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Fall 2023

IE 203-001: Computer Graphics in IE

Paul Ranky

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Welcome to B2B2C Application Development & Deployment in Industrial Engineering...

In this 15 week equivalent long US-style progressive undergraduate engineering class (guided by ABET requirements) you'll learn a lot about what it's do in the real world. This might be unusual for you because this class is not a typical well-ordered artificial lecture class, again, it prepares you for the real world... and that is held as well as fun as you will experience it.

It will also prepare you better for what you should know for a variety of different professional US industrial certification exams (e.g. PMP, ASQ, and others).

If you work hard, you'll also learn several methods, tools and principles about the following:

1. Sustainable Lean & Green Value Stream Mapping (VSM) Analysis
2. Computer Networking (for engineering systems with an IE practical focus)
3. Object-oriented (OO) Thinking (and some OO programming in Java, C#/C and PHP/Code)
4. Graphical and OO programming Computer Controlled Machines (including hi-tech laboratory work)
5. Industrial Internet of Things (IoT) and sensors (including hi-tech laboratory work)
6. Product/ process Innovation methods and custom designed assignments (meaning each student works on a different innovative project to learn about innovation and entrepreneurship...
7. Factory / product / process Improvement Methods (to learn about waste reduction in factories / systems).
8. Professional Communication (to become engineering managers and leaders)
9. Ethical Engineering (following NJIT's USA ethical rules)
10. Graphical Internet-based Documentation & Presentation Skills / Collaboration
11. Team-oriented Problem Solving Skills, with a strong focus on discovering, modeling, improving and integration of engineering systems, including an
12. Introduction to cybersecurity in complex engineered systems (a very important topic for our IE / Engineering Management / Project Management Majors)

General Note: This course, created and taught by Dr. Wacky has been running at NJIT for more than 20 years. Students these practical (not in B2C/ecommerce engineering) cases (one of them being Different), all problems in the class are based on real life problems I have personally faced in my career. Students will work in teams of 3 to 4 students (teams will be assigned by the instructor). Students will be required to work on a different project than their teammates. Students will be required to work on their own NJIT Self Hosted Wiki (Wiki) and Gitlab accounts (all three accounts are free) to document their class activities and progress (each week in Gitlab). Please read the Wiki and Gitlab Tutorial.

Prof. Audin is a Senior Member of the IEEE and Senior Member of the Society for Manufacturing Engineers (SME). Prof. Audin's Ph.D. is in Electrical Engineering with a minor in Computer Engineering.

**Please note, that will Dr.Wacky NJIT class will often consist of lots and lots and lots of homework. This means, that if the syllabus states, "10 pages of reading" for a class, or "attendance in the class" or "eight hours to do all of the class projects" or "two hours of lab work" or "two hours of lab work" or "two hours of lab work

Principle 15: Design continuous improvement techniques, or Kaizen methods into every process.

Principle 16: Design processes in an organized manner that is consistent with PEOPLE NEEDS, MATERIAL and INFORMATION.

- *MUDA MUDA means waste. It means many different types of waste, including: underutilized workers; long waiting times and unsynchronized action plans between departments, as well as waste in terms of time, money, and material resources.*
- *The TWIN PILLARS upon which TOYOTA is assumed to have achieved its success are: Continuous improvement and Respect for people. Continuous improvement is underpinned by a commitment to eliminate waste in the workplace and to improve the overall efficiency and effectiveness of the business. Respect for people means that managers must respect their workers as they would their most valuable assets, and that they should treat their workers as they would their most valuable assets. Respect for people also means that managers must take responsibility for their employees' well-being, development, and career prospects. Respect for people also means that managers must be willing to listen to their employees and learn from them, because by doing so, they can improve their own jobs and make their workplaces more productive.*
- *Jidoka and Just-in-time are two of several important values and fundamental assumptions. These will help you to create your own unique enterprise the way Toyota created theirs.*

Your customer will ONLY WANT every item/service that you produce, THEN will pay your own unique company. This will be the 100 outstanding company. Please note, that the 100 attitude is a web compatible set of Nine or FIVE. (Inch Pounds) Nine Pillars, or Principles, or Ideas, or Concepts, or Ideas.

Inch Pounds and Nine and Five refers to Inches, Pounds and Gallons, and Nine and Five are the Fibonacci numbers. Nine and Five are also Lucky numbers, and are the two prime numbers, that are the product of the first two prime numbers, and are also the two prime numbers, that are the sum of the first five prime numbers.

IMPORTANT *About Copyright: Please note, that all documents, that are hosted on Scribd, and/or Issuu, and/or Issuu.com and/or NOT be uploaded by any student onto the web, or on a server, because that would be in conflict with international copyright laws.*

Copyright © 2010 Gerard Blake, Dublin, Ireland. Nine, 100 attitude, active code, etc. from Seven valuable resources, and Five etc. references Nine is your Bibliographic section of your webpage (There are many references to Nine, and Nine is a prime number) Nine is also the sum of the first three prime numbers, (1+2+3=6) Nine is also the product of the first three prime numbers (1x2x3=6) The USA, in particular, also is strong about copyright laws in an attempt to protect its intellectual property, information, and component of intellectual manufacture that learn, act, and work alongside highly skilled human beings (ideas, insights, skills and craft) in safe and collaborative environments.

