National STEM Consortium
Reviewer Form

NSC Certificate Area

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

Title of Course**: MEC MECHANICAL SYSTEMS**

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.

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 within the Mechanical Systems 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. The course content includes the fundamental background physics and mathematics concepts to understand the function and operation of subsystem components and how they are integrated

into a complex system. The mechanical components studied in the course include lubricants, bearings, belts, chains, gaskets, seals, packings, and other mechanical components. Skill developed during the course include but are not limited to personal safety practices, related industry safety procedures, basic preventive and operational maintenance processes, as well as proper use and care of hand, measuring and alignment tools and the appropriate professional behavior in the workplace.

Course instruction begins with the perfunctory but required operating procedures involved with the classroom management system. This is immediately followed by the demonstration of Personal Protection Equipment and training equipment related safety, and use processes. Safety priorities also continue to be emphasized as the course materials move to the identification, characterization, function, installation, operation, and maintenance of key (bearings, shafts, clutches, belts, chains, and gears) mechanical system components and their alignment into a mechanical system. The last module of instruction emphasizes the technology expectations of integrated mechanical subsystems as well as the specific knowledge and skills needed by a technician troubleshooting such systems.

As the course proceeds, the technician knowledge and skill expectations are built based on a physics and mathematics STEM platform that includes precise measurements and subsequent calculation to determine force, torque, and energy of the mechanical system. The course of instruction within the third model incorporate STEM expectations that include material science knowledge required for gasket and belt selection based on material properties as well as power distribution estimations to optimize system performance.

The last segment including the final assessment of this course represents capstone experience that involves applying knowledge learned and skills attained in the course modules. The experience includes demonstration of the student's operation, maintenance and troubleshooting strategies as they relate to the protocols associated with the productive use of complex mechanical systems. Student "hands-on" performance is a key factor in this assessment process.

(ii) Standards Relevance:

The course address skills associated with several industry standards. Safety practices as identified by OSHA are integrated into course content and developed as required skills during the progress 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. In addition, the Association for Packaging and Processing Technologies (PMMI) offers industry credentials in the mechatronics discipline including individual certifications in mechanical systems. Typically, the mechanical systems certification would not be used in isolation, but as one component of the multi-certificate mechatronics certification. The Mechanical Systems course of the National Stem Consortium (NCS) Mechatronics certificate aligns well with the individual Introduction to Mechanical Components certificate. Additionally, the Mechanical Systems covers similar topics to those in the Siemens Level I

Mechatronics Certification course titled “Mechanical Components and Electrical Drives”, and should help prepare students for the Siemens Level I Mechatronics Certification. Below is the list of topics in the Siemens course (www.siemens-certification.com). The Siemens course covers some electrical drive topics. The bold mechanical topics below are including in the NSC Mechanical Systems course.

- **Mechanical systems and subsystems in support of flow of energy in the system**
- **Components for transmitting torque (e.g., gears)**
- **Support components (e.g., bearings)**
- **Fasteners**
- **Couplings and clutches**
- Basics of electrical drives (AC and DC)
- **Technical documentation**
- **Safety issues, including local regulations**
- **Preventive and routine maintenance of components including lubrication requirements, surface properties, and prevention of friction**
- **Troubleshooting of the mechanical components within a module or system**

(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. These high skill and high wage jobs generally attract students, 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 industry needs. The structure of a course that delivers this content is optimal when it meets “best in class” characteristics. The Mechanical Systems course developed through the National STEM Consortium Curriculum Development Project has the characteristics of a “best in class” course.

The Mechanical Systems course in the NSC Mechatronics Program is a comprehensive program of study of mechanical components commonly used in a number of industry business sectors. There is a national need for skilled workers in industrial facilities of many kinds with different focused technologies. The National Association of Manufacturers (NAM), its Manufacturing Institute (MI) have defined this need to include industrial maintenance technicians, which includes the mechatronics skill set. 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 mechanical systems as well as mechatronics technicians in their original grant application. These high skill and high wage jobs generally attract students, unemployed and underemployed workers due to the intrinsic hands-on nature of t he work, continuous livelong learning opportunities as well as strong career advancement potential.

The Mechanical Systems course in the NSC Mechatronics Program is a comprehensive program of study of mechanical components commonly used in a number of industrial business sectors. This includes many sectors of manufacturing, supply chain technology, energy production systems, retail sales, entertainment systems, material processing, and many subsectors and defined process areas of these umbrella categories. Because the fundamental mechanical systems technologies support this breadth of industries, course materials for Mechanical Systems 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 Mechanical Systems 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 lesson also provides references to a couple of 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 to community colleges throughout the United States.

The structure of this course, Mechanical Systems, is based on text, presentations, and internet resources. All of the course resources 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 fifteen lessons of typically 3 hours of combined lecture and laboratory practice. Lessons are grouped into 3 distinct modules, which provide a lot of flexibility for anyone delivering the course material in various length college credit courses or in short-term non-credit courses. The Mechanical Systems course also recommends a well-respected textbook that is universally available. Here 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

MECHANICAL SYSTEMS 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