

**National STEM Consortium
Reviewer Form**

NSC Certificate Area

Composite Materials
Technology

Cyber Technology

Electric Vehicle
Technology

Environmental
Technology

Mechatronics

Title of Course: **MEC AUTONOMOUS ROBOTS**

Please provide a qualitative analysis of the NSC Certificate program course materials based on the three criteria below (approximately one page per criterion). At the end of each review please use a scale of 1-3 (1=low; 2=medium; 3=high) to rate the overall quality of the materials in relation to that criterion.

Criteria:

- (A) Meets industry standards and needs (Identify relevant Industry Standards and Needs: technical, personal and interpersonal).
- (B) Represents “best in class,” nationally portable, one-year certificate programs that are in demand by workers and employers.
- (C) Can be disseminated quickly and widely to community colleges throughout the United States.

Name of Reviewer: *Marilyn Barger*

Date of Review: *03/14/2014*

(A) Meets industry standards and needs (Identify relevant Industry Standards and Needs: technical, personal and interpersonal).

(i) Industry Relevance:

There is a national need for skilled workers to begin to address the installation and operation of autonomous systems in many industrial facilities of all kinds that use different focused advanced technologies. The National Association of Manufacturers’ (NAM) Manufacturing Institute (MI) has defined this need as related to include industrial maintenance, and machine operations, which includes the mechatronics skill set. Industries across the country are rapidly adding automated robotic systems to their production facilities and their needs for skilled workers in this area are increasing equally as fast. Robots and robotic equipment of all types are integral components of mechatronic systems.

The materials provided within the MEC Autonomous Robots course address the introductory knowledge and skills required of all employees working anywhere in a production environment,

including the front-line material handlers, machine operators and multi-skilled maintenance technicians. The MEC Autonomous Robots course meets this need with an excellent and comprehensive instructional package for instructors, teachers and faculty. The materials reference current resources and include state of the art information about autonomous robots. Course materials also map to the current Department of Labor Competency Models for Advanced Manufacturing and Mechatronics. The course introduces and reinforces the fundamental science and technologies found in autonomous robots and focuses attention on the fact that robots are integrated systems with mechanical, electrical, communication, and computer subsystems. It also covers the history of robots and current applications of robotics in a variety of industrial, commercial and societal environment. The course culminates with a project that requires students to work in teams as well as develop troubleshooting skills.

The first of three modules introduces robotics, provides historical context, and covers the important mechanical structure, the mechanical movement including the underlying physics of robots, and the important material properties of various components. This module then introduces the other subsystems: electrical, power, and communication (includes introduction to programming, sensors input and end effectors).

The second module focuses on developing programming skills as well as details of sensors, actuators and end effectors, including mechanical grippers and vacuum/suction grippers, potentiometers (enable robotic movement), photodiodes, etc. Module three continues to introduce the science, technology and integration of additional sensors and more complicated programming for more complex robotic behavior. Robotic simulators, upload and download protocols are also included. In each of the 13 lesson plans the course package has detailed materials for delivering the course and implementing the robotic projects with the equipment defined in the course packet.

(ii) Standards Relevance:

The MEC Autonomous Robots course is a three credit-hour course (approximately 60 contact hours) introduction to and overview of robotics. There are several vendor specific certifications that might align to this course if an institution uses those particular commercial robots in their laboratory curriculum. Those colleges might choose to implement this kind of vendor certification if its regional industry partners commonly use the particular robot. That certification would then provide documentation that the holder of such had those specific skills. Additionally, comprehensive skills in robotics are a fundamental component of the overarching mechatronics certification that is planned to be the ultimate assessment of the one-year mechatronics certificate program. The culminating mechatronics certification will require students to have deeper knowledge and experience in all of the mechatronic subsystems including autonomous robots. Siemens Level I Mechatronics Certification is the target credential of the NSC STEM Consortium mechatronics program, <http://www.siemens-certifications.com/> and requires skills taught in the Autonomous Robots course.