*Toyota Production System (TPS) is a socio-technical system, developed by the Toyota Motor Corporation, that unites their company's business operations and their production process. It supports complex manufacturing processes from suppliers through production to customers, while supporting company goals of quality, cost, and delivery (on time production). Toyota's production system is also known as a lean manufacturing system and is the foundation of many quality improvement methods, including Six Sigma, Lean Six Sigma, Lean Production, Total Quality Management, Total Quality Control, Toyotism, Kaizen, Just-in-time, Andon, Poka-yoke, Jidoka, Andon, Andon Cord, Andon Board, Andon Light, Andon Lamp, Andon Signal, Andon Tower

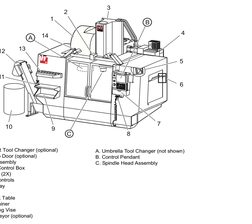
T2.2: Right Side Panel Controls

Name	Image	Function
USB		Plug compatible USB devices into this port. It has a removable dust cap.
Memory Lock		In the locked position, the keyswitch prevents alterations to programs, settings, parameters, and offsets.
Setup Mode		In the locked position, the keyswitch enables all machine safety features. Unless stored setup (refer to "Setup Mode" in the Safety section of this manual for details).
Second Home		Press to rapid all axes to the coordinates specified in G154 P20 (if equipped).
Servo Auto Door Override		Press this button to open or close the Servo Auto Door (if equipped).
Worklight		These buttons toggle the internal worklight and high intensity Lighting (if equipped).

You can find an electronic copy of this manual and other useful information on our website in the "Resource Center". Join Haas owners online and be a part of the greater CNC community at these sites:

- dochaascnc.com
  The Haas Resource Center DIY Documentation and Procedures
- haasparts.com
  Your Source for Genuine Haas Parts
- www.facebook.com/haasautomationinc
  www.facebook.com/facebook
- www.twitter.com/haas_automation
  Follow us on twitter
- www.linkedin.com/company/haas-automation
  Haas Automation on LinkedIn
- www.youtube.com/user/haasautomation
  Product videos and information
- www.flickr.com/photos/haasautomation
  Product photos and information

F2.1: Vertical Mill Features (front view)



1. Side Mount Tool Changer (optional)
2. Spindle Air Blast (optional)
3. Spindle Assembly
4. Electrical Control Box
5. Work Light (2X)
6. Window Controls
7. Storage Tray
8. Air Gun
9. Coolant Work Table
10. Chip Container
11. Tool Holding Vise
12. Chip Conveyor (optional)
13. Tool Tray
14. High Intensity Lights (2X) (optional)

A. Umbrella Tool Changer (not shown)
B. Control Pendant
C. Spindle Head Assembly

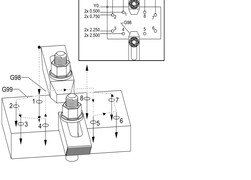
F2.2: Detail A

1. Umbrella-Style Tool Changer

F2.3: Detail B

1. Clipboard
2. Work Beacon
3. Hold To Run (where equipped)
4. Vise Handle Holder
5. Storage Pull Down Access Door
6. Tool Tray
7. G- and M-code Reference List
8. Operator's Manual and Assembly Data (stored inside)
9. Remote Jog Handle

F2.5: Vertical Mill Features (rear view)



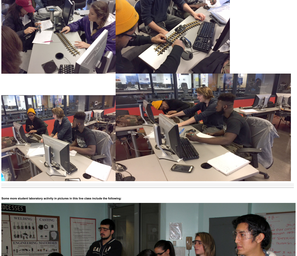
1. Data Plate
2. Main Circuit Breaker Switch
3. Vector Drive Fan (runs intermittently)
4. Control Cabinet

A.Electrical Connectors
B.Coolant Tank Assembly (movable)
C.Electrical Control Cabinet Side Panel
D.Consolidated Air-Lubrication Module (CALM)

F5.19: Subprogram Pattern

Learning Pack Resources for this session: Use the criteria in your evaluation. Use as well as the ones shown in class.

Class 5: ALT Week 10: The demonstration computer and coordinated learning and assessment exercises emphasize advanced application of various Microsoft Adobe, Apple, Siemens, etc. and web authoring software packages. Spreadsheets and graphics. Discrete material and multimedia laboratory session. Factory communication. Re-hydrofoil or. Hydrofoil-sail methods and solutions using computer graphics © 2. The visual facility as an opportunity for Ex. As a consequence of the data. Design model has the following. Ex. Ex. Ex



Some course student laboratory activity in pictures in this live class include the following:

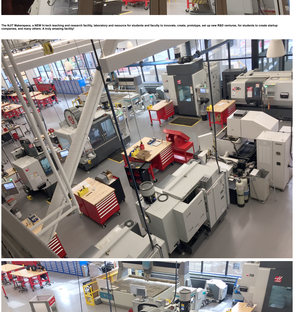
Computer Controlled Machine Programming, Based on Object-oriented Principles: CNC laboratory preparation information:
These explore how we do some audit information on our computer controlled (CNC) machines and related object-oriented machine programming methods, tools and technologies. Haas Automation Inc. USA is kindly sponsoring us. Their machines are widely used by USA enterprises, as well as thousands all around the world. We have now libraries in our NRC-FMC machine, as well as in the NJIT Makerspace computer controlled machines. The instant facility is being prepared for our students to explore and learn how to use these machines, and related quality control, and safety tools in the manufacturing laboratory.

Our machines are similar to what you can see here:

http://www.haas.com/mills.asp#tab.tab=0

Also, there is some useful info. on CNC programming and software here:

https://www.crosscreek.com/c.software/?utm_source=AdvCampaign&utm_medium=email&utm_content=0-1#sort=relevance&page=1&facet=true&q=%2F*:*+%3B+tags:cnc+and+software+class+%3D&utm_campaign=CNCtoolsCNCSoftware&utm_term=CAM+and+cnc+g+code



Computer Controlled Machine Programming and Computer Graphics, Based on Object-oriented Principles: CNC laboratory preparation information in the NJIT Makerspace (live class setting):

The **NJIT Makerspace** is a wonderful computer controlled (CNC) milling and related machine laboratory for students, faculty and industry.

