



Certification and Training for Automation and Mechatronics

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Introduction:

This article is a Work In Progress (WIP) paper that presents the faculty professional development which is an integral part of any academic institution. The curriculum and courses offered should be revised based on industry needs. The technology is advancing rapidly, and there is crying need for skilled workers in coming years. The Engineering Technology (ETEC) department at Sam Houston State University (SHSU) has just approved the Mechanical Engineering Technology (MET) and is committed to provide the best possible hands-on education so the students are work ready upon graduation. To ensure quality delivery of state-of-art MET education, two of the faculty were recently received different industry trainings which prepared them well for the courses they offered. These trainings are - FANUC Robotic Arm handling tool operation and programming; Amatrol Training on PLC Basics – AB5300 CompactLogix; and FANUC and SIEMENS CNC machining training.

In this WIP paper, the need and procedure for the authors to be certified by FANUC are described. The primary author also received week-long training from Amatrol in Programmable Logic Controllers (PLC). The other author received trainings on CNC machining, both from Siemens and FANUC. The primary goal is to have the authors ready and equipped with hands on skills for a fully automated environment where courses like Industrial Robotics, PLC, and Manufacturing can be taught. Since the primary authors' certification from FANUC in 2018, ETEC at SHSU has been recognized officially as one of their training sites. The Amatrol training also required the author to be onsite at the Amatrol facility and go through extensive hands-on skills for different components of PLC in Allan-Bradley logic. The CNC training includes both milling and turning certifications authorized by Siemens and Fanuc for their CNC controllers. For the Siemens controller, the authors receive a four days on-site training from a Siemens authorized instructor. The Fanuc certifications are based on 60 hours of online training (30 hours each for the milling and turning trainings).

FANUC Robotic Arm handling tool operation and programming:

The department of Engineering Technology at SHSU is blessed to receive a 25 million donation from Mr. Fred Pirkle. A good amount of this endowment money is used to purchase brand new equipment's. Among these equipment's are three FANUC LR MATE 200iD/4S robotic arms. The manufacturing company FANUC is based on Japan and controls major share of manufacturing and automation market. The FANUC Robotics certification process has three steps – onsite training, online exam, and finally, an approved lecture session. The onsite training generally involves exposure to FANUC robotic arms and program them to perform different tasks.

During the Summer of 2018, the primary author went for FANUC onsite training. The 32-hours long training took place from 06/05/2018 – 06/08/2018 at FANUC America local office in Houston, TX. Below is a summary of cost associated with different training hours; however this training received was paid for by Tech-Labs as part of the purchasing agreement. After the onsite training, the primary author received a certificate of participation and passed the online exam as required. The passing grade is an 80% out of 100. The final step to become a FANUC certified instructor is to record a teaching session and send to FANUC America for approval. The primary author taught "Industrial Robotics" class in Summer II 2018 and recorded certain sessions which was sent for

Standard Product Training	Training Location at FANUC Facility			Training Location at Customer Site	
	Price Per Student	Price Per Dedicated Course (8 Students)	Additional Student Rate for Dedicated Course Over 8 Students	Price Per Dedicated Course (8 Students)	Additional Student Rate for Dedicated Course Over 8 Students
4 Hour	\$242	\$1,839	\$121	\$1,936	\$133
8 Hour	\$484	\$3,678	\$242	\$3,872	\$266
16 Hour	\$968	\$7,357	\$484	\$7,744	\$532
24 Hour	\$1,452	\$10,454	\$726	\$11,616	\$799
32 Hour	\$1,936	\$12,390	\$968	\$13,165	\$1,065
40 Hour	\$2,420	\$15,488	\$1,210	\$16,456	\$1,331

approval. Upon submission and approval of the video, Dr. Basith was certified as FANUC Instructor. Later in the year, the other author Dr. Ma attended the onsite training as well. With the certification, our department is now recognized as official training site by FANUC America.

