# BMEn 2151 "Introductory Medical Device Prototyping"

Department of Biomedical Engineering, University of Minnesota

# Syllabus – Tentative Spring 2017

Instructor:	Prof. Steven Saliterman				
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	University of Minnesota	a			
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Location:	Medical Device Center				
TA:	Taingi Li	PLA A AM			
Office Hours:					
Location:	MDC				
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#### Lectures:

Lectures are on Monday & Wednesday 3:35 to 4:30 pm, and Friday 2:30 to 3:25 pm in the Medical Device Center (MDC). Fridays are a mix of discussion and exercise time.

**Lab:** Short discussions and workshop time for exercises are in the MDC, new CSE Student Workshops, and Mechanical Engineering Student Shop. These occur on Friday and independently.

#### Credits: 2

<u>Prerequisites</u>: The class size is initially limited to 20 students, and priority will go to CSE lowerdivision students who have completed BMEn 2401 (Programming/MATLAB). If seats remain available, others may add the class with permission from the instructor.

#### **Course Goals and Objectives**

Students will become acquainted with the following topics:

- Engineering drawing with SolidWorks
- CAM and 3D FDM printing
- Lathe, mill, and other shop instruction
- Biomaterials & biocompatibility
- Digital and analog electronics, SPICE
- Programming in C
- Microcontrollers, sensors and actuators



## **Required Books:**

Scherz, P. and S. Monk, *Practical Electronics for Inventors*, 4<sup>th</sup> ed., McGraw Hill, NY (2016). Cost is \$22.78.

## **Required Software:**

Arduino (free download) SolidWorks (free from the University) Multisim and Ultiboard (free student evaluation period, then \$39.95 to purchase)

## Optional Software (all can be downloaded for free):

Fritzing MPLAB IDE Integrated Programming Environment (IPE) MPLAB C Compiler MPLAB Code Configurator

## Reference Books (all are available on reserve from Prof. Saliterman in the MDC):

Electronics:

- Baker, B. A., *Baker's Dozen: Real Analog Solutions for Digital Designers*, Elsevier Newnes, Burlington, MA (2005).
- Belin, H.M. Design of Op Amp Circuits, Blacksburg, H.W. Sams Indianapolis, IN (1977).
- Carr, J.C. IC Timers, H.W. Sams, Indianapolis, IN, (1997)
- Jung, W., *Op Amp Applications Handbook*, Elsevier Newnes, Analog Devices, Burlington, MA (2006) Free on the web.
- Jung, W.G., IC Op Amp Cookbook 3<sup>rd</sup> ed. H.W. Sams, Indianapolis, IN (1991).
- Kochan, S.G., Programming in C, 3rd ed. H.W. Sams, Indianapolis, IN, (2005).
- Lancaster, D. and H.M. Berlin, CMOS Cookbook, H.W. Sams Indianapolis, IN (1988).
- Monk, S. Fritzing for Inventors, Tab McGraw Hill Education, New York, NY (2016).
- Monk, S. Hacking Electronics, Tab McGraw Hill Education, New York, NY (2013).
- Platt, C, *Encyclopedia of Electronic Components: Power Sources and Conversion*, Vol. 1, MakerMedia, Sebastopol, CA (2013)
- Platt, C, *Encyclopedia of Electronic Components: Signal Processing*, Vol. 2, MakerMedia, Sebastopol, CA (2014).
- Platt, C, *Encyclopedia of Electronic Components: Sensors*, Vol. 3, MakerMedia, Sebastopol, CA (2016).

Platt, C, *Electronics*, 2<sup>nd</sup> ed., MakerMedia, Sebastopol, CA (2015)

Platt, C, More Electronics, MakerMedia, Sebastopol, CA (2014)

## Engineering Drawing & CADD/CAM:

- Cogorno, G.R., Geometric Dimensioning and Tolerancing for Mechanical Design, McGraw Hill, 2<sup>nd</sup> ed., New York, NY (2011)
- Lombard, M. SolidWorks 2011 Parts (or later), Wiley, Indianpolis, IN (2011)
- Madsen, D. A. and D. P. Madsen, *Engineering Drawing and Design*, 5th ed., Delmar Cengage Learning, Clifton Park, NY, (2012)

## Machining:

Fitzpatrick, M., Machining and CNC Technology, McGraw Hill, New York, NY (2014).