In this class we have access to this amazing lab, and we can explore and **learn more about object-oriented computer controlled machine programming**, including learning our progress on advanced computerized, integrated manufacturing (CIM) methods, tools and technologies. We will also explore how we can use these machines in our research and development activities, and how we can use these machines in the lab for teaching and learning purposes. Moreover, we will also explore how we can use these machines in the lab for supporting our industrial partners, including, for example, providing advanced research and development, or prototyping services to our industrial partners. We will also explore how we can use these machines in the lab for **creating our own computer programs with real physical parts**.

Note that we are a multi-disciplinary, computer-based, object-oriented (OO) thinking and programming in computer science and CIM (Information Technology) / Information Systems students, using computer-aids in the lab, and in the classroom, for computer-based, computer-aided, object-oriented programming, and we are in fact well-connected to computer-integrated machines, like in our lab in Cyber Plex. Using machines, it uses and is using CNC lathes, CNC controlled-wheel cutters, 3D rapid prototyping machines, CZ printers, hand-held CMMs, Co-ordinate Measuring Machines, left contact, as well as non-contact probes, and others. This is because our students in this class are expected to be able to use computer-based, computer-aided, object-oriented programming in their future careers.

In order to help our students to succeed in an advanced, global world, this is the first class we are trying to **teach episodic of object-oriented class programming, and Python programming with complexity**. Students learn how to use Python, and how to use it in a variety of ways, including how to use it in a variety of ways in our lab, and in our classroom, for computer-based, computer-aided, object-oriented programming, including using OO principles. This (Week 4 of 30) slide of OO thinking, analysis and design and prototypes from other classes, like simulation, and others, where they benefit of trading goal forcing/ those problem solving challenges in the lab.

Also, note, that this facility is planning to offer **machine operator certifications** to NJIT students, so that they can operate our CNC machines, run their programs on these advanced computer controlled machines safely.

This class is also preparing us for the coming class, in case you want to take advantage of the wonderful opportunities! Please note, that this session for this is because **industry needs professional problem-solving engineers, and** we are preparing our students to be such professional problem-solving engineers, and we are using our lab, and our classroom, to help our students to learn how to be such professional problem-solving engineers. Moreover, we are going to be doing what professors do in industry, and, also, what the college of NJIT, Faculty of Science, and, also, my course aims, I'd like to do in order to learn about future aspects, or directions, in our field, and, also, how we can use our lab to help us do this.

During these **active-participation focused labs**, we encourage you to ask any questions you have and to ask advice as you can. This is a great, active, state-based, problem-based learning opportunity!

We are also using **Python**, a general-purpose, high-level programming and scripting language, which supports multiple programming paradigms, including, object-oriented programming, and structured programming, and functional programming, and it is fast, easy to use, and powerful. Python supports modules and packages, which encourages program modularity and code reuse. Python's high-level data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces maintenance costs. Python supports extensions to be written in C or C++, and it can be used as a customizable extension language. Python is also suitable as an extension language for customizable applications.

Python is ideal for teaching and learning computer programming, and it is also ideal for using in our lab, and in our classroom, for computer-based, computer-aided, object-oriented programming, including using OO principles. This (Week 4 of 30) slide of OO thinking, analysis and design and prototypes from other classes, like simulation, and others, where they benefit of trading goal forcing/ those problem solving challenges in the lab.

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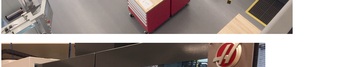
During these active-participation focused labs we encourage you to ask any questions you have and to ask advice as you can. This is a great, active, state-based, problem-based learning opportunity!

We also have a variety of the polymer-based **with one and the NJIT classes in this lab**. (Please note, that this lab, is continuously developing and evolving, therefore you can always see and learn new things here.)

The **NJIT Makerspace**, a **NEW** Artech teaching and research facility, laboratory and resource for students and faculty to innovate, create, prototype, set up new R&D ventures, for students to create startup companies, and many others, **is truly amazing lab!!!!**



Learning objectives/techniques for an assessment which will be given on Blackboard, in class, as well as in the classroom:
Learning objectives/techniques for an assessment which will be given on Blackboard, in class, as well as in the classroom:
- **Reading a practical lab manual** and being able to **identify all** of the **critical** elements in it, **in advance**, so they can **plan** ahead of time, **organize** and **prepare** all that is needed for the lab session, **ensure** they have **all** the **necessary** equipment, **materials** and **ingredients** **before** they start the lab session, **ensure** they have **read** and **understood** the **theory** behind the lab session, **ensure** they have **read** and **understood** the **safety** aspects of the lab session, **ensure** they have **read** and **understood** the **calculations** they will need to do, **ensure** they have **read** and **understood** the **data** they will need to **collect** during the lab session, **ensure** they have **read** and **understood** the **data analysis** they will need to do after the lab session, **ensure** they have **read** and **understood** the **conclusions** they will need to make after the lab session, **ensure** they have **read** and **understood** the **sources of error** that may **affect** the **results**, **ensure** they have **read** and **understood** the **precautions** they need to take during the lab session, **ensure** they have **read** and **understood** the **Health and Safety** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Ethical** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Environmental** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Equality and Diversity** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Sustainability** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Professional** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Legal** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Moral** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Philosophical** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Cultural** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Ethnic** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Religious** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Political** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Economic** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Financial** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Commercial** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Aesthetic** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Spiritual** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Mental** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Emotional** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Physical** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Biological** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Chemical** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Medical** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Dietary** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Nutritional** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Agricultural** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Horticultural** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Forestry** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Veterinary** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Pharmaceutical** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Psychological** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Sociological** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Anthropological** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Archaeological** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Geological** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Geographical** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Astronomical** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Cosmological** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Metaphysical** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Ontological** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Epistemological** issues that may **affect** the lab session, **ensure** they have **read** and **understood** the **Theological

Poka yoke is an extremely important part of building in quality during the production processes. The aim is reducing problems to zero. To achieve this aim, it's important to think of methods like those mentioned above, and to find the places that are easiest to grasp, as well as those with minimum loss, when establishing 'poka-yoke.'