The same course was offered in Summer II 2019. Since the primary author is a certified instructor, the students enrolled for this course received a certificate for onsite training issued in FANUC America provided format and signed by the primary author. Figure 1(a) shows the first ever graduating batch of Engineering Technology students who received this certificate. This certification of training will certainly encourage our students to get more involved hands on for robotics training. The department is now working diligently to send authors for further training and hoping to take the advantage of being a FANUC recognized official training site by offering trainings to industry personnel. The training schedule in Houston TX and at FANUC America site is limited and seats fills up real quick. Engineering Technology department at SHSU will be a good alternative and serve the purpose to resolve this issue.

Amatrol Training for PLC:

As mentioned before, using the Fred Pirkle Endowment Fund, our department purchased 9 PLC trainers to offer automation course to our students. The primary author Dr. Basith attended a week long training at the main Amatrol training facility in Jeffersonville, IN. The training was on PLC Basics for AB5300 CompactLogix and took place between 07/15/2019 to 07/19/2019. Regular fee for such training varies between \$695-\$995/seat. However, if you are employed in academic institution and your organization purchased some of their trainers for teaching purpose, the registration is free. There as a mandatory \$135 administrative fee that covers classroom supplies, lunch, and shuttle service to Amatrol from the preferred hotel, which is the Sheraton Louisville Riverside located at 700 West Riverside Drive, Jeffersonville, IN. The closest airport is Louisville International Airport (SDF) in Kentucky. There are shuttles to and from the airport to the designated hotel. The training is basically a fun one with all hands on skills. We created programs in relay logic, solved different logic using different parameters. There were two groups: one for Allan-Bradley logic and the other for Siemens logic. This is really helpful for instructors, specially the communication issues for networked computers. The training site itself is awesome with hundreds of available instruments for different courses including but not limited to Advanced Manufacturing, Mechatronics, CNC Machining, HVAC, Power and Green Energy Technology, Mining, Oil & Gas etc. Figure 1(b) shows a random PLC troubleshooting equipment at the training facility.



(a)

(b)

Figure 1: (a) First batch of students receiving FANUC training certification in Engineering Technology department at SHSU and (b) PLC troubleshooting station at Amatrol Training.

CNC Training and Certification:

According to the 2018 Deloitte [1] and The Manufacturing Institute skills gap and future of work study', programming skills applied to industrial robots and automated manufacturing system such as computer numerical control (CNC) machine are one of the five critical skills expected to be needed to succeed in the future manufacturing industry . In addition to the certification for operation and programming of FANUC industrial robots, the ETEC department at SHSU provides training to students so that they possess the skills to obtain the following industrial CNC certifications:

- FANUC Certified Online CNC Turning Center
- FANUC Certified Online CNC Milling Center
- SIEMENS LEAP Certification Level 1 – Turning
- SIEMENS LEAP Certification Level 1 – Milling

The training is achieved by the offering of a sequence of two machining technology courses. The first course assumes that students have no experience with machining or related equipment. It serves as an introduction to the problems, techniques, and processes of modern machining technologies as well as commonly used tools and equipment. The second course of the sequence focuses on the programming based on the G-Code using both SIEMENS and FANUC controllers. In the introduction course, instruction is given in the use of hand operating machining equipment including band saw, grinder, drill press, vertical milling machine, and metal lathe machine; common tools for measurement and inspection including caliper, micrometer, height gauge, and dial gauge indicator; product planning and development including path design, discussion of cutting tools, machining feeds, and machining speeds; shop safety, and potential career opportunities. The focus is placed on the following essential turning and milling operations as well as tools for these operations:

- Turning: Straight turning, Facing, Drilling, Boring, Cut-off, Threading and Tapering
- Milling: Face milling, Drilling, Boring, End milling, Counter boring, Reaming and Tapping