## Materials:

Hill, D., *Design Engineering of Biomaterials for Medical Devices*, Wiley, New York, NY (1998). John, V. *Introduction to Engineering Materials 3<sup>rd</sup> ed.*, Industrial Press Inc., New York, NY (1992) Modjarrad, K. and S. Ebnesajjad, *Handbook of Polymer Applications in Medicine and Medical De-*

*vices*, 1st ed., Elsevier, William Andrew (2014) Ratner, B.D., A.S. Hoffman, F.J. Schoen, J.E. Lemons, *Biomaterials Science* 3<sup>rd</sup> ed. Society for Bio-

## Microcontrollers and Mechatronics:

materials, Academic Press, New York (2013).

Boxall, Arduino Workshop, No Starch Press, San Francisco, (2013).

Lynch, K.M., N. Marchuk, E.L. Matthew, *Embedded Computing and Mechatronics with the PIC32 Microcontroller*, Newnes-Elsevier, Waltham, MA (2016).

Scarpino, M. Motors for Makers, Que, Indianapolis, IN, (2016).

## **Programming:**

Kochan, S.G. *Programming in C*, 3<sup>rd</sup> ed. Developers library, Sams Publishing, Indianapolis, IN (2005).

Monk, S., *Programming Arduino: Getting Started with Sketches*, Tab – McGraw Hill Education, New York, NY (2012).

Monk, S., *Programming Arduino: Next Steps*, Tab – McGraw Hill Education, New York, NY (2012). Reas, C and B. Fry, *Processing: A Programming Handbook for Visual Designers and Artists*, 2<sup>nd</sup> ed. MIT (2014).

**Examinations:** See Class Schedule spreadsheet.

**Homework:** Reading assignments (25 pages/week) and exercises (some of which will be done during Lab time, others independently.)

Class Time: About 60% lecture, 30% exercises, and 10% discussion.

#### **Exercises**

You will be required to complete assigned exercises in engineering drawings, 3D FDM part fabrication, machining parts, breadboarding analog and digital circuits, C programming, and interfacing an Arduino to various sensors and actuators.

## **Grading**

Midterm exam	25%	
Exercises:	25%	
Project and participation:	15% Presentation	
	10% Participation	
Final exam:	25%	

If you are having difficulties with the material please let Prof. Saliterman or the TA know. We will meet with you and set up whatever is necessary for you to improve. If you perform poorly on a test, it is possible to study again and retake an examination. The examinations are short essay style, and not open book. Do no bring study materials or calculators into the examination room unless instructed to do so.

**<u>Course Conflicts:</u>** Please notify the instructor if you have a course or final examination conflict.



# **University Policies**

# Administrative Policy for Legitimate Absences

Students may be absent absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include illness of the student or his or her dependent, participation in intercollegiate athletic events. For other University of Minnesota policies regarding absences and makeup work, please see:

http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html

## **Board of Regents Policy on Academic Freedom**

Please read this important information on the University of Minnesota's Board of Regents Policy on Academic Freedom and Responsibility http://regents.umn.edu/sites/default/files/policies/Academic Freedom.pdf

## Board of Regents and Administrative Policy on Conduct, Teaching, and Learning

Please familiarize yourself with the Student Conduct Code and Administrative Policy on Teaching and Learning:

http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html http://regents.umn.edu/sites/default/files/policies/Student Conduct Code.pdf

## **Board of Regents Policy on Equity, Diversity, Equal Employment Opportunity, and Affirmative** Action

Please see this important information on the University of Minnesota's Board of Regents Policy on Equity, Diversity, Equal Employment Opportunity, and Affirmative Action: <u>http://regents.umn.edu/sites/default/files/policies/Equity\_Diversity\_EO\_AA.pdf</u>

## **Board of Regents Policy on Sexual Harassment**

Please see this important information on the University of Minnesota's Policy on Sexual Harassment:

http://regents.umn.edu/sites/default/files/policies/SexHarassment.pdf

## **Disability**

The University of Minnesota is committed to providing equitable access to learning opportunities for all students. Disability Services (DS) is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations.

