ACADEMIC PROGRAM PROPOSAL FORM

(*Revised: January 2021*)

DIRECTIONS: *Use this form when proposing a new major or primary field of study, new emphasis (BAS only), or new degree or certificate (30+credits) program.* ***For more detail on the NSHE program approval process, see the last page of this form.***

DATE SUBMITTED: 5/21/2024

Date of AAC Approval:	
06-05-24	

INSTITUTION: University of Nevada, Reno

Date of Board Approval:

REQUEST TYPE:

- ☐ New Degree
- ☒ New Major or Primary Field of Study
- ☐ New Emphasis (BAS only)

DEGREE: Check applicable box

- ☐ Certificate: 30+ Credits
- ☐ Associate of Science (AS)
- ☐ Associate of Applied Science (AAS)
- ☐ Bachelor of Arts (BA)
- ☒ Master of Science (MS)
- ☐ Doctor of Philosophy (Ph.D.)
- ☐ Associate of Arts (AA)
- ☐ AA/AS
- ☐ Bachelor of Applied Science (BAS)
- ☐ Bachelor of Science (BS)
- ☐ Master of Arts (MA)
- ☐ Other or Named Degree:_____

MAJOR OR PRIMARY FIELD OF STUDY (i.e. Animal Science): Robotics

INCLUDED IN THE NSHE PLANNING REPORT: ☒ **Yes** ☐ No
(Website for NSHE Planning Reports: . https://nshe.nevada.edu/system-administration/departments/asa/reports/planning/

TOTAL NUMBER OF CREDITS TO PROGRAM COMPLETION: 30

PROPOSED SEMESTER/TERM OF IMPLEMENTATION: Spring 2025

Action requested (specify full program title):

The University of Nevada, Reno requests approval of a new Master of Science in Robotics degree program

A. Brief description and purpose of proposed program. For proposed certificates (30+ credits), provide any existing degree or program under which the certificate falls.

Currently, there is no robotics graduate program at UNR. We are proposing a new program in robotics. The multi-disciplinary Robotics M.S. degree will prepare students from a wide range of

disciplines for successful research and industrial careers. This will help to advance the teaching goals of the robotics faculty at UNR and allow for more focused recruitment ofo robotics students, contributing to a globally competitive education. This new Robotics M.S. program will teach students to understand the kinematics and dynamics of the physical systems, component design, sensing/actuation and computation for state-of-the-art robotic systems in order to better train Engineering students in the fundamentals of robotics and prepare them for advanced Ph.D. research or careers outside of academia. Students will have the opportunity to tailor their graduate education to focus on particular interests while working with a broad team of mentors from multiple departments. The creation of a Masters of Science of in Robotics degree will broaden the educational impact of the College of Engineering and broaden the opportunities for students.

This program will teach students to understand the kinematics and dynamics of the physical systems, component design, sensing/actuation and computation for state-of-the-art robotic systems. Graduate students seeking the degree of Master of Science are given the opportunity to focus on an interdisciplinary course of study in robotics and perform research through the Thesis option (Plan A) or to study several different subjects in robotics through the Courses-Only option (Plan B).

B. Provide a list and description of institutionally approved expected student learning outcomes

Student Learning Objective (SLO):

SLO 1: Students will demonstrate an ability to apply robotics research and theory to advance the art, science and practice of the discipline.

SLO 2: Students will demonstrate an ability to design and conduct experiments as well as to analyze, interpret, apply and disseminate the data.

SLO 3: Students will demonstrate an understanding of fundamental research methodologies and potential applications of robotic systems.

C. Provide an institutionally approved plan for assessing student learning outcomes

Courses-only masters students will demonstrate their knowledge in robotics by completing a program of study in robotics that incorporates both breadth and depth in robotics knowledge. The program of study will include certain required courses and elective courses, many of which are interdisciplinary, and will also include a substantial fundamental research component that is related to robotics.

Thesis masters students will further demonstrate comprehensive knowledge in robotics by completing a unique program of study that is developed in consultation with their advisor(s) and members of their thesis committee. The research is expected to advance the current knowledge base in robotics. The results of the research will be presented in a M.S. thesis, from which one or more scholarly articles will be published in professional research conferences or journals.