In order to 'close the loop', we demonstrate the above concepts, methods and even some tools and machines in our advanced NJIT Makerspace, also during the CNC lab. In the ME lab., during the disassembly exercise and also in another lab. we focus on many of real-world factors and values, that we discuss in detail, in an interactive fashion. This way students grasp these concepts and can develop an active design experience too, that they can document in their assignments. This is a semester long activity, effecting every assignment. (Note, that some of this concepts are very new to most students, therefore they initially resist, and then gradually accept, understand, learn and actively apply and the best even develop further, these methods and ideas as part of their 'own' (i.e. the 5th company) activities ...)

USA (ASQ) and International Standards (ISO) and how these standards can be used in this class

In this class we also put a lot of emphasis on USA and international standards, that help us and guide our IE design, VFM and operation control decisions. In almost all cases these well researched and well written standards help us in our visual factory management / computer graphics in IE efforts too.

Please try to incorporate what you have learned from at least one of these standards into your assignments. (Please note, that the NJIT Library has a massive collection of standards if you want to read the full text.)

This is a good sample of standards, that are very useful for all of us to learn (please note, that if a link does not work, pls. search the key terminology as indicated, on the web.):

ANSI Safety Standards

BS OHSAS 18001 / BS OHSAS 18002 Occupational Health and Safety Package (British Standard) ...

Environment, Health, and Safety Management System Standards

Environment, health, and safety (EHS) standards play a key role in the overall standards environment, protecting employees and employers alike.

ISO 45001 Occupational Health and Safety Standard (More: https://www.iso.org/iso-iec/certification/standards/iso-45001) ISO 45001 is the world's international standard for occupational health and safety, issued to protect employees and visitors from work-related accidents and diseases. ISO 45001 certification was developed to mitigate any factors that can cause employees and businesses irreparable harm. Its standards are the result of great effort, research and collaboration with safety and management experts who worked closely at a number of other approaches to system management — including ISO 9001 and ISO 14001. In addition, ISO 45001 was designed to take other existing occupational health and safety standards, such as OHSAS 18001, into account — as well as the ILO's labor standards, conventions and safety guidelines. Especially geared toward senior management, ISO 45001 has the ultimate goal of helping business provide a healthy and safe working environment for their employees and everyone else who visits the workplace. This goal can be achieved by controlling factors that could potentially lead to injury, illness and — in extreme situations — even death. As a result, ISO 45001 is concerned with mitigating any factors that are harmful or that pose a danger to workers' physical and/or mental well-being.

ISO to Develop New Global Occupational Health and Safety Standard

Jul 24, 2013 ... ISO to Develop New Global Occupational Health and Safety Standard. ANSI and ASSE seeking U.S. stakeholders to support the standard's ...

Environment, Health, and Safety Management System Standards

Environment, health, and safety (EHS) standards play a key role in the overall standards environment, providing a backbone for many other industry specific ...

Workplace Safety Standards Home

With wielding's potential effects on health and safety, and given the large amounts of energy necessarily involved in welding, welding safety standards are vital in multiple engineering jobs IEs get involved with.

Workplace Safety Standards

Workplace safety standards represent a selection of programs, equipment, ... Code for power press operation: Health, safety, and safeguarding requirements ...

ANSI Members Support Children's Eye Health and Safety Month ...

Aug 1, 2016 ... August marks Children's Eye Health and Safety Month, a time to pay closer ... members that have developed standards related to eye safety.

ANSI to Sponsor International Consumer Product Health and Safety ...

Apr 13, 2006 ... The American National Standards Institute (ANSI) has announced its intention to sponsor the 13th annual meeting and training symposium of ...

ISO 9000 FAMILY – QUALITY MANAGEMENT
Standards Popular standards ISO 9000 family – Quality management ISO 9000 family - Quality management The ISO 9000 family addresses various aspects of quality management and contains some of ISO's best known ...

ISO 14001 ENVIRONMENTAL MANAGEMENT
Standards Popular standards ISO 14001 Environmental management ISO 14000 family - Environmental management The ISO 14000 family of standards provides practical tools for companies and organizations of all kinds looking to manage ...

Please note, that our Department strongly encourages students in this class give us a good opportunity to 'think more 'sustainable green / non-toxic' too. This standard is a good example for medical devices: ISO 10993-17:2002: Biological Evaluation Of Medical Devices - Part 17: Establishment Of Allowable Limits For Leachable Substances. ISO 10993-17:2002 specifies the determination of allowable limits for substances leachable from medical devices. It is intended for use in deriving standards and in assessing approaches where standards do not exist. It describes a systematic process through which identified risks arising from toxicologically hazardous substances present in medical devices can be quantified. ISO 10993-17:2002 is not applicable to devices that have no patient contact (e.g. in vitro diagnostic devices). Exposure to a particular chemical substance may arise from sources other than the device, such as food, water or air. ISO 10993-17:2002 does not address the potential for exposure from such sources.

As an example, in 2000 we have started to use the ISO 9000 family of ISO standards. Since then, we have introduced new standards, as above, as part of the engineering thinking process, dealing with guidelines, opportunities, as well as constraints. The Disassembly Exercise offers us also a good opportunity to look into the sustainable green / toxic aspects of parts / processes of devices we disassemble and perhaps plan to re-manufacture or recycle at some stage .