If you have, or think you may have, a disability (e.g., mental health, attentional, learning, chronic health, sensory, or physical), please contact <u>DS at 612-626-1333</u> to arrange a confidential discussion regarding equitable access and reasonable accommodations. If you are registered with DS and have a current letter requesting reasonable accommodations, I encourage you to contact me early in the semester to review how the accommodations will be applied in the course.

## **Grade Definitions**

The University of Minnesota's "Grading and Transcripts" policy can be reviewed here: <a href="http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html">http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html</a>

## Mental Health and Stress Management Services

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating, and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce your ability to participate in daily activities. University of Minnesota services are available to assist you with addressing these and other concerns you may be experiencing. You can learn more about the broad range of confidential mental health services available on campus via www.mentalhealth.umn.edu. Please visit

http://mentalhealth.umn.edu/ for several resources for students, their parents, faculty, and staff.

#### Student Conduct Code

The University of Minnesota's Student Conduct Code: can be reviewed here: <a href="http://regents.umn.edu/sites/default/files/policies/Student Conduct Code.pdf">http://regents.umn.edu/sites/default/files/policies/Student Conduct Code.pdf</a>

#### BMEn 2151 - Introductory Medical Device Prototyping Class Schedule Spring 2017, M and W - 3:35-4:30 and F - 2:30-3:25, Two Credits Prof. Steven S. Saliterman

