

**National STEM Consortium
Reviewer Form**

NSC Certificate Area

Composite Materials
Technology

Cyber Technology

Electric Vehicle
Technology

Environmental
Technology

Mechatronics

Title of Course: **MEC HYDRAULICS & PNEUMATICS**

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:

The National Association of Manufacturers’ (NAM), Manufacturing Institute (MI) has identified the need for industrial maintenance technicians, which includes the mechatronics with a hydraulic and pneumatic skill set. The materials provided within the MEC Hydraulic and Pneumatics course address the specific need for an understanding and skills attainment of the basics of fluid systems. The instruction package for this course includes lecture notes, some visual presentations, standard content text book references, student and instructor reference materials, demonstrations, and student hands-on activities that introduce and as well as reinforce the engineering science and its industrial applications for hydraulic and pneumatic systems. The course content includes the fundamental background physics, science and mathematics concepts necessary to understand the function and operation of the fluid (pneumatic and hydraulic)

“subsystem” components that are part of complex and integrated mechatronic systems. This course is set up in four modules of 20 hours of instruction each.

Course includes instructions on safety and operating procedures involved with the classroom management system. The first technical module covers introductory safety for hydraulic and pneumatic equipment and introduction to the nomenclature of different types of valves, gages and components. Students learn about the physical properties of gases and liquids and perform calculations using the ideal gas laws, Archimedes’ and Bernoulli’s equations. Lastly in this module the students learn how to trace the energy flow through a mechatronic system.

Module two focuses on air handling and operations in pneumatic systems and how to safely operate control and troubleshoot an air compressor and its air reservoir. Students will also learn about conductors, hoses, pipes, and lubrication for pneumatic systems. Additionally, students will learn to draw and interpret functional diagrams of compressors as well as read, understand and interpret the data sheets and specifications for pneumatic components. The third module focuses on operation, control, and preventative maintenance of hydraulic and pneumatic systems. Students learn component symbols and how to draw and read a fluid system schematic with the basic components. Maintenance lessons stress selection of proper fluids, fluid testing, fluid contamination and filtering, as well as pressure, viscosity, density and temperature measurements in working systems. At the system level, students learn how to troubleshoot system issues due to actuators, motors and air-driven equipment; and diagram pressure control and directional control valves illustrating the energy, mass and/or material flow through a system. Operational mode safety is always stressed for all equipment as interpreted from component, system schematics, and commercial specification data sheets.

In the fourth module, students learn the design and construction features of hydraulic and pneumatic components including actuators, directional control valves and motion control valves. The safe operational parameters of these components as well as their role in a system are reinforced. Students will experience more system level troubleshooting; safe operations and specifics of safety circuits and quick exhaust valves.

Plans for all lessons are provided and are extensive and comprehensive. Course materials include industry supplied reference manuals. Some PowerPoint presentations,

- Lesson 5 Powerpoints MEC_HandP_Lecture_HandPBasics2-26 slides provides Introduction lesson points on mass, volume, density, calculations and overview of flow concepts.
- Lesson 6 Powerpoints MEC_HandP_Lecture_HandPBasics1-20 slides provides same lesson points for Pascal’s law, pressure calculations, transmission and multiplication of force.
- Lesson 9 Powerpoints MEC_HandP_Lecture_Actuators-36 slides from University of Barcelona Automatic Control and Computer Engineering Department on technical Powerpoints MEC_HandP_Lecture_Solenoid-4 slides from FESTO introducing 3/2 way directional control valve with solenoid actuation and spring return.
- Lesson 11 Powerpoints MEC_HandP_Lecture_DirectionalControlValves-7slides from FESTO introducing the 5/2 way directional control valve with double solenoid actuation.
Powerpoints MEC_HandP_Lecture_ReedSwitches_Counters_Timers-7slides that

present introduction to reed and proximity switches.

Powerpoints MEC_HandP_Lecture_Relays-15 7slides from FESTO introducing Electro-magnetically actuated switches.

Lesson 11 Powerpoints MEC_HandP_Lecture_DoubleActingCylinder7slides are also available.

(ii) Standards Relevance:

The stand-alone course address skills associated with credentials of several industry standards including, those of the International Fluid Power Society (IFPS, <http://www.ifps.org/Certification/index.htm>) and the Association for Packaging and Processing Technologies (PMMI, <http://www.pmmi.org/Education/>). The IFPS offers various certifications in very focused areas of fluid machinery operation and repair. The newly released PMMI Fluid Systems certification is a comprehensive certification of entry-level fluid systems and is one of individual certifications that comprise the PMMI mechatronics suite of credentials. More pertinent to the STEM Consortium Mechatronics 30 credit hour academic Certificate is this course's alignment to the Siemens Level 1 Mechatronics certification. In this particular course, the student learning outcomes that align to this certification are identified in the course master outline, however, a more detailed skills level alignment would be more useful to anyone adopting this course. Students in courses that follow the course plan should, therefore, be prepared for the hydraulic and pneumatic Siemens Level I Mechatronics Certification assessment (target credential of the NSC STEM Consortium mechatronics program, <http://www.siemens-certifications.com/>).

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

High skill and high wage jobs in hydraulic and pneumatic control attract students, veterans, unemployed, and underemployed workers who like the hands-on nature of the work, continuous lifelong learning opportunities as well as strong career advancement potential. The structure of a course of study that delivers this content is optimal when it meets “best in class” characteristics. The MEC Hydraulic and Pneumatics course 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 unless he/she had specific needs or equipment. This course has an excellent lesson plan structure with specific detailed lesson plans and assessments. Any competent instructor familiar with the fundamentals of industrial fluid systems could deliver the course content with the materials provided.

The Hydraulic and Pneumatics course in the NSC Mechatronics Program is a comprehensive program of study of hydraulic and pneumatic systems that are integral to a number of technologies used by many industrial business sectors including manufacturing, supply chain technology, chemical and biological processing, material handling, processing, and many others. The course materials provided are divided into 15 lessons, are excellent, up to date, well written and appropriate for the Hydraulic and Pneumatics course at an introductory level. Appropriate resources are identified and at least one approach to delivering the material is suggested. Lesson

includes: student learning outcomes, handouts, lab/activity materials, references, simulations, assessments, and a time spent per lesson guideline. This course includes tests as well as final assessment that could be use if the materials were taught as outlined or could be used a guide for developing a new test or final assessment if similar equipment and/or activities were used in the course. Individual activities could be crossed referenced to other equipment by alignment through the student learning outcomes.

The lessons for this course also specify the expected background knowledge for students to be successful in the course. The course outline also emphasizes how critically important personal and interpersonal skills are as well as their integration into the technical course by using work team environments. The course integrates knowledge and skill attainment throughout the course while also encouraging implementation of the best teaching and learning strategies for this mastery by most learning styles of these kinds of materials.

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

The structure of this course, MEC Hydraulics & Pneumatics based on text, presentations, hands-on activities/labs and Internet resources. All of the course resources would be easy for an education institution to implement the same program anywhere in the US. Although some of the learning materials are specific to specific suppliers, the course can be implemented in any the institution that has Hydraulic and Pneumatic trainers. The content is also conducive to language translation to facilitate course delivery globally. The course modules are divided into discrete lessons that can be scheduled and offered in a variety of time frames. Lessons are grouped into 4 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 MEC Hydraulic and Pneumatics course also recommends well-respected textbooks and curriculum aligned to equipment that is 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

| HYDRAULICS AND PNEUMATICS 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 | 2 |
| (c) Can be disseminated quickly and widely to colleges in the US | 3 |