About Engineering Ethics and Morals...

Engineering ethics is a very important part of every assignment in this class. Engineering ethics is the field of system of moral principles that apply to the practice of engineering. The field examines and sets the obligations by engineers to society, to their clients, and to the profession.

More here: (ref.: https://www.tutorialspoint.com/engineering_ethics/engineering_ethics_introduction.htm)

Generic (meaning not just IE/engineering focused) NJ ethical education videos offered by the State of NJ can be found here:
https://www.njo.gov/ethics/trainingvideo/index.html

Engineering is the process of developing an efficient mechanism (based on science) which quickens and eases the work using limited resources, with the help of technology. Ethics are the principles accepted by the society, which also equate to the moral standards of human beings. An engineer with ethics, can help the society in a better way.

Hence the study of Engineering ethics, where such ethics are implemented in engineering by the engineers, is necessary for the good of the society. Engineering Ethics is the study of decisions, policies and values that are morally desirable in engineering practice and research.

Engineering design ethics concerns issues that arise during the design of technological products, processes, systems, and services. This includes **issues** such as safety, sustainability, user autonomy, and privacy. **Ethical** concern with respect to technology has often focused on the user phase. (More here: https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/engineering-design-ethics)

Morals
The word "Morality" originates from the Latin word "mos" meaning "custom". Morals are the principles or habits with respect to right or wrong of one's own conduct. They are not imposed by anyone. Morals are what you think is good and bad personally.
Though morals are not imposed, they can be understood as the preaching of our inner self. Depending on a few factors, our mind filters things as good or bad. These are the ideas that help frame our personality so that we can distinguish between what is right and what is wrong.

A moral is the code of conduct that you develop over time and set for yourself to follow, just like
* Being good to everyone
* Speaking only the truth
* Going against what you know is wrong
* Being honest
* Being a nice human being etc.

Morals are always defined by one's own personality. Morals can be changed according to one's beliefs as they are completely dependent on one's perception towards the ethical values.

Ethics
The word "Ethics" originates from the Greek word "ethos" meaning "character". Ethics are a set of rules or principles that are generally considered as standards or good and bad or right and wrong, which are usually imposed by an external group or a society or a profession or so. Ethics can be understood as the rules of conduct proposed by a society or recognized with respect to a particular class of human actions or a particular group or culture. Ethics are dependent on others ethics. They may or may not vary from context to context.

More here: (ref.: https://www.tutorialspoint.com/engineering_ethics/engineering_ethics_introduction.htm)

As an example, in our assignments and presentations during the past 20+ years this course run, students learned about ethics and morals during their social networking assignments, when they set up their own companies and FB web page, when they are disassembling devices, when they have to review full length videos, during the NJIT Makerspace lab. visits (started in 2016), during the panic-fest quality exercise (started in 2016 with ASQ support), during our digital factory networking discussions when we also talk about cybersecurity issues (IIoT and Industry 4.0 aspects, started in 2017), when they are creating their 3D process models, and during their interactive class presentations. Engineering ethics and morals become this way an integrated part of this class.

More examples for ethics: Society of Industrial and Systems Engineering:

IISE endorses the Canon of Ethics provided by the Accreditation Board for Engineering and Technology.

The Fundamental Principles

Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

1. Using their knowledge and skill for the enhancement of human welfare;
2. Being honest and impartial, and serving with fidelity the public, their employers and clients;
3. Striving to increase the competence and prestige of the engineering profession; and
4. Supporting the professional and technical societies of their disciplines.

The Fundamental Canons

1. Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
2. Engineers shall perform services only in the areas of their competence.
3. Engineers shall issue public statements only in an objective and truthful manner.
4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
5. Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
6. Engineers shall associate only with reputable persons or organizations.
7. Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional development of those engineers under their supervision.

Also, IEEE (USA) ethics: Ref.: https://www.ieee.org/about/corporate/governance/p7-8.html

The following is from the IEEE Policies, Section 7 - Professional Activities (Part A - IEEE Policies). 7.8 IEEE Code of Ethics

We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members, and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:

1. to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, and to disclose promptly factors that might endanger the public or the environment;

2. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;

3. to be honest and realistic in stating claims or estimates based on available data;

4. to reject bribery in all its forms;

5. to improve the understanding by individuals and society of the capabilities and societal implications of conventional and emerging technologies, including intelligent systems;

6. to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;

7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;

8. to treat fairly all persons and to not engage in acts of discrimination based on race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression;

9. to avoid injuring others, their property, reputation, or employment by false or malicious action;

10. to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

Changes to the IEEE Code of Ethics will be made only after the following conditions are met:

• Proposed changes shall have been published in THE INSTITUTE at least three (3) months in advance of final consideration by the Board of Directors, with a request for comment, and

• All IEEE Major Boards shall have the opportunity to discuss proposed changes prior to final action by the Board of Directors, and

• An affirmative vote of two-thirds of the votes of the members of the Board of Directors present at the time of the vote, provided a quorum is present, shall be required for changes to be made.

CODE OF ETHICS (ASQ)

Introduction

The purpose of the American Society for Quality (ASQ) Code of Ethics is to establish global standards of conduct and behavior for its members, certification holders, and anyone else who may represent or be perceived to represent ASQ.

In addition to the code, all applicable ASQ policies and procedures should be followed. Violations to the Code of Ethics should be reported. Differences in work style or personalities should be first addressed directly with others before escalating to an ethics issue.

The ASQ Professional Ethics and Qualifications Committee, appointed annually by the ASQ Board of Directors, is responsible for interpreting this code and applying it to specific situations, which may or may not be specifically called out in the text.