1     Wordnessky     1/19977     Introduction to Medical Drive Prototyping     Matson & Madson & Medican Selections     Shot week       2     Mording     1/232017     Janamentals of Engineering Drawing     Matson & Medican Selections     Jab 1 - Drawing exercises & 3D FDM printing.       3     Wordnessky     1/232017     Janamentals of Engineering Drawing     Matson & Medican Selections     Jab 1 - Drawing exercises & 3D FDM printing.       3     Wordnessky     1/22017     Janamentals of Engineering Drawing     Matson & Medican Selections     Jab 1 - Drawing exercises & 3D FDM printing.       4     Mording     2/22017     Discussion: Machine Shop Part 8 and 9     SoleWords Nations Selections     Lab 2 - Drawing exercises & 3D FDM printing.       4     Mording     2/22017     Discussion: Machine Shop Part 8 and 9     SoleWords Nations Selections     Lab 4 - Continuation of militathe training.       5     Mording     2/122017     Biomaterials Part 1 - Overview     Rater et al. selections     Lab 4 - Continuation of militathe training schedule.       6     Wordnesky     2/22017     Biomaterials Part 2 - Polymers     Mordiantal selections     Lab 5 - Fabricate part on milor lab.       7     Mordney     2/22017	Week	Day	Date	Торіс	Reading Assignment *	Weekly Labwork
Friday     1722/017     Fundamentals of Engineeing Drawing     Madison & Madison & Madison selections       2     Monday     1222017     Damic SoldWorks Part 1     Madison & Madison selections       3     Monday     1222017     Damic SoldWorks Part 2     SoldWorks build (TBD)       9     Monday     1222017     Decessor: Machine Solp Part 1     SoldWorks build (TBD)       9     Monday     1222017     Damic SoltWorks Parts 2 and 3     Madison & Madison selections     Lab 2 - Drawing exercises & 3D FDM priving.       4     Monday     2202017     Damic SoltWorks Parts 2 and 3     Madison & Madison selections     Lab 2 - Drawing exercises & 3D FDM priving.       6     Monday     2202017     Damic SoltWorks Parts 3 and 4     Madison & Madison selections     Lab 3 - ME safety videos and militable training.       6     Monday     2202017     Biomaterials Part 3 - Downwers     Estatations     Lab 4 - Continuation of militable training.       7     Medinay     2202017     Biomaterials Part 3 - Downwers     Moday     Saleternan selections     Lab 5 - Fabricate part on mill or lather       7     Medinay     2202017     Biomaterials Part 3 - Cownwers     Saletera	1	Wednesdav	1/18/2017	Introduction to Medical Device Prototyping		Short week
Wednesday     Procession     SoldWorks studnal (TBD)       3     Monday     1/32017     Decreation Solution Solution Stop Part 2 and 3       4     Wednesday     2/2017     Bernine Stop Part 2 and 3     SoldWorks studnal     Lab 2 - Drawing exercises & 3D FDM printing.       4     Monday     2/2017     Dernic SoldWorks Parts 3 and 4     Madson & Madson selections     Lab 3 - ME safety videos and milliathe training.       4     Monday     2/2017     Dernic SoldWorks Parts 3 and 4     SoldWorks studnal     SoldWorks stud					Madson & Madson selections	
Wednesday     Procession     SoldWorks studnal (TBD)       3     Monday     1/32017     Decreation Solution Solution Stop Part 2 and 3       4     Wednesday     2/2017     Bernine Stop Part 2 and 3     SoldWorks studnal     Lab 2 - Drawing exercises & 3D FDM printing.       4     Monday     2/2017     Dernic SoldWorks Parts 3 and 4     Madson & Madson selections     Lab 3 - ME safety videos and milliathe training.       4     Monday     2/2017     Dernic SoldWorks Parts 3 and 4     SoldWorks studnal     SoldWorks stud						
Friday     Friday     Friday     Friday     Decusion: Machine Shop Part 1       3     Monday     21/2017     Machine Shop Parts 2 and 3     SoldWorks tutorial     Lab 2 - Drawing exercises & 3D FDM pinting.       4     Morday     22/2017     Decusation: Machine Shop Parts 3 and 4     Machason & Madson selections     Lab 2 - Oraving exercises & 3D FDM pinting.       4     Morday     22/2017     Decusation: Machine Shop Parts 6 and 6     SoldWorks tutorial     Lab 2 - ME safety videos and milliathe training.       5     Monday     21/30201     Demos SoldWorks Parts 6 and 6     SoldWorks tutorial     Lab 4 - Continuation of milliathe training.       6     Monday     21/302017     Bornasteria Bart 1 - Overview     Ratior et. al. selections     Lab 5 - Ebincate part on mill or table.       6     Monday     22/202017     Biomasteria Bart 1 - Socompatibily     Salamman selections     Lab 5 - Ebincate part on mill or table.       7     Monday     22/20217     Analog Crouits Part 1 - Clocuit Theory     Scherz and Monk selections     Lab 6 - Breadboard analog crouit       8     Monday     33/20217     Decusator: Test Ecoloment     Scherz and Monk selections     Lab 7 - Characdetrae ciouit <td>2</td> <td></td> <td></td> <td></td> <td></td> <td>Lab 1 - Drawing exercises &amp; 3D FDM printing.</td>	2					Lab 1 - Drawing exercises & 3D FDM printing.