D. Contribution and relationship of program objectives to

i. NSHE Master Plan / Strategic Goals

a. Access – ***Increase participation in postsecondary education***

The Robotics M.S. will provide access to graduate-level studies in robotics sensing, computation, and actuation from Computer Science & Engineering, Mechanical Engineering, and Electrical and Biomedical Engineering perspectives for students hoping to pursue careers in robotics while still allowing them to leverage their disciplinary engineering skills and mindsets.

b. Success – ***Increase student success***

The Robotics M.S. will serve as a robust independent graduate degree. Further, research-driven results from this program will serve to increase the research and teaching capacity across the participating departments and raise the standards for performance in the College of Engineering.

- The Robotics MS degree will supplement existing graduate degrees offered by the College of Engineering that can lead to a successful career in robotics. However, this degree will facilitate interdisciplinary study more easily and effectively than prior degrees. To help with this process, the robotics faculty will conduct regular reviews to assure that required and core courses will effectively prepare students for interdisciplinary study.
- Each MS student will receive a robotics faculty advisor who will guide them with course selection, identifying relevant research areas, and to help monitor the program for necessary changes. We will also use an career advisory board made up of both faculty to represent research careers and industry members who will help shape the program based on robotics industry needs.

c. **Close the Achievement Gap –** ***Close the achievement gap among underserved populations***

Initial evidence indicates that this program is of high interest to traditionally underserved students as it has included students who identify across a broad range of demographic identifiers including women, students from racial/ethnic groups traditionally minoritized in computing, and socio-economic statuses. Graduates of the program will have the foundational knowledge to be highly successful in the workforce and in academia, setting them up to be examples and mentors for the next generation workforce.

d. Workforce – ***Collaboratively address the challenges of the workforce and industry education needs of Nevada***

The NSHE Master Plan calls for a Robotics M.S., acknowledging the potential for students with advanced robotics training. Engineering jobs offer significantly greater opportunities for individual economic advancement and development of the State compared to careers in other fields (Nevada Governor's Office of Science, Innovation, and Technology, 2019). Graduates may also create robotics companies to create robotics solutions for homes, offices, schools, or factories.

e. Research – ***Co-develop solutions to the critical issues facing 21st century Nevada and raise the overall research profile***

The Robotics M.S. program will attract outstanding students. Students in this program will join successful and established research teams studying critical problems facing engineering and society at large. Graduates will raise the research profile of the College of Engineering while growing the pool of well-educated citizens prepared to address the grand challenges facing society (National Academies of Engineering, 2019). Graduates will learn about the social context of engineering, engineering education, and engineering design and bring a holistic perspective to solving the complex issues facing Nevada and the 21st Century.

ii. Institutional mission and core themes

The Robotics M.S. will produce competent and confident leaders inspired by UNR's land-grant foundation that has always and must always connect the University to the growing and changing needs of the people of Nevada. The programmatic design supports each of the three core values of the Institution are addressed below:

Learning: Students will develop a robust knowledge of how to design, implement, and study robotic systems. This degree will include a focus on the core robotics components of sensing, actuation, and computation. These core robotics themes will be built across the major departments participating in the MS program, CSE, ME, and EBME.

Discovery: Graduate students enrolled in this M.S. will have the option through independent study, professional paper, internship, or thesis courses to conduct foundational research to develop and implement robotics innovations in engineering. Findings will be communicated to broader audiences in Nevada and nationally through refereed robotics journals and conferences.

Engagement: This institutional robotics program will help address workforce needs in the statewide Science and Economic Plan. The institution's plan stresses the importance of STEM degrees, especially those that align with manufacturing, robotics, and battery development. This degree will help with all three of these key areas. Additionally, K-12 robotics competitions are a key component of the state education strategy for STEM adoption and inclusion. This program will provide more training resources for that effort as well.

iii. Campus strategic plan and/or academic master plan

The Robotics M.S. strengthens campus strategic plan Goals 3 (Lead for Nevada), 4 (Transform the World), and 6 (Expand the Wolf Pack Impact) through its activities.

