core Course<br>• 1 Non-Credit Course | • 3 Core Course<br>• 2 Technical Elective<br>• Thesis proposal submission and research initiation | • 1 Technical Elective<br>• Thesis work<br>• Thesis Progress Presentation | • 1 Technical Elective<br>• Thesis work<br>• Thesis Progress Presentation | • Thesis work<br>• Thesis Progress Presentation | • Thesis work<br>• Thesis Defense |

## 6. Evaluation System (Grade Descriptors)

| Numerical Score Band (%) | Letter Grade | Grade Point | Explanation |
|---|---|---|---|
| 96 and above | A+ | 4.0 | Outstanding |
| 84 and below 96 | A | 3.6 | Excellent |
| 72 and below 84 | B | 2.8 | Good |
| 60 and below 72 | C | 2.0 | Satisfactory |
| 50 and below 60 | D | 0.0 | Certificate of attendance |
| | F | 0.0 | Fail |

**Evaluation of Course Work**

| Item | Assignments (Five) | Mid-term examination | Final examinations | All |
|---|---|---|---|---|
| Weightage % | 35 | 15 | 50 | 100 |

## 7. Course Description

| Course code | Course Title | Description |
|---|---|---|
| DS-CR-501 | Programming for Data Science | <ul><li>Introduce the fundamental concepts of programming with a focus on data science</li><li>Learn the basics of coding, data structures, and data manipulation to prepare them for more advanced data science coursework.</li><li>Create code to solve practical data science problems through hands-on assignments.</li></ul> |
| DS-CR-502 | Data Analytics and Visualization | <ul><li>Explores the fundamental principles and practices of data analytics and visualization.</li><li>Learn how to collect, clean, analyze, and visualize data to extract valuable insights and communicate their findings effectively.</li><li>Descriptive and inferential statistical analysis.</li><li>Study Data mining algorithms for Regression, Time Series Analysis, and Classification Data</li><li>Each student or team selects a dataset, conducts an analysis, and creates a data visualization project.</li><li>Project presentations and peer evaluations.</li></ul> |
| DS-CR-550 | Data Engineering and Architecture | <ul><li>Gain an in-depth understanding of data modelling, data storage, data processing, and the design of scalable data architectures.</li><li>Break down data engineering problems and architectural designs into their constituent components.</li><li>Generate original data engineering and architectural designs for specialized data ecosystems.</li><li>Construct innovative solutions to complex data engineering</li></ul> |

| Course code | Course Title | Description |
| --- | --- | --- |
| | | and architectural challenges. |
| DS-CR-503 | Machine Learning for Data Science | • Explores the theory and practice of statistical machine learning.<br>• Students will gain a deep understanding of various machine learning algorithms, their statistical foundations, and practical applications.<br>• Each student or team selects a real-world dataset and applies machine learning techniques to solve a problem.<br>• Project presentations and peer evaluations. |
| DS-CR-551 | Deep Learning | • Explores the theory and practice of deep learning, a subset of machine learning that focuses on neural networks with multiple layers.<br>• Students will gain expertise in building, training, and applying deep learning models to various tasks, including image recognition, natural language processing<br>• Each student or team selects a real-world dataset and applies deep learning techniques to solve a problem.<br>• Project presentations and peer evaluations. |
| DS-CR-504 | Research Methods for Data Science | • Learn to apply research methods such as theoretical/empirical/exploratory research, modelling in the context of data science.<br>• Describe various data collection methods, both quantitative and qualitative.<br>• Interpret statistical and computational techniques used in data analysis for research.<br>• Generate original research proposals and hypotheses in the data science domain.<br>• Develop strong critical thinking skills, the ability to design and conduct data-driven research, and the capacity to communicate their findings effectively. |
| DS-TH-699 | Thesis | • Independent research under the guidance of a faculty advisor.<br>• Original research contribution in the field of data science. |

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