Monday     132017     Demo: SolidWorks Parts 2 and 3     Madams & Madson & Madson selections     Lab 2 - Drawing exercises & 3D FDM printing.       4     Monday     222017     Demo: SolidWorks Parts 3 and 4     SoleWorks tutorial     Lab 2 - Drawing exercises & 3D FDM printing.       4     Worksedy     220017     Demo: SolidWorks Parts 5 and 6     SoleWorks tutorial     Lab 3 - ME solety videos and mill/athe training.       5     Monday     220217     Demo: SolidWorks Parts 5 and 6     SoleWorks tutorial     Lab 4 - Continuation of mill/athe training.       6     Monday     2202017     Demo:solidWorks Parts 5 and 6     SoleWorks tutorial     Lab 4 - Continuation of mill/athe training.       7     Monday     2202017     Demorarise Part 1 - Overview     Rater ent at a selections     Lab 5 - Fabricate part on mill rathe.       7     Monday     2222017     Bomaterise Part 1 - Overview     Solarman selections     Lab 5 - Fabricate part on mill rathe.       7     Monday     2222017     Analog Cincula Part 1 - Oreview     Scherz and Monk selections     Lab 7 - Characterize cincult       8     Monday     322017     Mildern Exam Part 1 - Oreview     Scherz and Monk selections     Lab 7 - Characterize					SolidWorks tutorial (TBD)	
Wednesday     21/2017     Machine Shop Part 2 and 3     SoldWorks tutorial       4     Monday     22/2017     Demo: SoldWorks Parts 3 and 4     Madison & Madison & Madison Selections     Lab 3 - ME safety videos and millishe training.       5     Monday     21/2017     Demo: SoldWorks Parts 3 and 6     SoldWorks tutorial     Lab 4 - Continuation of millishe training.       5     Monday     21/2017     Computer Akide Manufacturing Parts 1 & 2     Figger Parts 2     Lab 4 - Continuation of millishe training schedule.       6     Monday     22/2017     Biomaterials Part 2 - Polymers     Modiard selections     Lab 5 - Fabricate part on mill or lathe.       6     Monday     22/2017     Biomaterials Part 2 - Polymers     Modiard selections     Lab 5 - Fabricate part on mill or lathe.       7     Monday     22/2017     Biomaterials Part 1 - Corucitwe     Safterma selections     Lab 6 - Breadboard analog circuit       7     Monday     22/2017     Malago Circuits Part 1 - Oraview     Safterma and Monk selections     Lab 6 - Dreadboard analog circuit       8     Monday     38/2017     Malago Circuits Part 1 - Oraview     Scherz and Monk selections     Lab 7 - Characterize circuit <td< td=""><td></td><td>Friday</td><td>1/27/2017</td><td>Discussion: Machine Shop Part 1</td><td></td><td></td></td<>		Friday	1/27/2017	Discussion: Machine Shop Part 1		
Wednesday     21/2017     Machine Shop Part 2 and 3     SoldWorks tutorial       4     Monday     22/2017     Demo: SoldWorks Parts 3 and 4     Madison & Madison & Madison Selections     Lab 3 - ME safety videos and millishe training.       5     Monday     21/2017     Demo: SoldWorks Parts 3 and 6     SoldWorks tutorial     Lab 4 - Continuation of millishe training.       5     Monday     21/2017     Computer Akide Manufacturing Parts 1 & 2     Figger Parts 2     Lab 4 - Continuation of millishe training schedule.       6     Monday     22/2017     Biomaterials Part 2 - Polymers     Modiard selections     Lab 5 - Fabricate part on mill or lathe.       6     Monday     22/2017     Biomaterials Part 2 - Polymers     Modiard selections     Lab 5 - Fabricate part on mill or lathe.       7     Monday     22/2017     Biomaterials Part 1 - Corucitwe     Safterma selections     Lab 6 - Breadboard analog circuit       7     Monday     22/2017     Malago Circuits Part 1 - Oraview     Safterma and Monk selections     Lab 6 - Dreadboard analog circuit       8     Monday     38/2017     Malago Circuits Part 1 - Oraview     Scherz and Monk selections     Lab 7 - Characterize circuit <td< td=""><td>3</td><td>Monday</td><td>1/302017</td><td>Demo: SolidWorks Parts 2 and 3</td><td>Madson &amp; Madson selections</td><td>Lab 2 - Drawing exercises &amp; 3D FDM printing</td></td<>	3	Monday	1/302017	Demo: SolidWorks Parts 2 and 3	Madson & Madson selections	Lab 2 - Drawing exercises & 3D FDM printing