For Goal 3, the campus strategic plan wants activities that “3B. Emphasize career preparedness across the academic curriculum and within advising to bridge skill gaps for students,” “3E. Identify opportunities to expand offerings, both degree and non-degree, to serve Nevada’s education, creative and workforce development needs,” and “3F. Enhance the growth of an entrepreneurial ecosystem by collaborating with industry and government agencies to accelerate economic and workforce development in Nevada.” This M.S. program will enhance all 3 sub-goals by providing students and faculty a programmatic connection to robotics careers and enhance focus on student training and advisement for those industries. The planned industrial advisory board will help maintain a connection for both graduating students and faculty to the current job market in robotics and help steer the program to the benefit of the students’ employment prospects.

Finally, as a workforce development goal the Robotics M.S. will serve as an upskilling/retraining program meeting “6D. Assess opportunities to better serve alumni and improve the University’s continued investment in the Wolf Pack post-graduation through lifelong learning and other engagements”. We will work with local industry to identify training needs for engineers trained and currently employed who need to gain expertise in robotics and provide a program that can serve as a training resource for workforce development from engineers who are currently employed.

iv. Other programs in the institution

Many of the graduate courses that are developed or improved as a result of this program will also be of use to Computer Science & Engineering, Mechanical Engineering, and Electrical and Biomedical Engineering graduate programs as well. As it stands, the current configuration of the Robotics M.S. degree leverages existing courses. We hope to reduce robotics course overlap across departments and facilitate more cross-disciplinary collaboration in teaching of robotics across all constituent departments. While this program will be currently offered from existing courses at UNR, the improved collaboration will likely spur more collaboration across departments in creating new courses to address the state-of-the-art in this quickly evolving and interdisciplinary topic. These developments will also serve to strengthen related programs in Computer Science & Engineering, Mechanical Engineering, and Electrical Engineering and their preparation of students for the workforce of the future.

v. Other related programs in the System

Currently, there are no other graduate degree programs within NSHE focused on robotics. There are related programs such as minors in Advanced Manufacturing and Unmanned Autonomous Systems, but no graduate degree programs in robotics currently exist.

vi. If the program was not included in the NSHE Planning Report, please explain why.

The program was included in the NSHE planning report for 2023-2027.

E. Evaluation of need for the program

i. The need for the program and the data that provides evidence of that need

The need for the addition of a Robotics MS program at the University of Nevada, Reno (UNR) is firmly grounded in the growing demand for robotics expertise in several industries. Several data points highlight the significance of this program and its potential impact:

- Industry Demand: Labor market data reveals a consistent rise in job postings for robotics-related positions across different sectors, including manufacturing, healthcare, transportation, and agriculture (Ahiuwalla, 2022). These positions often require advanced knowledge and skills, emphasizing the need for a specialized program like a Robotics MS to meet industry demands (Lyman, 2019). The industrial job market is projected to rise from $41.7B in 2021 to over $80B in 2028 (Zion 2022). A recent search for robotics job opportunities on LinkedIn yielded over 17,000 current job openings. A 2024 search of AcademicKeys for robotics positions yielded 96 current academic positions that are open.
- Industry Partnerships: Robotics faculty frequently collaborate with robotics, advanced manufacturing, mining, and other companies seeking to collaborate on robotics research and projects. The interest from these partners underlines the potential benefits the program could bring in terms of addressing industry needs and fostering regional growth.
- Technological Advancements: Robotics technology is rapidly evolving, and its integration into various sectors is expected to increase significantly in the coming years. A Robotics MS program would ensure that UNR students are well-prepared to keep up with the latest advancements and contribute to cutting-edge research.
- Impact on Research: The addition of a Robotics MS program at UNR could lead to increased research funding and collaboration opportunities, contributing to technological advancements in the field. The potential for patents, publications, and recognition would raise the university's research profile.

- National and Regional Recognition: A Robotics MS program would position UNR as a leading institution in the robotics education landscape, attracting students from across the country and region. Currently, the research program in robotics at UNR is ranked 32nd on csrankings.org. Further developing robotics pedagogy would positively impact the university's reputation and contribute to a diverse and competitive student body.

ii. Student population to be served

This program will work to recruit students who have completed an engineering degree at the B.S. level to pursue studies in robotics as most of the prerequisite material is covered through undergraduate degree programs. Through this MS process, students will be trained to address goals set by the National Academy of Engineering to broaden participation, and by the President of the United States' Council of Advisors for Science and Technology (PCAST) to produce 1,000,000 new STEM graduates within the next decade to maintain and increase national prominence. The program will also benefit graduate students in other engineering and STEM disciplines who will broaden their understanding of Robotics, more and more becoming critical in several areas of the job market.