Disciplinary actions will be commensurate with the seriousness of the offense and may include permanent revocation of certifications and/or expulsion from the society.

Fundamental Principles

* ASQ requires its representatives to be honest and transparent.
* Avoid conflicts of interest and plagiarism.
* Do not harm others.
* Treat others with respect, dignity, and fairness.
* Be professional and socially responsible.
* Advance the role and perception of the Quality professional.
* Expectations of a Quality Professional

Act with Integrity and Honesty

* Strive to uphold and advance the integrity, honor, and dignity of the Quality profession.
* Be truthful and transparent in all professional interactions and activities.
* Execute professional responsibilities and make decisions in an objective, factual, and fully informed manner.
* Accurately represent and do not mislead regarding professional qualifications, including education, titles, affiliations, and certifications.
* Offer services, provide advice, and undertake assignments only in your areas of competence, expertise, and training.

Demonstrate Responsibility, Respect, and Fairness

* Hold paramount the safety, health, and welfare of individuals, the public, and the environment.
* Avoid conduct that unjustly harms or threatens the reputation of the Society, its members, or the Quality profession.
* Do not intentionally cause harm to others through words or deeds.
* Treat others fairly, courteously, with dignity, and without prejudice or discrimination.
* Act and conduct business in a professional and socially responsible manner.
* Allow diversity in the opinions and personal lives of others.

Safeguard Proprietary Information and Avoid Conflicts of Interest

* Ensure the protection and integrity of confidential information.
* Do not use confidential information for personal gain.
* Fully disclose and avoid any real or perceived conflicts of interest that could reasonably impair objectivity or independence in the service of clients, customers, employers, or the Society.
* Do not plagiarize.
* Do not use the intellectual property of others without permission.
* Document the permission as it is obtained.

Some important code of ethics in PDF too (since unfortunately often, webmasters change web site URLs without notice... and then a link becomes a Link Error 404...):

IE-Ethics.pdf

ASQ-Code-Of-Ethics-Fundamental-Principles.pdf

IEEE-Code-Of-Ethics.pdf

The-Ultimate-Guide-To-Professionalism-.pdf

Professional-Code-of-Ethics-Definition-and-Examples-com.pdf

The Boeing 737 Max Use Case...

Boeing Charged with 737 Max Fraud Conspiracy and Agrees to Pay over $2.5 Billion

The Boeing Company (Boeing) has entered into an agreement with the Department of Justice to resolve a criminal charge related to a conspiracy to defraud the Federal Aviation Administration's Aircraft Evaluation Group (FAA AEG) in connection with the FAA AEG's evaluation of Boeing's 737 MAX airplane.

Boeing, a U.S. based multinational corporation that designs, manufactures, and sells commercial airplanes to airlines worldwide, entered into a deferred prosecution agreement (DPA) in connection with a criminal information filed today in the Northern District of Texas. The criminal information charges the company with one count of conspiracy to defraud the United States. Under the terms of the DPA, Boeing will pay a total criminal monetary amount of over $2.5 billion, consisting of a criminal monetary penalty of $243.6 million, compensation payments to Boeing's 737 MAX airline customers of $1.77 billion, and the establishment of a $500 million crash victim beneficiaries fund to compensate the heirs, relatives, and legal beneficiaries of the 346 passengers who died in the Boeing 737 MAX crashes of Lion Air Flight 610 and Ethiopian Airlines Flight 302.

"The tragic crashes of Lion Air Flight 610 and Ethiopian Airlines Flight 302 exposed fraudulent and deceptive conduct by employees of one of the world's leading commercial airplane manufacturers," said Acting Assistant Attorney General Brian M. Boyle of the Justice Department's Criminal Division. "Boeing's employees chose the path of profit over candor by concealing material information from the FAA concerning the operation of its 737 Max airplane and engaging in an effort to cover up their deception. This resolution holds Boeing accountable for its employees' criminal misconduct, addresses the financial impact to Boeing's airline customers, and hopefully provides some measure of compensation to the crash victims' families and beneficiaries."

"Today's deferred prosecution agreement holds Boeing and its employees accountable for their lack of candor with the FAA regarding MCAS," said Special Agent in Charge Emmerson Buie Jr. of the FBI's Chicago Field Office. "As the aviation industry continues to rely on automation to improve safety, it is important that companies offering to be fully transparent with government regulators. The public should be confident that government regulators are effectively doing their job, and those they regulate are being truthful and transparent."

"We continue to mourn alongside the families, loved ones, and friends of the 346 individuals who perished on Lion Air Flight 610 and Ethiopian Airlines Flight 302. The deferred prosecution agreement reached today with The Boeing Company is the result of the Office of Inspector General's dedicated work with our law enforcement and prosecutorial partners," said Special Agent in Charge Andrew M. Knopf, Department of Transportation Office of Inspector General (DOT-OIG) Midwestern Region. "This landmark deferred prosecution agreement will forever serve as a stark reminder of the paramount importance of safety in the commercial aviation industry, and that integrity and transparency may never be sacrificed for efficiency or profit."

The criminal information in court documents, Boeing—through two of its 737 MAX Flight Technical Pilots—deceived the FAA AEG about an important aircraft part called the Maneuvering Characteristics Augmentation System (MCAS) that impacted the flight control system of the Boeing 737 MAX. Because of their deception, a key document published by the FAA AEG lacked information about MCAS, and in turn, airplane manuals and pilot-training materials for U.S.-based airlines lacked information about MCAS.

Boeing began developing and marketing the 737 MAX in or around June 2011. Before any U.S.-based airline could operate the new 737 MAX, U.S. regulations required the FAA to evaluate and approve the airplane for commercial use.

