**National STEM Consortium**
**Reviewer Form**

NSC Certificate Area

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|---|---|---|---|---|
| Composite Materials Technology | Cyber Technology | Electric Vehicle Technology | Environmental Technology | **Mechatronic**s |

Title of Course**: MEC INDUSTRIAL ROBOTICS**

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: *09/30/2013*

## (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 in industrial facilities of many kinds with different focused technologies. The National Association of Manufacturers' (NAM), Manufacturing Institute (MI) has defined this need to include industrial maintenance technicians, which includes the mechatronics skill set. The materials provided for the Industrial Robotics course address this need with an instruction package that includes lecture notes, visual presentations, standard content text book references, student and instructor reference materials, demonstrations, and student hand's-on activities that introduce and reinforce engineering science (why things work) and safety (how things work) fundamentals of robotic systems. The

course content includes the fundamentals of robotics technologies used in manufacturing and other industrial environments. The course emphasizes the workings of mechanical manipulators in a safe manner. It also covers important spatial positions, orientation, and frames of the manipulators; programming using manufacturers specific software; robotic nomenclature, classifications, input/output sensor interfacing, workcell design, and learning centric applications . Skill developed during the course include but are not limited to personal safety practices, related industrial robot safety procedures, basic robot programming skills, setup, operation, preventive maintenance procedures, and reinforcement of appropriate personal and professional behavior in the workplace. Course instruction begins with the perfunctory but required operating procedures involved with the classroom management system and review of the course objectives. The first module covers basic definitions and classifications of robots as well as some historic and sociological perspectives. Module one also introduces various programming and data entry platforms that support robotic operations and the process of selecting the right robot for a particular task.

The second module focuses on the technology details of various mechanical, electrical, controls, and fluid power subsystems in a robot as well as how they work together. The third module deals with a robot's interaction with its working environment. Topics explored include end effectors, sensors, and actuators as well as the essential physics and mathematics fundamental needed to integration of these components into any robotic systems. Module four covers specific program commands with their accompanying required program language manipulation skills to assure safe effective robot operation. Module four also continues the integration of all previous course materials into comprehensive, end of course projects and troubleshooting exercises that simulate actual industry related applications.

(ii) Standards Relevance:

The course address skills associated with several industry standards. Safety practices as identified by OSHA are immediately introduced and subsequently integrated into course content as well as demonstrated as required skills during the course through the hands-on activities within the course. Also not specifically isolated as a course lesson but integrated into the course structure are the tenants of the safety and maintenance related criteria for the nationally recognized MSSC Certified Process Technician industry certification. This course alone would not sufficiently prepare a student to take the MSSC CPT tests, but will strengthen their preparation.

In addition, the Association for Packaging and Processing Technologies (PMMI) anticipates offering industry credentials specifically in Robotics as a specialty of Mechatronics within the next two year. Additionally, basic robotics is a core application skill in their existing PMMI Mechatronics certification. Additionally, there are some vendor-specific robotic certifications. Although good, they do require training on specific equipment. The FANUC CERT program (Certified Education Robot Training, www.fanuc.org) covers topics offered in the NSC MEC Industrial Robotics course, but applies to vendor specific hardware. The topics in the Industrial Robotics course are generalized to be applicable to a variety of equipment and hardware vendors.

**(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 partner had defined specific local and regional industry needs for mechanical systems as well as mechatronics technicians in their original grant application. Regional industry high skill and high wage jobs generally attract students, unemployed, and underemployed workers due to their geographic location, the intrinsic hands-on nature of the work, continuous lifelong learning opportunities as well as strong career advancement potential. The development of this localized workforce requires curricula that provide the knowledge and skills required to meet the national needs of the industry. The structure of a course that delivers this content with these expectations is optimal when it meets "best in class" characteristics. The Industrial Robotics course, developed through the National STEM Consortium Curriculum Development Project has the characteristics of a "best in class" course with many hands-on laboratory activities, important skills attainment tasks in robotic programming, and robot setup operation and maintenance practice experiences. The Mechatronics certificate program provides two robotics-focused courses as electives. Depending on local industry needs, generally one of these two courses is part of the program at each of Mechatronics Team colleges.

The Industrial Robotics course in the NSC Mechatronics Program is a comprehensive program of study of industrial robotics commonly used in many different industry business sectors. As with the other courses within National STEM Consortium curriculum portfolio, there is a national need for skilled workers with robotic skills in industrial facilities of many kinds. The National Association of Manufacturers' (NAM) Manufacturing Institute (MI) has defined this need to include technicians with robotics skills as included in the mechatronics skill set. Additionally, the local and/or regional needs as identified by the NSC Mechatronics Team college partners have categorized specific local and regional industry needs for robotic skills to be blended into mechatronics technicians as outlined in their original grant application. Technical work related to industrial robotics represent high skill and high wage jobs generally that are very attractive to students, unemployed and underemployed workers. Such work is fundamentally hands-on nature of the work, provides continuous livelong learning opportunities as well as provide strong career advancement potential.

The Industrial Robotics course in the NSC Mechatronics Program is a comprehensive introduction to programming, setup, operation and maintenance. This includes topics of value to many sectors of manufacturing, supply chain technology, energy production systems, retail sales, entertainment systems, material processing, and others as well as the support process areas defined under these umbrella categories. Because the fundamental robotic technologies support this breadth of industries and applications, the course materials for Industrial Robotics are applicable not only across the United States, but across the globe.

In summary, the course materials provided are very good, up to date, well written and appropriate for the Industrial Robotics course. Many appropriate resources are identified for each topic, and at least one approach to delivering the material is suggested. Each lesson

includes lecture notes, handouts, and activity materials, expected student learning outcomes, reference list, and a guideline for how much time should be spent on each lecture topic and lab or classroom activity. The lessons also provide references to various equipment-vendor specific activities, making the lessons extremely flexible, and therefore, user friendly for any educational institution anywhere. It also specifies how expected background knowledge and how critically important personal and interpersonal skills are integrated into the technical course by using work team environments. The course integrates knowledge and skill attainment throughout the course encouraging implementation of the best teaching and learning strategies for this mastery of this kind of materials.

**(C) Can be disseminated quickly and widely in community colleges through the United States.**

The structure of the industrial robotics course for the NSC Mechatronics certificate is based on text, presentations, activities, and internet resources. All of the course resources provided make it easy for an education institution to implement the same program anywhere in the United States. This content is also conducive to language translation to facilitate course delivery globally. The course is divided into fourteen lessons of typically 3 hours of combined lecture and laboratory practice. Lessons are grouped into 3 distinct modules, which provide the needed flexibility for anyone delivering the course material in various length college credit courses or in short-term non-credit courses. The Industrial Robotics course also recommends a well-respected introductory textbook that is universally available. There are recommendations /suggestions for appropriate laboratory equipment that would be helpful for institutions wanting to adopt this course. 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**

| INDUSTRIAL ROBOTICS - 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 |