iii. Procedures used in arriving at the decision to offer the program

Robotics has been an interdisciplinary focus for research and teaching in the College for more than a decade. However, over time, the College of Engineering has achieved a critical mass of faculty (more than 10 across four departments within the College), so that offering a Robotics M.S. degree is easily feasible. Furthermore, the interdisciplinary training needs for robotics at the graduate level have driven the discussion to create a Robotics M.S. program that can serve as a common recruitment and training resource for faculty across all departments. Discussions about the necessity of and the structure of the program have involved the chairs of the involved departments, as well as the robotics faculty who would be offering the courses as part of the pr Finally, the addition of this degree to the NSHE strategic plan outlines the system-level priority for robotics education.

iv. Organizational arrangements required within the institution to accommodate the program

The Robotics M.S. program will be housed under the Dean's office in the College of Engineering. The program fits with several departments, including Computer Science & Engineering, Mechanical Engineering, and Electrical and Biomedical Engineering, but the interdisciplinary nature of the program makes it sensible to put it at the College level. The program will be administered by a Robotics MS program director. This program director will consult with the Dean of Engineering, and the Chairs of the Mechanical Engineering, Computer Science & Engineering, and the Electrical and Biomedical Engineering departments regarding the course scheduling, admission requirements, and the resources required to provide and sustain the MS program.

v. The timetable, with dates, for implementation steps

The program was routed for approval by UNR through the Spring and Summer 2024. We anticipate the formal launch of the program in Spring 2025. All courses required for this program are already being offered at UNR. Once the degree program is active, existing students will be offered the chance to transfer into the program.

vi. If this or a similar program already exists within the System, what is the justification for this addition? Please describe the nature and extent of the consultation with other institutions that have similar programs.

Although there are robotics/mechatronics programs at the associate's degree level in NSHE, there is currently no other graduate degree in the field

vii. Evidence of employment opportunities for graduates (state and national). Include information on institutional review of the need for the program based on data from the Nevada P-20 Workforce Research Data System and/or any other applicable sources.

The Nevada P20 Workforce Research Data System does not have specific categories for Robotics. However, the system does show high demand for related fields like Mechanical Engineering (16/year at the MS level), Electrical Engineering (16/year at the MS level), Network & Computer Systems Analysts & Administrators (39/year at the MS level), and Software Development (40/year at the MS level).

Outside of Nevada, job websites like indeed.com show over 39,000 jobs available looking for robotics skills. AcademicKeys.com (a higher-education jobs site) lists 129 currently open faculty jobs in robotics. The individuals who graduate from this program would enter into a market that is underserved and in need of new applicants who are likely to serve the state of Nevada and national engineering programs. Robotics education as a sub-discipline is not currently classified within national or state-level databases. As such, the information above reflects the most current representation of student employment prospects.

F. Detailed curriculum proposal

i. Representative course of study by year (options, courses to be used with/without modification; new courses to be developed)

Suggested Course of Study

Thesis Plan

First semester:

- CPE 670 Autonomous Mobile Robots **OR**
  ME 622 Introduction to Robotics (3 units)
- 600/700 level courses (6 units) (3 units core, 3 of core/elective)

Second semester:

- 600/700 level courses (9 units) (3 units core, 6 units core/elective)

Third semester:

- 600/700 level courses (3 units) (3 units core/elective)
- Thesis (3 units)

Fourth semester:

- 600/700 level courses (3 units) (3 units core/elective)
- Thesis (3 units)

Non-Thesis Plan

First semester:

- CPE 670 Autonomous Mobile Robots **OR**
  ME 622 Introduction to Robotics (3 units)
- 600/700 level courses (6 units) (3 units core, 3 units core/elective)

Second semester:

- 600/700 level courses (9 units) (3 units core, 6 units core/elective)

Third semester:

- 600/700 level courses (9 units) (3 units core, 6 units core/elective)

Fourth semester:

- 600/700 level courses (6 units) (6 units core/elective)

Required Courses

Students must complete **one** of the following courses with a grade of B or better, if they have not already done so at undergraduate or graduate level:

- CPE 670 - Autonomous Mobile Robots **OR**
- ME 622 - Introduction to Robotics

Breadth Requirement

M.S. students must complete one course from each of the following areas with a grade of "B" or better. The most recent list of courses offered in each area can be found in the robotics program handbook.