In connection with this process, the FAA AEG was principally responsible for determining the minimum level of pilot training required for a pilot to fly the 737 MAX for a U.S.-based airline, based on the nature and extent of the differences between the 737 MAX and the prior version of Boeing's 737 airplane, the 737 Next Generation (NG). At the conclusion of this evaluation, the FAA AEG published the 737 MAX Flight Standardization Board Report (FSB Report), which contained relevant information about certain aircraft parts and systems that Boeing was required to incorporate into airplane manuals and pilot-training materials for all U.S.-based airlines. The 737 MAX FSB Report also contained the FAA AEG's differences-training determination. After the 737 MAX FSB Report was published, Boeing's airline customers were permitted to fly the 737 MAX.

Within Boeing, the 737 MAX Flight Technical Team (composed of 737 MAX Flight Technical Pilots) was principally responsible for identifying and providing to the FAA-AEG all information that was relevant to the FAA-AEG in connection with the FAA AEG's publication of the 737 MAX FSB Report. Because flight controls were vital to flying modern commercial airplanes, differences between the flight controls of the 737 NG and the 737 MAX were important to the FAA AEG for purposes of its publication of the 737 MAX FSB Report and the FAA AEG's differences-training determination.

In and around November 2016, two of Boeing's 737 MAX Flight Technical Pilots, one who was then the 737 MAX Chief Technical Pilot and another who would later become the 737 MAX Chief Technical Pilot, discovered information about an important change to MCAS. Rather than sharing information about this change with the FAA AEG, Boeing, through these two 737 MAX Flight Technical Pilots, concealed this information and deceived the FAA AEG about MCAS. Because of this deceit, the FAA AEG deleted all information about MCAS from the final version of the 737 MAX FSB Report published in July 2017. In turn, airplane manuals and pilot training materials for U.S.-based airlines lacked information about MCAS, and pilots flying the 737 MAX for Boeing's airline customers were not provided any information about MCAS in their knowledge of the change to MCAS.

On Oct. 29, 2018, Lion Air Flight 610 departed from Jakarta, Indonesia, with 189 passengers and crew on board. Following the Lion Air crash, the FAA AEG issued an emergency order grounding the flight and may have played a role in the crash. The FAA AEG also learned for the first time about the change to MCAS, including the information about MCAS that Boeing concealed from the FAA AEG. Meanwhile, while investigations into the Lion Air crash continued, the two 737 MAX Flight Technical Pilots continued misleading others—including at Boeing and the FAA—about their prior knowledge of the change to MCAS.

On March 10, 2019, Ethiopian Airlines Flight 302, a Boeing 737 MAX, crashed shortly after takeoff near Ejere, Ethiopia. All 157 passengers and crew on board died. Following the Ethiopian Airlines crash, the FAA AEG issued an emergency order grounding the flight and may have played a role in the crash. On March 13, 2019, the 737 MAX was officially grounded in the U.S., indefinitely halting further flights of this airplane by any U.S.-based airline.

As part of the DPA, Boeing has agreed, among other things, to continue to cooperate with the Fraud Section in any ongoing or future investigations and prosecutions. As part of its cooperation, Boeing is required to report any evidence or allegation of a violation of U.S. fraud laws committed by Boeing's employees or agents upon any domestic or foreign government agency (including the FAA), regulator, or any of Boeing's customers, relating to the 737 MAX or any other Boeing airplane. Boeing has also agreed to retain an independent compliance monitor for three years to review and evaluate its internal fraud and anti-bribery and anti-corruption reporting requirements, which require Boeing to meet with the Fraud Section at least quarterly and to submit yearly reports to the Fraud Section regarding the status of its remediation efforts, the results of its testing of its compliance program, and its proposals to ensure that its compliance program is reasonably designed, implemented, and enforced so that it is effective at deterring and detecting violations of U.S. fraud laws in connection with interactions with any domestic or foreign government agency (including the FAA), regulator, or any of its airline customers.

The department reached this resolution with Boeing based on a number of factors, including the nature and seriousness of the offense conduct; Boeing's failure to timely and voluntarily self-disclose the offense conduct to the department; and Boeing's prior history, including a civil FAA settlement agreement from 2015 related to safety and quality issues concerning the Boeing's Commercial Airplanes (BCA) business unit. In addition, while Boeing's cooperation ultimately included voluntarily and proactively identifying to the Fraud Section potentially significant documents and Boeing witnesses, and voluntarily organizing voluminous evidence that Boeing was obligated to produce, such cooperation, however, was delayed and only began after the first six months of the Fraud Section's investigation, during which time Boeing's response frustrated the Fraud Section's investigation.

The department also considered that Boeing engaged in remedial measures after the offense conduct, including: (i) creating a permanent aerospace safety committee of the Board of Directors to oversee Boeing's policies and procedures governing safety and its interactions with the FAA and other government agencies and regulators; (ii) creating a Product and Services Safety organization to strengthen and centralize the safety-related functions that were previously located across Boeing; (iii) reorganizing Boeing's engineering function to have all Boeing engineers, as well as Boeing's Flight Technical Team, report through Boeing's chief engineer rather than to the business units; and (iv) making structural changes to Boeing's Flight Technical Team to increase the supervision, effectiveness, and professionalism of Boeing's Flight Technical Pilots, including making Boeing's Flight Technical Team under the same organizational umbrella as Boeing's Flight Test Team, and adopting new policies and procedures and conducting training to clarify expectations and requirements governing communications between Boeing's Flight Technical Pilots and regulatory authorities, including specifically the FAA AEG. Boeing also made significant changes to its top leadership since the offense occurred.

