State University of New York at Buffalo

Department of Mechanical and Aerospace Engineering

MAE 476 / 576: Mechatronics

Spring Semester - 2003

Mini Assignment 2 (Part 2)

Theme: Analysis of Different Mechatronic Courses Available

Instructor: Dr. Venkat Krovi

Teaching Assistant: Chin-Pei Tang

.	University	Course content	Lab/Research content	analysis
1	Massachusetts Institute Of Technology	design of mechatronic systems (integrate mechanical, electrical, and control systems engineering). Topics are aliasing, quantization, electronic feedback, power amplifiers, digital logic, encoder interfacing, and motor control.	Lab cover topics such as aliasing , quantization, electronic feedback, power amplifiers, digital logic, encoder interfacing, and motor control. The labs make extensive use of Simulink, a Matlab toolbox which allows for graphical simulation and programming of real-time control systems.	It covers the basic of mechatronics. emphasis is on lab
02	**Stanford University**	ME318introduction to electro-mechanical design and embedded systems. gain experience in systems integration is to give them tools to enable them to work at a relatively high level of abstraction .	It requires integration of software and hardware, are designed to introduce the capabilities of the electronic functions and software tools Equipping the students with higher-level tools such as an integrated development environment, real-time operating system with integrated application framework, signal conditioning, and motor drive function blocks	By using these higher-level tools, the students are able to concentrate on solving the larger problem rather than spending all of their time learning the details necessary to design every sub-system from scratch
03	**Northwestern university**	Introduction to the design of microprocessor-controlled electromechanical systems. Interfacing sensors and actuators to a personal computer and a single-board computer. Electrical and mechanical design, prototyping, and construction. Dissection of a commercial mechatronic product	Students learned to interface sensors and actuators to a singleboard computer. In the second half of the course, students worked in teams to build mechatronic systems of their own design.	The course gives emphasis to more practical works
04	**Sant clara university**	Use of microprocessors in the control of machinery. Microprocessors and microcomputers. Assembly-language programming. Interface design. Use of digital computers for the simulation and control of systems of machines. Development of mathematical models for systems. Numerical integration methods. State variables. Computer programs for simulation and control	applications; manipulator models; design considerations; control fundamentals; model and sensor based control algorithm development; walking robots; medical and space robotics; experimental mechatronics.	It deals with much electronics part
05	**American university of beirut**	Sensors, sensor noise and sensor fusion; actuators; system models and automated computer simulation; information, perception, and cognition; planning and control; architectures, design, and development; team project.		

06	Virginia tech	signal conditioning, sensors, actuators, microcontrollers, and software	Labs will be assigned to help students better understand the material covered in class. Labs will cover basic usage and operation of the PIC microprocesser and the prototyping board (VT84) built by the students. Motor dynamics and basic PID control will be also covered	This course addresses different elements of a mechatronics system
07	Georgia Institute of technology	• 16-Bit microprocessor: introduction, hardware overview, programming, interrupts, on-chip subsystems, parallel I/O • Choice of embedded computers; choice of level of languages: assembly, high level, object oriented for real-time programming (such as C), Simulink • Analog and digital devices: Op-amp, ADC, DAC, and power transistors • Sensors, actuators, and their applications to intelligent manufacturing and mechatronic systems • Modeling and control of electro-mechanical systems • Modeling of various actuators: (DC motors, stepper motors, induction motors), and sensors (position, velocity, force, tactile, and ultrasonic)	• Lab 0: Introduction to lab equipment, real-time environment • Lab 1: Real-time tools,Signal Processing, Sampling, Quantization • Lab 2: Analog low-level and power electronics • Lab 3: Motor Control; Discrete-time control • Lab 4: Switching amplifier design and control • Lab 5: Signal interfacing; Real-time programming constructs	This course is for electrical engg.dealing with the microprocessor.
08	Rensselaer Polytechnic Institute, Troy	1. Introduction to Mechatronics 2. Mechatronic System Design (discussed throughout the course) 3. Physical / Mathematical Modeling and Analysis of Dynamic Systems 4. Control System Design; Analog-Control Computer-Control Implementation 5. Analog and Digital Control Electronics 6. Control Sensors and Actuators 7. Interfacing Sensors, Actuators, and Microcontrollers/Computers 8. Real-Time Programming 9. Advanced Concepts (e.g., magnetic bearings/levitation, fuzzy logic control, active materials)	Application of the impedance method of modeling active material to plate structure 2.Magnetic coupling b/w.DC tachometer and motor and its effect 3 Friction compensation of Machine drives 4.Design and control nonlinear high-speed,high accuracy positioning system under the influence of friction .	Main emphasis is on design and application.
09	University of California,Berkeley	Design and control of intelligent robotic systems and automated machines. study of the mechanical phenomena which is relevant to the computer industry	Robot design and control Manufacturing process control Human-machine systems Motion control Machine design Computer software for real time control and diagnositics Mechanical systems modeling,	This is for the robotics and had some application of me

			identification and control Computer mechanics	
10	Kettering University, Flint	1Introduction and overview 2 Introduction of microprocessor 3 Mechanism design with instrumentation Introduction to sensors / transducers 4.single conditioning circuit,actuator 5.mechatronics system design 6.mechatronics product identification	1Introduction of programming 2Introduction to sensor 3.sensor programming 4.introduction to actuators	It covers the programming part in the lab and