- Actuation and Control
- Reasoning and Computation
- Sensing

Robotics Core Courses

Students must complete **four** of the following courses with a grade of B or better:

- CS 655 - Mobile Sensor Networks
- CPE 671 - Advanced Robotics
- CS 691 - Intro to Aerial Robotics
- CS 691 - Human-Robot Interaction
- CS 777 - Robotics for Humanity
- CS 790x - Seminar in Robotics
- CS 791 - Robot Manipulators
- CS 791 - Multi-robot control and reinforcement learning

- ME 658 - Flight Stability and Control
- ME 682 - Aerodynamics
- ME 710 - Linear Systems
- ME 712 - Adaptive Control
- ME 713 - Robust Control

- EE 626 - Microprocessor Applications
- EE 661R - Stochastic Systems
- EE 671 - Control Systems II
- EE 672 - Digital Control Engineering
- EE 776 - Nonlinear Control Systems

Robotics Electives

Students can use any of the above courses or these additional courses for their additional course credits. Students can take 9 elective credits for the Thesis option or 15 elective credits for the non-Thesis option:

- CS 679 - Pattern Recognition
- CS 682 - Artificial Intelligence
- CS 685 - Computer Vision
- CS 620 - Human-Computer Interaction
- CS 622 - Introduction to Machine Learning
- CS 687 - Fundamentals of Deep Learning
- CS 793X - Robotics Independent Study
- CS 786 - Advanced Computer Vision
- CS 790Q - Seminar in Machine Learning

- ME 650 - Additive Manufacturing Technology
- ME 611 - Comparative Biomechanics
- ME 644 - Intermediate Dynamics
- ME 663 - Nonlinear dynamics and chaos
- ME 740 - Advanced dynamics

- EE 681 - Image Analysis
- EE 663 - Communication Systems
- EE 680 - Digital Signal Processing
- EE 786 - Deep Learning
- EE 665 - Wireless Sensor Networks
- EE 693H - Machine Intelligence
- EE 782 - Introduction to Random Signals and Estimation
- BME 626 - Biomedical Instrumentation

- MATH 620 - Mathematical Modeling
- STAT 661 - A First Course In Probability
- STAT 753 - Stochastic Models and Simulation
- STAT 775 - Advanced Study of Topics in Probability and Statistics

ii. Program entrance requirements

Applicants to the master's degree program should have a bachelor's degree in engineering, mathematics, or science and have minimum experience that includes the equivalent of an Engineering minor. Applicants should further meet the following minimum criteria and the materials for admission:

- A minimum undergraduate GPA of 3.0.
- A minimum GRE Quantitative score of at least 156.
- A minimum TOEFL score of 80 or IELTS score of 6.5 for international applicants.
- A one-page personal statement describing research interests and career goals.
- Two letters of recommendation.

Admission decisions are competitive, and satisfaction of the above thresholds does not guarantee an admission. Exceptions to these criteria may be made for applicants who show exceptional promise.

iii. Program completion requirements (credit hours, grade point average; subject matter distribution, preprogram requirements)

Masters level students may choose Plan A (Thesis) or Plan B (Courses-Only). Each option requires that the students complete a theory course and that their courses span several areas of specialization within the college. The specific requirements of each option are detailed below:

- Thesis Option
  - This option requires a total of 30 units
  - 24 units of regular courses
    - 12 credits of this coursework must be completed at the 700 level.
  - 6 thesis units (CS/EE/ME/CPE/BME 797)
- Courses Only Option
  - This option requires a total of 30 credits of coursework.
  - 12 credits at the 700-level.
  - 18 credits at the 600/700-level.

At most one independent study and one internship study up to 3 credits each is allowed for both options.

Program requirements are listed in more detail below:

Breadth Requirement

M.S. students must complete one course from each of the following areas with a grade of “B” or better. The most recent list of courses offered in each area can be found in the robotics program handbook.