Monday     245/2017     Demo: SoldWorks Parts 3 and 4     Madson & Madson selections     Lab 3 - ME safety videos and mil/lafte training.       Wednesdy     2/4/2018     Decussion: Machine Shop Part 6     SoldWorks tutorial     Lab 4 - Continuation of mil/lafte training.       Fiday     2/10/2018     Bocassion: Machine Shop Part 6 and 6     SoldWorks tutorial     Lab 4 - Continuation of mil/lafte training.       Fiday     2/11/2017     Bornaterials Part 1 - Overview     Ramer 4. al. selections     Lab 4 - Continuation of mil/lafte training.       6     Monday     2/17/2017     Bornaterials Part 2 - Paymens     Modgarrad selections     Lab 5 - Fabricate part on mill or lafte.       6     Monday     2/22/2017     Analog Circuits Part 1 - Circuit Theory     Scherz and Monk selections     Lab 6 - Breadboard analog circuit       7     Monday     3/8/2017     Mediamer 2 - Analyfiers     Berlin selections     Lab 6 - Breadboard analog circuit       8     Monday     3/8/2017     Mediamer 2 - Analyfiers     Berlin selections     Lab 7 - Characterize circuit       9     Monday     3/8/2017     Mediamer 2 - Analyfiers     Scherz and Monk selections     Lab 7 - Characterize circuit       9     Monday						
Wednesdy     28/2017     Demo: Solid/Works Parts 5 and 6     Solid/Works Lutorial       5     Monday     2/10/2017     Computer Atided Manufacturing Parts 1.8.2     Fitzpatrick selections     Lab 4 - Continuation of mil/lathe training schedule.       6     Monday     2/17/2017     Biomaterials Part 1 - Overview     Monday     Lab 5 - Fabricate part on mill or lathe.       7     Monday     2/22/2017     Biomaterials Part 2 - Polymers     Modgarrad selections     Lab 5 - Fabricate part on mill or lathe.       7     Monday     2/22/2017     Analog Circuits Part 1 - Circuit Theory     Scherz and Monk selections     Lab 6 - Breadboard analog circuit       7     Monday     3/8/2017     Analog Circuits Part 1 - Circuit Theory     Scherz and Monk selections     Lab 7 - Characterize circuit       8     Monday     3/8/2017     Midterm Exam Part 1 - Drawing     Scherz and Monk selections     Lab 7 - Characterize circuit       9     Monday     3/8/2017     Midterm Exam Part 2 - Communication     Scherz and Monk selections     Lab 7 - Characterize circuit       9     Monday     3/2/2017     Midterm Exam Part 2 - Communication     Scherz and Monk selections     Lab 8 - Design a circuit board		Friday	2/3/2017	Discussion: Machine Shop Parts 4 & 5		
Wednesdy     28/2017     Demo: Solid/Works Parts 5 and 6     Solid/Works Lutorial       5     Monday     2/10/2017     Computer Atided Manufacturing Parts 1.8.2     Fitzpatrick selections     Lab 4 - Continuation of mil/lathe training schedule.       6     Monday     2/17/2017     Biomaterials Part 1 - Overview     Monday     Lab 5 - Fabricate part on mill or lathe.       7     Monday     2/22/2017     Biomaterials Part 2 - Polymers     Modgarrad selections     Lab 5 - Fabricate part on mill or lathe.       7     Monday     2/22/2017     Analog Circuits Part 1 - Circuit Theory     Scherz and Monk selections     Lab 6 - Breadboard analog circuit       7     Monday     3/8/2017     Analog Circuits Part 1 - Circuit Theory     Scherz and Monk selections     Lab 7 - Characterize circuit       8     Monday     3/8/2017     Midterm Exam Part 1 - Drawing     Scherz and Monk selections     Lab 7 - Characterize circuit       9     Monday     3/8/2017     Midterm Exam Part 2 - Communication     Scherz and Monk selections     Lab 7 - Characterize circuit       9     Monday     3/2/2017     Midterm Exam Part 2 - Communication     Scherz and Monk selections     Lab 8 - Design a circuit board						