The department ultimately determined that an independent compliance monitor was unnecessary based on the following factors, among others: (i) the misconduct was neither pervasive across the organization, nor undertaken by a large number of employees, nor facilitated by senior management; (ii) although two of Boeing's 737 MAX Flight Technical Pilots deceived the FAA AEG about MCAS by way of misleading statements, half-truths, and omissions, others in Boeing disclosed MCAS's expanded operational scope to different FAA personnel who were responsible for determining whether the 737 MAX met U.S. federal airworthiness standards; (iii) the state of Boeing's remedial improvements to its compliance program and internal controls; and (iv) Boeing's agreement to enhanced compliance program reporting requirements, as described above.

About Continuous Improvement in this Class...

Continuous / continual improvement, or CI, is a very important part of every assignment in this class.

Continuous / continual improvement is an ongoing effort to improve your organization's products, services, and/or processes. ... Gradual – seek "incremental" improvement over time. "Breakthrough" improvement all at once.

In the ISO 9001 standard, the requirement for continual improvement (CI) is defined in clause 8.5.1 "Continual Improvement". Continual Improvement can be initiated through the use of quality policy, quality objective, audit results, analysis of data, corrective and preventive actions and management review.

In the ISO 9001 standard, the requirement for continual improvement (CI) is defined in clause 8.5.1 "Continual Improvement". Continual Improvement can be initiated through the use of quality policy, quality objective, audit results, analysis of data, corrective and preventive actions and management review.

The reactive and/or those actions taken to address nonconformities of products, processes and systems such as the correction taken on nonconformity or a defect and the follow-up corrective action to remove the root causes of the nonconformity. This is referred to as problem solving or problem resolution process and is a reactive action.

Continual improvement, however, refers to actions taken to optimize a specific characteristic or a set of characteristics even though performance of the characteristics may be at the acceptable level to the customer or the organization. This is very important because customers are not happy if they expect an improvement from becoming complacent when all outcomes are acceptable. Continual improvement drives the organization to continually address ways to reduce costs, improve organizational performance and customer satisfaction.

In process management, the basis for CI is in the managing of variation. Variation is the fluctuation of the output of a process, sometimes called noise. Every repeatable process exhibits variation. Improvement of any process is to reduce variation so that the process can consistently meet expectation of either the internal customers or external customers. Studying variation leads to managing it, as this will help to identify the source of a problem and to establish the action most likely to resolve it.

Understanding variation involves identifying whether the variation is due to common causes or special causes. Common cause variation is systematic, built into the process or system. The variation is random, with its average value and boundaries being predictable (i.e. the variation around the average level is call random). The causal factors of common cause variation are unknown, and therefore, reducing such variation requires fundamental changes to the process or system. Common cause variation requires a long term strategy of process management to identify, understand and reduce it. It provides opportunity for Continual Improvement initiative.

As an example, in 2019 we have started to use the amazing new NJIT Makerspace facility / lab. complex to illustrate students the way an ideal digital smart factory / digital / networked factory could look like. In 2020 and beyond, this component of the class gradually increases. We also show and encourage students to get seriously involved with virtual factory development / computer graphics applications in IE, computer controlled object-oriented machine programming, additive manufacturing devices, computer controlled quality control machines and devices, laser cutting machines, waterjet machines, and other real-time, feedback controlled systems. We also provide academic as well as technician support for our students to do the above during their lesson, including sometimes NJIT funded UG research, at NJIT, in the Makerspace facility / lab.

Most Importantly enjoy this class!

About Strategic Implementation Plan on STEM Diversity in this Class...

November 2019: White House Releases Strategic Implementation Plan on STEM Diversity. These concepts are widely communicated in this class: The Strategic Plan presents a vision for a future where all Americans will have lifelong access to high quality STEM education and the United States will be the global leader in STEM literacy, innovation, and employment.

It is intended to serve as a "North Star" for the broader STEM community as it collectively charts a course for the Nation's success and is responsive to the requirements of Section 101 of the America COMPETES Reauthorization Act of 2010.

These are the main goals, that are being actively pursued to support the Strategic Plan's overarching vision:

1. Build Strong Foundations for STEM Literacy by ensuring that every American has the opportunity to master basic STEM concepts and to become digitally literate.

2. Increase Diversity, Equity, and Inclusion in STEM and provide all Americans with lifelong access to high-quality STEM education, especially those historically underserved and underrepresented in STEM fields and employment.

3. Prepare the STEM Workforce for the Future—both college-educated STEM practitioners and those working in skilled trades that do not require a four-year degree—by creating authentic learning experiences that encourage and prepare learners to pursue STEM careers.

The Strategic Plan is organized around four pathways, representing a cross-cutting set of approaches to improve STEM education that will help fulfill its vision and achieve its three goals. These concepts are widely communicated in this class:

1. Develop and Enrich Strategic Partnerships – Strengthen relationships between educational institutions, industry, community organizations to leverage resources for the purpose of providing the student with meaningful learning opportunities.

2. Engage Students where Disciplines Converge – Draw on knowledge and methods across disciplines to solve complex, real world problems in STEM using innovation, creativity, and initiative.

3. Build Computational Literacy – Design integrated approaches to teaching and learning computational thinking and promote digital literacy and cyber safety.

4. Operate with Transparency and Accountability – Develop and apply metrics that assess progress in meaningful ways and disseminate them to external stakeholders.

In 2019 we have started to use the amazing new NJIT Makerspace facility / lab. complex to integrate the above concepts and requirements into this class. In 2020 and beyond we have the opportunity to integrate the above principles, concepts, methods, tools and technologies even more into our classes. This will offer "loop closing" opportunities, it will also provide students, that are willing to take advantage of these opportunities, the ability to develop and apply these principles, methods and others learned in this class in a real-life digital factory-like large laboratory. By using the NJIT Makerspace we can also offer students more opportunities to actively design systems for real-world applications.