- Actuation and Control
- Reasoning and Computation
- Sensing

Robotics Core Courses

Students must complete **four** of the following courses with a grade of B or better, if they have not already done so at undergraduate or graduate level:

- CS 655 - Mobile Sensor Networks
- CPE 671 - Advanced Robotics
- CS 691 - Intro to Aerial Robotics
- CS 691 - Human-Robot Interaction
- CS 777 - Robotics for Humanity
- CS 790x - Seminar in Robotics
- CS 791 - Robot Manipulators
- CS 791 - Multi-robot control and reinforcement learning

- ME 658 - Flight Stability and Control
- ME 682 - Aerodynamics
- ME 710 - Linear Systems
- ME 712 - Adaptive Control
- ME 713 – Robust Control

- EE 626 - Microprocessor Applications
- EE 661R - Stochastic Systems
- EE 671 - Control Systems II
- EE 672 - Digital Control Engineering
- EE 776 - Nonlinear Control Systems

Robotics Electives

Students can use any of the above courses or these additional courses for their additional course credits. Students can take 9 elective credits for the Thesis option or 15 elective credits for the non-Thesis option:

- CS 679 - Pattern Recognition
- CS 682 - Artificial Intelligence
- CS 685 - Computer Vision
- CS 620 - Human-Computer Interaction
- CS 622 - Introduction to Machine Learning
- CS 687 - Fundamentals of Deep Learning
- CS 793X - Robotics Independent Study
- CS 786 - Advanced Computer Vision
- CS 790Q - Seminar in Machine Learning

- ME 650 - Additive Manufacturing Technology
- ME 611 - Comparative Biomechanics
- ME 644 - Intermediate Dynamics
- ME 663 - Nonlinear dynamics and chaos
- ME 740 - Advanced dynamics

- EE 681 - Image Analysis
- EE 663 - Communication Systems

- EE 680 - Digital Signal Processing
- EE 786 - Deep Learning
- EE 665 - Wireless Sensor Networks
- EE 693H - Machine Intelligence
- EE 782 - Introduction to Random Signals and Estimation
- BME 693D - Biorobotics/biomechatronics (will offer soon)
- BME 626 - Biomedical Instrumentation

- MATH 620 - Mathematical Modeling
- STAT 661 - A First Course in Probability
- STAT 753 - Stochastic Models and Simulation
- STAT 775 - Advanced Study of Topics in Probability and Statistics

iv. Accreditation consideration (organization (if any) which accredits program, requirements for accreditation, plan for attaining accreditation - include costs and time frame)

n/a

v. <u>For certificates only:</u> Name of any state, national and/or industry recognized certification(s) or licensing examination(s) for which certificate prepares the student, if applicable

n/a

G. Method of Delivery (for the purpose of state authorization [NC-SARA])

i. How will this academic program be delivered when the program begins? (mark all that apply)

☒ **100% face-to-face courses**

a. ☐ Learning Placements

Does the academic program have learning placements (e.g. internships, externships, clinical placements, student teaching, etc.) that *may take place outside the state of Nevada?*

☒ **Yes**
☐ **No.**

H. Institutional Review Process

i. Date of Faculty Review (may include additional information, as needed)

The program was approved by Robotics Faculty on 2/13/23. Approval from the College of Engineering curriculum committee occurred on 4/5/24. The University Courses and Curriculum Committee approved the program on 4/23/24.

ii. Describe the process for review and approval by the appropriate academic policy body of the institution

The program was reviewed and approved by the University's Graduate Council on 4/9/2024, and by the University Courses and Curricula Committee on 4/23/2024.

I. Readiness to begin program

i. List the educational and professional qualifications of the faculty relative to their individual teaching assignments

All current faculty were hired for positions in the Computer Science & Engineering, Mechanical Engineering, Electrical and Biomedical Engineering, and Civil and Environmental Engineering. The faculty have Ph.D.'s in robotics-related fields from leading institutions in the field. Additionally, the faculty have been recognized at international conferences for their potential as emerging scholars in robotics education, won best paper awards at international robotics conferences, and have been recognized for their high levels of mentoring in the field. The faculty have over 100 publications in leading robotics journals and over 500 conference papers in robotics. The faculty have received multiple federal grants in robotics research from the National Science Foundation, Nevada Space Grant Consortium, Office of Naval Research, the National Institutes of Health, and the Department of Transportation. The current funding of these grants is over $50 million dollars. The efforts outlined above align with the faculty teaching assignments in the program that focus on each of these areas of success.