Friday     21/02018     Descusion: Machine Shop Part 6     Image: Computer Aided Manufacturing Parts 1 & 2.       5     Monday     21/32017     Computer Aided Manufacturing Parts 1 & 2.     Fitzpatick selections     Lab 4 - Continuation of millishe training schedule.       6     Wednesday     21/32017     Workshop Trm (ab services)     Modigared selections     Lab 5 - Fabricate part on mill or lathe.       6     Monday     22/2017     Biomaterials Part 2 - Polymers     Modigared selections     Lab 5 - Fabricate part on mill or lathe.       7     Monday     22/2017     Mondar Selections     Lab 6 - Breactboard analog circuit       7     Monday     22/2017     Molder Selections     Lab 6 - Breactboard analog circuit       8     Monday     23/2017     Molder Selections     Lab 7 - Characterize circuit       8     Monday     3/82017     Moders Selections     Lab 7 - Characterize circuit       9     Monday     3/82017     Morks Selections     Lab 7 - Characterize circuit       9     Monday     3/82017     Morks Selections     Lab 7 - Characterize circuit       9     Monday     3/82017     Morkselections     Lab 7	4					Lab 3- ME safety videos and mill/lathe training.
Monday     2/13/2017     Computer Aided Manufacturing Parts 1.8.2     Fickapartick selections     Lab 4 - Continuation of millifathe training schedule.       Fickapartic     2/17/2017     Biomaterials Part 1 - Orveive     Rater et. al. selections     Lab 4 - Continuation of millifathe training schedule.       Monday     2/202017     Biomaterials Part 2 - Polymers     Modgarrad selections     Lab 5 - Fabricate part on mill or lathe.       Wednesday     2/22/2017     Biomaterials Part 3 - Biocompatibility     Modgarrad selections     Lab 6 - Breadboard analog circuit       7     Monday     2/22/2017     Analog Circuits Part 1 - Circuit Theory     Scherz and Monk selections     Lab 6 - Breadboard analog circuit       8     Monday     3/82/017     Midtem Exam Part 1 - Drawing     Scherz and Monk selections     Lab 7 - Characterize circuit       9     Monday     3/82/017     Midtem Exam Part 1 - Logic Gates     Lancaster selections     Lab 8 - Breadboard digital circuit       9     Monday     3/22/017     Policel Circuits Part 1 - Logic Gates     Lab 8 - Breadboard digital circuit       9     Monday     3/22/017     Fabricating Electronic Circuits     Scherz and Monk selections     Lab 9 - Desigin a circuit board <td< td=""><td></td><td></td><td></td><td>4</td><td>SolidWorks tutorial</td><td></td></td<>				4	SolidWorks tutorial	
Wednesday     2/15/2017     Biomaterials Part 1 - Deverview     Rather et. al. selections     Last 5 - Fabricate part on mill or lathe.       6     Monday     2/22/2017     Biomaterials Part 2 - Polymers     Modgarad selections     Lab 5 - Fabricate part on mill or lathe.       7     Monday     2/22/2017     Biomaterials Part 3 - Biocompatibility     Salterman selections     Lab 5 - Fabricate part on mill or lathe.       7     Monday     2/22/2017     Analog Circuits Part 1 - Circuit Theory     Scherz and Monk selections     Lab 6 - Breadboard analog circuit       8     Monday     3/2017     Midterm Exam Part 1 - Drawing     Scherz and Monk selections     Lab 7 - Characterize circuit       8     Monday     3/2017     Midterm Exam Part 1 - Ouesions     Scherz and Monk selections     Lab 7 - Characterize circuit       9     Monday     3/202077     Diplat Circuits Part 1 - Logic Gates     Lancaster selections     Lab 8 - Breadboard digital circuit       9     Monday     3/202077     Diplat Circuits Part 1 - Logic Gates     Scherz and Monk selections     Lab 9 - Design a circuit beard       10     Monday     3/20207     Fabricating Electronic Circuits     Scherz and Monk selections     Lab 9 - De		Filday	2/10/2018	Discussion: Machine Shop Part 6		
Wednesdy     2/15/2017     Bornaterials Part 1 - Dreview     Rather et. al. selections     Last 5 - Fabricate part on mill or lathe.       6     Monday     22222017     Biomaterials Part 3 - Biocompatibility     Salterman selections     Lab 5 - Fabricate part on mill or lathe.       7     Monday     22222017     Biomaterials Part 3 - Biocompatibility     Salterman selections     Lab 5 - Fabricate part on mill or lathe.       7     Monday     22272017     Analog Circuits Part 1 - Circuit Theory     Scherz and Monk selections     Lab 6 - Breadboard analog circuit       8     Monday     3/20217     Monder Selections     Lab 7 - Characterize circuit       8     Monday     3/82017     Midterm Exam Part 1 - Drawing     Scherz and Monk selections     Lab 7 - Characterize circuit       8     Monday     3/82017     Midterm Exam Part 1 - Logic Gates     Lancaster selections     Lab 8 - Breadboard digital circuit       9     Monday     3/202017     Digital Circuits Part 1 - Logic Gates     Lancaster selections     Lab 8 - Breadboard digital circuit       9     Monday     3/270017     Digital Circuits Part 1 - Logic Gates     Chortran selections     Lab 9 - Design a circuit board       1	5	Monday	2/13/2017	Computer Aided Manufacturing Parts 1 & 2	Fitzpatrick selections	Lab 4 - Continuation of mill/lathe training schedule.