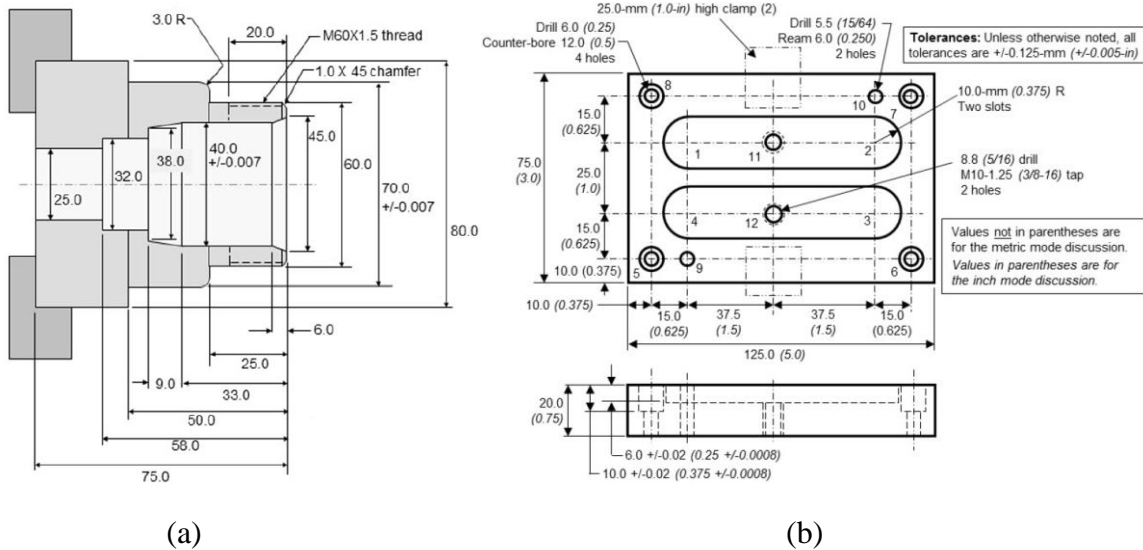


Figure 2: (a) Turning final project and (b) Milling final project

The first course uses lectures to build students’ fundamental understanding of the processes and emphasizes hands-on operation using a manual lathe and a vertical milling machine. Figure 2(a) shows the final turning project and Figure 2(b) shows the final milling project. In the two projects, all turning and milling operations discussed above are required.

The second course focuses on understanding the G-Code and programming CNC turning and milling centers to perform the same set of turning and milling operations discussed in the first course. The course first introduces students to the G-Code and then use the computer-aided manufacturing (CAM) software (NCGuide for FANUC and Sinumerik for SIEMENS). Once the programs are developed and verified in the software environment by simulation, they will be imported to an EMCO Concept Turn 60 tabletop lathe and an EMCO Concept Mill 55 tabletop mill to make the parts. The same projects that are shown in Figure 2(a) and Figure 2(b) are used in the second course for turning and milling correspondingly.

Once the student completed the Sinumerik Training, the students will be awarded the certifications since the instructors are certified SIEMENS trainer. To obtain the FANUC certification, the students will still have to complete a FANUC Online training session offered by FANUC Inc. The instructor who attended this training is Dr. Ma. The training was for four days: Monday 01/07/2019 to Thursday 01/10/2019 (two for turning and the other two for milling).

Future Work and Conclusion:

This is a work in progress paper and continuous process of development. Another author very recently went for the FANUC Vision training for an internally funded project both received (another accepted paper in ASEE 2020). The main goal is to prepare the Mechanical Engineering Technology (MET) curriculum with mechatronics concentration where these instructors (authors of this paper) can contribute heavily. A wireless networking class is also being developed and one author hope to get the Cisco Certification soon.

Reference

1. Deloitte, <https://www2.deloitte.com/us/en/pages/manufacturing/articles/future-of-manufacturing-skills-gap-study.html>, accessed Jan., 2020