ii. List the anticipated sources or plans to secure qualified faculty and staff

Existing qualified core faculty are already in place at the University. Current engineering faculty have indicated a willingness to support the program to ensure sustained success in appropriate courses. Engineering faculty qualifications for teaching courses in the program will be evaluated by the core faculty. Additionally, faculty could support the courses in the program based on their experiences in higher education and their research interests.

iii. Contribution of new program to department's existing programs (both graduate and undergraduate) and contribution to existing programs throughout the college or university

Since these courses already exist within the College, the programs would benefit from more stable enrollment from the Robotics program and would also be enhanced by a more focused interest in keeping these courses at the state-of-the-art for participation in the robotics MS program.

iv. Recommendations from prior program review and/or accreditation review teams

N/A

J. Resource Analysis

i. Proposed source of funds (enrollment-generated state funds, reallocation of existing funds, grants, other state funds)

The program will not require additional funds. Faculty (who are on state lines) currently advise and support graduate students who are hosted by existing M.S. programs across the College of Engineering.

ii. Each new program approved must be reviewed for adequate full-time equivalent (FTE) to support the program in the fifth year. Indicate if enrollments represent 1) students formally admitted to the program, 2) declared majors in the program, or 3) course enrollments in the program.

a. (1) Full-time equivalent (FTE) enrollment in the Fall semester of the first, third, and fifth year.

1st Fall semester 11.25

3rd Fall semester 18.75

5th Fall semester 22.5

(2) Explain the methodology/assumptions used in determining projected FTE figures.

Currently, MS students affiliated with labs across all relevant programs include far more than the 20 students included in the Y2 numbers presented above. We anticipate some measure of growth in the program above those 20 students as the program matures. Given that most robotics PhD students also get a MS degree en-route, we anticipate that future robotics PhD students will already obtain a Robotics MS as well.

b. (1) Unduplicated headcount in the Fall semester of the first, third, and fifth year.

1st Fall semester 15

3rd Fall semester 25

5th Fall semester 30

(2) Explain the methodology/assumptions used in determining projected headcount figures.

The program is expected to have a steady-state headcount of 30 students. This number is based on current student enrollment in various engineering graduate degrees who are completing Robotics theses and dissertations and expected growth of the Robotics program based on trends from peer institutions.

iii. Budget Projections – Complete and attach the Five-Year Program Cost Estimate and Resource Requirements Table.

Attached

K. Facilities and equipment required

i. Existing facilities: type of space required, number of assignable square feet, space utilization assumptions, special requirements, modifications, effect on present programs

Currently the robotics program courses utilize existing labs and teaching facilities in the CSE, ME, and EBME departments. These facilities are adequate to teach the courses proscribed in the Robotics MS program. We also have adequate equipment spread across the departments.

ii. Additional facilities required: number of assignable square feet, description of space required, special requirements, time sequence assumed for securing required space

None required

iii. Existing and additional equipment required

None required

L. Describe the adequacy and availability of library and information resources

Adequate for current teaching needs.

M. Student services

i. Describe the capacity of student support services to accommodate the program. Include a description of admissions, financial aid, advising, library, tutoring, and others specific to the program proposal

We would use the existing student services across the CSE/ME/EBME programs. These are adequate for student support. We anticipate that most students would be self-funded or funded from TA/RA lines.

ii. Describe the implications of the program for services to the rest of the student body

No additional costs would be required.

N. Consultant Reports – If a consultant was hired to assist in the development of the program, please complete subsections A through C. A copy of the consultant's final report must be on record at the requesting institution.

N/A

i. Names, qualifications and affiliations of consultant(s) used

N/A

ii. Consultant's summary comments and recommendations

N/A

iii. Summary of proposer's response to consultants

N/A

O. Articulation Agreements

i. Articulation agreements were successfully completed with the following NSHE institutions. (Attach copies of agreements)

N/A

ii. Articulation agreements have not yet been established with the following NSHE institutions. (Indicate status)

N/A

iii. Articulation agreements are not applicable for the following institutions. (Indicate reasons)

N/A

P. Summary Statement

Knowledge of robotics stretches across departments and is of high value in research and industry today. This proposed new major will help graduate students prepare themselves for a wide range of very attractive careers that will serve the state of Nevada, and will produce students who are prepared for research and industry in a very interdisciplinary area.

