National STEM Consortium
Reviewer Form

NSC Certificate Area

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

Title of Course**: MEC ADVANCED PLCS**

The following review of the elective, Advanced PLC, course in the Mechatronics course of study is part of the qualitative analysis of the NSC Certificate program course materials. This review is based on the three criteria listed below; The review is also quantitatively summarized with a score on a scale of 1-3 (1=low; 2=medium; 3=high).

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: *06/30/2014*

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

(i) Industry Relevance:

The national need for skilled workers has been identified in key technologies that address the installation, operation, and maintenance of manufacturing control systems that support various focused advanced technologies. The National Association of Manufacturers' (NAM) Manufacturing Institute (MI) has also connected this need to the mechatronics skill set required in industrial maintenance, and machine operations. Industries across the country are now completely comfortable with the use of Programmable Logic Controllers as the sensors input interface, control scheme implementer, and signal conditioning interfaces for process final control elements in all aspects of their manufacturing operation. This complete immersion of PLCs into manufacturing has lead to the increased implementation of the advanced language elements available in all major PLC brands. Thus, the PLC skills technicians possessed just a

few years ago are below the expectations of manufacturers in today's automated manufacturing floor.

The materials provided within the MEC Advanced PLC course addresses this advanced PLC knowledge and skills requirements for employees working anywhere in an automated production environment. Today these employees include the front-line material handlers, machine operators, and multiple skilled maintenance technicians. This course meets this need with an excellent and comprehensive instructional package for maximum benefit to instructors and students.

The first module reviews the materials presented in the Introduction to Programmable Logic Controllers course that is also included in the Mechatronics curriculum set. Topics covered include PLC purpose, function, main parts, timer and counter operations, and the Master Control Reset Instruction. That introductory course continues with the Jump instruction, subroutine functionality, and important input/output configurations and related instructions. The module then shifts to fault routine and troubleshooting, and data manipulation concepts and instructions. The module ends with explanations of data I/O interfaces and the closed-loop control concept.

The second module moves to the advanced instruction set. Students will work with various mathematical and register instructions. Attention is paid to the bit and word format for these instructions. Troubleshooting related to these instructions is included in this group of lessons. The module finishes with analog and digital modules, their function, operation, and relevance to the math and register instruction typically used to condition this input and output information.

The third module returns the student to the practical elements of PLC technology as it relates to various control scheme options. ON/OFF, PID and Motion control schemes are presented and worked with. Data communicative options that include Data Highway, Serial, Field bus, and Prfibus-DP are studied. Students are also exposed to SCADA Supervisory Control and Data Acquisition. Finally, the course provides more details about PLC enclosure, electrical noise, leaky I/O, ground issues, and voltage variations. Extended details about program editing, PLC commissioning, and total system troubleshoot best practices are provided.

(ii) Standards Relevance:

The MEC Advanced PLC course provides approximately 60 contact hours (presumably but not stated a 3 credit course) that addresses the programming and operation of PLCs with a specific attention to Allen-Bradley and Siemens controllers. The lessons follow best practices as outlined by these manufacturers and as such address relevant industry standards. Although not emphasized, if there are relevant standards supported by Allen-Bradley and Siemens that specifically address PLC knowledge and skills, students should be prepared to seek these certifications. It is certainly the case that the culminating mechatronics certification will require students to have deeper knowledge and experience in all of the mechatronic subsystems including their related automated control systems. As students proceed through this elective course, the content provided reinforces the background knowledge that strengthens student mechatronics related skills and knowledge as acquired in the required degree driven courses.

(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 PLC technician expertize. These high skill and high wage jobs support mechatronics professionals and their hands-on nature attract students, veterans, unemployed, and underemployed workers. This need combined with its relevance to the mechatronics workforce support student selection of this curriculum elective.

The structure of a course that delivers this content is optimal when it meets "best in class" characteristics. I believe that the MEC Advanced PLCS 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 blended with current identified technician needed skill related 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 MEC Advanced PLCS course in the NSC Mechatronics Program is a comprehensive course of study with an emphasis on advanced PLC programming and concepts. Additionally, to assure its sate-of-the-art status, the NSC Mechatronics Team college partners used local and/or regional manufacturers to define course expectations. The course has a regimented structure with some degree of flexibility. Delivery options are centered on some selection of laboratory activities but it is the nature of the course content that it flows in a structured manner. However, course presentations are characterized by a comprehensive instructional material package, structured hands-on activities that have open-ended options, and good assessment instrument examples. The lesson plans include suggestions that will be of value to qualified instructors.

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

The structure of the MEC Advanced PLCs course is based on presentations and a specific text. The lab activities and demonstrations are supplied from a specific education equipment provider. If these two conditions were met, 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, within copyright restrictions of the text and laboratory material providers, 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 are sequentially content driven and the nature of the course subject matter does not allow much flexibility. However, it can with some ingenuity, be delivered in various length college credit courses or in short-term non-credit courses/modules. This is particularly the case if Module I, the review of the introductory PLC course, is trimmed or removed.

OVERALL QUALITY RATING

ADVANCED PLCs - 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	2