Successful completion of the culminating certification will recognize and affirm core skills in robotics programming, operation and troubleshooting.

(B) Represents “best in class,” nationally portable, one-year certificate programs that are in demand by workers and employers.

In addition to the identified need by NAM, the NSC Mechatronics Team college partners had defined specific local and regional industry needs for robotic programmers and technicians as well as other related automation /mechatronic technicians in their original grant application. These high skill and high wage jobs generally attract students, veterans, unemployed, and underemployed workers due to the intrinsic hands-on nature of the work, continuous lifelong learning opportunities as well as strong career advancement potential. The development of this workforce requires curricula that provide the knowledge and skills required to meet current industry needs. The structure of a course that delivers this content is optimal when it meets “best in class” characteristics. I believe that the MEC Autonomous Robots course developed through the National STEM Consortium Curriculum Development Project has the characteristics of a “best in class” course. “Best in class” can be defined as providing state-of-the art and current content; formatted for flexible delivery options; and offer a comprehensive package of materials so a qualified faculty could offer the course with no additional materials.

The Autonomous Robots course in the NSC Mechatronics Program is a comprehensive program of study of robotic systems commonly used in a number of industry and business sectors. The Additionally, the local and/or regional needs were defined by the NSC Mechatronics Team college partners had defined specific local and regional industry needs for robotics technicians as well as mechatronics technicians in their original grant application. These high skill and high wage jobs generally attract students, veterans, and incumbent workers who are attracted to the intrinsic hands-on nature of this work, the continuous lifelong learning opportunities as well as strong career advancement potential.

The course materials provided are excellent, up to date, comprehensive, well written and appropriate for the introductory course in Autonomous Robotics. Many appropriate and current resources are identified for each topic in every module, and multiple approaches for delivering the material is suggested. Each lesson includes lecture notes, presentations, handouts, linked online content, well defined activities/labs, assessment guides, expected student learning outcomes, reference list, and a guideline of the estimated time that should be spent on each topic, lab or classroom activity. The lesson plans include suggestions for how to deliver the course in a blended environment, which will be helpful for those interested in offering portions of the course modules via an online platform. The course materials also offer a detailed description and recommendations for appropriate from various commercial vendors as well as suggested qualifications of the instructor.

Industry has made it clear that students must have the opportunity to work directly with related equipment, and this course provides multiple hands-on, project-based learning opportunities for students. It also specifies how expected background knowledge and how critically important personal and interpersonal skills are integrated into this technical course by using work team environments throughout the course lab activities. The course integrates and builds knowledge and skill attainment throughout the modules and encourages implementation of the best teaching and learning strategies for mastery of topics in the course.

(C) Can be disseminated quickly and widely to community colleges throughout the United States.

The structure of the Autonomous Robots course is based on text, presentations, lab activities, demonstrations, instructor guides and online resources. All of the course materials would be easy for an education institution to implement as the same course anywhere in the United States by a faculty or instructor with a related technical background. This content is also conducive to language translation to facilitate the course being delivered globally. The course is divided into three modules of typically twenty hours of combined lecture and laboratory hands-on practice. The three distinct modules provide a lot of flexibility for anyone delivering the course material in various length college credit courses or in short-term non-credit courses/modules. Providing generic laboratory activities together with equipment-specific examples will greatly help many potential users to stand up this course with different equipment. The MEC Autonomous Robots course also recommends a well-respected textbook universally available. The course package, as delivered to me via zip file would be very easy for an instructor to implement quickly provided he/she had the appropriate background and laboratory equipment.

OVERALL QUALITY RATING

| AUTONOMOUS ROBOTS - COURSE REVIEW CRITERIA | SCORE (1-3, 3 highest) |
|---|-------------------------------|
| (a) Meets industry standards and needs (Identify relevant Industry Standards and Needs: technical, personal and interpersonal). | 3 |
| (b) Represents “best in class”, nationally portable 1-year certificate that is in demand by workers and employers | 3 |
| (c) Can be disseminated quickly and widely to colleges in the US | 3 |