Program Resource Requirements. Indicate all resources needed including the planned FTE enrollment, projected revenues, and estimated expenditures for the first, third and fifth fiscal years of the program. Include reallocation of existing personnel and resources and anticipated or requested new resources. Third and fifth year estimates should be in dollars adjusted for inflation. If the program is contract related, explain the fiscal sources and the year-to-year commitment from the contracting agency(ies) or party(ies). Note: This form reflects the NWCCU's Substantive Change Budget Worksheet as of 8/28/17.

College/University: ___*University of Nevada, Reno* _____ **Program:** ___Robotics, M.S._____

I. PLANNED STUDENT ENROLLMENT

Note *: Enrollment numbers (A + B) for each fiscal year should match the FTE/Headcount numbers in the Academic Program Proposal Form (Sect. I.ii.).*	**FY 1:**	**FY 2025**	**FY 3:**	**FY 2027**	**FY 5:**	**FY 2029**
	FTE	Headcount	FTE	Headcount	FTE	Headcount
A. New enrollments to the Institution	4	5	15	20	23	30
B. Enrollments from Existing Programs	8	10	4	5	0	0

II. REVENUE

	FY 1:	**FY 2025**	**FY 3:**	**FY 2027**	**FY 5:**	**FY 2029**
	On-going	One-time	On-going	One-time	On-going	One-time
1. New Appropriated Funding Request						
2. Institution Funds	$0					
3. Federal (e.g. grant, appropriation)						
4. New Tuition Revenues (registaration fee) from Increased Enrollments*	$59,906		$110,250		$146,003	
5. Other Student Fees (associated with the program)*						
6. Other (i.e., Gifts)						
Total Revenue	$59,906	$0	$110,250	$0	$146,003	$0

Note *: Total Revenue (Section I) should match Total Expenditures (Section III)*

III. EXPENDITURES

	FY 1: FY 2025		FY 3: FY 2027		FY 5: FY 2029	
	On-going	One-time	On-going	One-time	On-going	One-time
A. Personnel Costs						
1. FTE (**Total FTE for all personnel types**)	0.275	0	0.66	0	1.04	0
Faculty	0.275		0.66		1.04	
Adjunct Faculty						
Grad Assts						
Research Personnel	0					
Directors/Administrators						
Administrative Support Personnel						
Other: _____						
	Expenditures for personnel type below must reflect FTE levels in Section A.1. above.					
2. Faculty	$47,297		$85,800		$135,200	
3. Adjunct Faculty					$21,168	
4. Graduate Assistants						
5. Research Personnel	$0		$0		$0	
6. Directors/Administrators						
7. Administrative Support Personnel						
8. Fringe Benefits						
9. Other:						
Total Personnel Costs	$47,297	$0	$85,800	$0	$156,368	$0

	FY 1:	FY ____	FY 3:	FY ____	FY 5:	FY _____
	On-going	One-time	On-going	One-time	On-going	One-time
B. Operating Expenditures						
1. Travel						
2. Professional Services						
3. Other Services						
4. Communications						
5. Materials and Supplies	$2,000		$10,000		$5,000	
6. Rentals						
7. Marketing materials and Advertising	$2,000		$3,000		$3,000	
8. Miscellaneous						
Total Operating Expenditures	$4,000	$0	$13,000	$0	$8,000	$0

	FY 1:	FY ____	FY 3:	FY ____	FY 5:	FY _____
	On-going	One-time	On-going	One-time	On-going	One-time
C. Capital Outlay						
1. Library Resources						
2. Equipment						
Total Capital Outlay	$0	$0	$0	$0	$0	$0
TOTAL EXPENDITURES (IIIA + IIIB + IIIC):	$51,297	$0	$98,800	$0	$164,368	$0

Note: Total Expenditures (Section IIIA-C total) should match Total Revenue (Section I)

Budget Notes (optional):

Faculty Salary Based on 2023 average and assuming 32.3% fringe. Assuming 11 faculty teaching on average 1 course per year (10% of salary) in years 1-3 and 13 faculty teaching one course on average in year 5, these courses are filled on average with 30% robotics students in year 1, 60% in year 3, and 80% in year 5 (accounting for student growth in the program).

Starting in Y5 if additional course creation is required, we plan for a LOA budget of $8,000 + 32.3% fringe for additional courses.