6     Monday     2/20/2017     Biomaterials Part 2 - Polymers     Modjarrad selections     Lab 5 - Fabricate part on mill or lathe.       7     Monday     2/22/2017     Analog Circuits Part 1 - Circuit Theory     Salterman selections     Lab 6 - Breadboard analog circuit       7     Monday     2/22/2017     Analog Circuits Part 2 - Anplifiers     Scherz and Monk selections     Lab 6 - Characterize circuit       8     Monday     3/2017     Midterm Exam Part 1 - Drawing     Scherz and Monk selections     Lab 7 - Characterize circuit       8     Monday     3/2017     Midterm Exam Part 2 - Questions     Scherz and Monk selections     Lab 7 - Characterize circuit       8     Monday     3/2017     Midterm Exam Part 2 - Questions     Scherz and Monk selections     Lab 8 - Breadboard digital circuit       9     Monday     3/22017     Digital Circuits Part 1 - Logic Gates     Lancaster selections     Lab 8 - Breadboard digital circuit       9     Monday     3/22017     Programming in C Part 2     Contrant selections     Lab 9 - Design a circuit board       10     Monday     3/3/2017     Programming in C Part 2     Kochrant selections     Lab 10 - C programming exercise						
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Wednesday     2222017     Biomaterials Part 3- Biocompatibility     Saliterman selections     Interman selections       Morkay     2272017     Analog Circuits Part 1- Circuit Theory     Scherz and Monk selections     Lab 6 - Breadboard analog circuit       Wednesday     3/12017     Analog Circuits Part 2 - Anplifiers     Berlin selections     Lab 6 - Characterize circuit       Friday     3/2017     Midterm Exam Part 1 - Drawing     Scherz and Monk selections     Lab 7 - Characterize circuit       Wednesday     3/82017     Midterm Exam Part 2 - Questions     Scherz and Monk selections     Lab 7 - Characterize circuit       Wednesday     3/202017     Midterm Exam Part 2 - Questions     Scherz and Monk selections     Lab 8 - Breadboard digital circuit       Spring Break J/32017-9/172017     Poigtal Circuits Part 1 - Logic Gates     Lancaster selections     Lab 8 - Breadboard digital circuit       Wednesday     3/222017     Digital Circuits Part 2 - Communication     Scherz and Monk selections     Lab 9 - Design a circuit board       Wednesday     3/222017     Programming in C Part 1     Mork Selections     Lab 9 - Design a circuit board       Wednesday     4/322017     Arduino Microcontroller Part 2     Kochrank selections     La						
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Wednesday   4/26/2017   Team 3 and 4 presentations     Friday   4/28/2017   Team 5 and 6 presentations     15   Monday   5/1/2017   Team 7 and 8 presentations     Wednesday   5/3/2017   Team 9 and 10 presentations     Friday   5/5/2017   Team 9 and 10 presentations     Friday   5/5/2017   Course Review     16   Final Exam - 2 hr. Closed Book Exam		Filday	4/21/2017	workshop Time		
Wednesday   4/26/2017   Team 3 and 4 presentations     Friday   4/28/2017   Team 5 and 6 presentations     15   Monday   5/1/2017   Team 7 and 8 presentations     Wednesday   5/3/2017   Team 9 and 10 presentations     Friday   5/5/2017   Team 9 and 10 presentations     Friday   5/5/2017   Course Review     16   Final Exam - 2 hr. Closed Book Exam	14	Mondav	4/24/2017	Team 1 and 2 presentations		
Friday   4/28/2017   Team 5 and 6 presentations     15   Monday   5/1/2017   Team 7 and 8 presentations     Wednesday   5/3/2017   Team 9 and 10 presentations     Friday   5/5/2017   Course Review     16   Final Exam - 2 hr. Closed Book Exam						
Wednesday 5/3/2017 Team 9 and 10 presentations   Friday 5/5/2017 Course Review   16 Final Exam - 2 hr. Closed Book Exam			4/28/2017			
Wednesday 5/3/2017 Team 9 and 10 presentations   Friday 5/5/2017 Course Review   16 Final Exam - 2 hr. Closed Book Exam						
Friday 5/5/2017 Course Review   16 Final Exam - 2 hr. Closed Book Exam	15					
16 Final Exam - 2 hr. Closed Book Exam						
		Friday	5/5/2017			
	16			Final Exam - 2 hr. Closed Book Exam		
*All reference books listed on the Syllabus are on reserve in the Medical Device Center.	*All refere	ence books liste	d on the Sylla	bus are on reserve in the Medical Device Center	er.	
Reading also includes information contained in the Workshop exercises.	Reading					