National STEM Consortium
Reviewer Form

NSC Certificate Area

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

Title of Course**: MEC ENGINEERING DRAFTING AND CAD**

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:

Drafting and CAD skills are relevant to a segment of the technical workforce that is in the critical machining pathway. The National Association of Manufacturers' (NAM), Manufacturing Institute (MI) recognizes this general requirement and specific need and includes this skill subset as part of the mechatronics skill set portfolio. The materials provided within the Engineering Drafting and CAD 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 the fundamentals skills and knowledge of computer-based drafting and design technologies used in manufacturing and other industrial environments. This survey

course presents drafting & CAD modeling techniques specific to mechatronic systems. Students will learn about sketching techniques, multi-view drawings, and proper dimensioning. The student will then gain hands-on experience with SolidWorks. SolidWorks is a solid-modeling drafting program that enjoys widespread use and gaining popularity with the machining industry sector. It is used to produce engineering models and drawings. Solid-modeling techniques, creating documentation drawings, file management, drawing standards & assemblies will all be covered. The students will finish the class by completing a mechatronic specific CAD project.

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 of mechanical drawings as well as fundament of hand drawing, dimensioning, line types, sections, standard views, and sketching. The first module ends with instruction that addresses the installation of the SolidWorks software. Module 2 begins the instruction of the computer-aided drafting skills associated with fundamental skills and commonly used software tools. Students continue to have significant hands-on "seat" time to learn and practice their skills. Module 3 focuses on bringing together the fundamental and single piece constructs into mechanical assemblies' diagrams emphasizing design and construction issues. Students are introduced to the use of templates; more advanced software tools, and are ultimately expected to produce accurate exploded assembly drawings. Although 3D printers are recommended as optional supplemental equipment, no lessons are included on integrating this technology into the structured learning environment.

(ii) Standards Relevance:

The course address skills associated with several industry CAD standards. Also not specifically isolated as a course lesson but integrated into the course structure are the fundamentals necessary to successfully complete the SolidWorks Associate CSWA Certification. Most of the other recommended software packages suggested for this course have competency based, on-line certifications to document course completers' skill and knowledge attainment.

Knowledge and skills developed in this course represent a background basis for appreciation and successful completion of other courses in a systematic mechatronics program. In order to fully understand, operate, troubleshoot and maintain any mechatronic based equipment, the ability to read and correctly interpret the technical drawings for the equipment is critical. The minimal skill subset in basic print reading as developed in the Engineering Drafting and CAD course are required for successful completion of the Association for Packaging and Processing Technologies (PMMI) Mechatronics Certification as well as the Siemens Mechatronics certification.

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

In addition to the recognized need by NAM, the NSC Mechatronics Team college partners have defined specific local and regional industry CAD needs for mechanical systems as well as mechatronics technicians in their original grant application. These high CAD skill and high wage jobs generally attract students, unemployed, and underemployed workers due to the direct correlation between CAD activities and the intrinsic hand-eye imaginative nature of the work, the continuous lifelong learning opportunities, as well as the strong career advancement potential.

The structure of a course that delivers this content is optimal when it meets "best in class" characteristics. The MEC Engineering Drafting and CAD course, developed through the National STEM Consortium Curriculum Development Project, has the characteristics of a "best in class" course with many standalone hands-on activities that provide the "seat" time to assure important skills attainment in computer-based engineering drafting, print reading, and interpretation. The Mechatronics certificate pathway provided in this course represents one of several selective courses for the full 30-credit program. Depending on local industry needs, colleges could choose to include this certification route in the students' course of study. If not part of the 30-credit hour program, the course is still important as a tool for skill development in basic print reading to meet that skill proficiency expectation in some required courses.

The Engineering Drafting and CAD course in the NSC Mechatronics Program is a comprehensive program of study of hand and computer-based engineering drafting skills commonly used in many industrial business sectors. The National Association of Manufacturers' (NAM) Manufacturing Institute (MI) has defined this need to include CAD and drafting skills as included within the mechatronics skill set. Additionally, the local and/or regional CAD needs as defined by the NSC Mechatronics Team college partners' interactions with specific local and regional industries were indicated in the original grant application.

The MEC Engineering Drafting and CAD course in the NSC Mechatronics Program is a comprehensive introduction to mechanical drawing, sketching, computer-based drafting and the use of basic software tools needed to accurately construct 3D mechanical drawings. Graphic and drawing skills are used in many industrial sectors including most sectors of manufacturing, supply chain technology, energy production systems, retail systems, entertainment systems, material processing, and other sectors and defined process areas of these umbrella categories. The breadth of industries and applications that utilize these skills assures that the course materials for Engineering Drafting and CAD are applicable not only across the United States, but across the globe.

The course materials provided are very good, up to date, well written and appropriate for the Engineering Drafting and CAD 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, activity materials, expected student learning outcomes, references, and a guideline for how much time should be spent on each lecture topic, hands-on lab or classroom activity. Lessons also provide references to various equipment-vendor specific activities that help make the learning experience extremely flexible, and user friendly for any educational

institution anywhere. The guide also indicates how a work team environment can be employed to integrated expected background knowledge as well as critically important personal and interpersonal skills into the technical course. The course integrates knowledge and skill attainment throughout its structure encouraging implementation of the best teaching and learning strategies for mastery of this kind of materials.

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

The structure of the Engineering Drafting and CAD course for the NSC Mechatronics certificate is based on text, computer program(s), presentations, activities, and Internet resources. All of the course materials are electronically accessible and would be 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 (20 hours of instruction each), which provides the flexibility required delivering the course material in various length college credit courses or in short-term non-credit courses. The Engineering Drafting and CAD syllabus also suggests several industry standard software packages that institutions, depending on declared local industry needs, can choose from. The specific instructional package submitted has lessons focused on one (SolidWorks) of the several recommended software packages that provide a generic outline of what an introductory course should include so that those using other software packages could easily adapt the lessons to the specifics of the alternative programs. There is a plethora of well-respected introductory textbooks universally available in addition to a "step-by-step" tutorial text for details on software use. There are recommendations/suggestions for required computers to run the software as well as 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

INTRODUCTION TO HIGH TECH MANUFACTURING - 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 community colleges in the US	3