MiniHW2_Lollett

University	Microprocesor	Emphasis	Projects	Rate(1-10)
Colorado State http://www.engr.colostate.edu/~dga/me307.html	PIC	Electronics and Control	Microcontroller Based Mechatronic Design	7
Virginia Tech http://mechatronics.me.vt.edu/home.html	PIC	Systems and Communications	Various	6
Carnegie-Mellon http://www.ece.cmu.edu/~fedder/mechatronics/Syllabus.html	68HC16 microcontroller	integration of mechanism, electronics, and computer control	basic controls, motor drives, mechanisms, sensors, IR communications, and motion planning	8
University of Utah http://www.mech.utah.edu/~me3200/	No specified	Control	Sumo, skiing robots	9
University of Illinois at Urbane-Champagne http://robot0.ge.uiuc.edu/~spong/deere/	No specified	basic concepts and practical techniques of real-time computing and software interfacing for manufacturing systems	Various	9
University of Maryland at College Park http://www.enme.umd.edu/ice_lab/teach/ME489L/new.html	No specified	create intelligent machines: mechanical	design and implement a complete	6

		devices embedded with small computers	mechatronic system, putting in practice their knowledge of materials, mechanism design, software design, electronics, and algorithms	
Santa Clara University http://screem.engr.scu.edu/mech143/course.html	Basic Stamp	Sensors, actuators, microprocessor programming	Integration of sensors, actuators and control	5
North Carolina State University http://courses.ncsu.edu:8020/mae534/lec/001/course_info.html	No specified	Programming embebedded systems, basic analog and digital electronics, sensors and actuators	Programming microprocessors, interfacing with sensors and actuators	6
San Jose State University http://info.sjsu.edu/web-dbgen/catalog/courses/ME190.html	Not specified	Process modeling from test data. Computer-aided dynamic system control analysis and design. Application and integration of	Development of smart and intelligent products with micro-controller.	5

		micro-controller for digital process and servo control.	controller.	
Georgia Institute of Technology http://www.me.gatech.edu/me/academics/graduate/sem_conv/ME6405.htm	16-bit Microprocessor	Modeling and Control of Sensors and actuators. Interfaces and microprocessor languages	Not specified	

Garth Mathe
MAE 576

Mini-Assignment 2

1. **West Virginia University**

Web site: http://www.mae.wvu.edu/courses/syllabi/mae211.htm

Emphasis: practical applications with a fair amount of fabrication

Projects examples: All projects involve electro-mechanical design, sensor interfacing, and computer programming. Past projects include an autonomous car, an elevator, a parts-kitting machine and a two-axis robot.

Rating: Sophomore level course with no prerequisites. Probably limited to simpler applications.

2. **The University of Western Australia**

Web site: http://www.mech.uwa.edu.au/courses/MD310/

Emphasis: more theoretical with design stressed

Project examples: sand weighing machine-self test and fault detection, remote axis to telelabs from university computer labs or home. Telelabs include: electric iron-self test and fault diagnosis, two axis robot-gripper design, sand weighing machine-self test and fault detection.

Rating: Seems to be a junior/senior undergrad level course. Appears to get into semi-complex topics.

3. **San Jose State University**

Web Site: http://info.sjsu.edu/web-dbgen/catalog/courses/ME190.html

Emphasis: theoretical with design

Project Examples: Process modeling from test data. Computer-aided dynamic system control analysis and design. Application and integration of micro-controller for digital process and servo control. Development of smart and intelligent products with micro-controller.

Rating: Mid-level undergrad course from the sounds of it.

4. **Santa Clara Robotic Systems Laboratory**

Web Site: http://mech337.engr.scu.edu/

Emphasis: theoretical with some practical applications

Project Examples: Matlab-based simulation and limited work with real robotic manipulators incorporated into class. No actual projects (not a degree program).

Rating: As a certificate program with seemingly very basic course content, I would not recommend this class to an engineering student, rather for a technician.

5. The University of Utah

Web Site: http://www.mech.utah.edu/~santosh/mechatronics.html

Emphasis: theoretical with a design project

Project Examples: basketball playing robots, sumo wrestling robots, Indiana Jones course running robot

Rating: Junior level year long mechatronics course. Seems to be a very robust class, with a whole year many topics can be covered.

6. Institute of Technology Blanchardstown

Course: Mechatronics practice 1

Web Site: http://www.itb.ie/Courses/bn009.htm

Emphasis: practical, hands on work

Coursework: Safety, soldering, component work, electronic assembly, basic metal work, project.

7. Institute of Technology Blanchardstown

Course: Mechatronics practice 2

Web Site: http://www.itb.ie/Courses/bn009.htm

Emphasis: practical, hands on work

Coursework: Engineering workshop theory and practice, advanced manufacturing, joining materials, turning, measurement, milling

8. Institute of Technology Blanchardstown

Course: Mechatronics practice 3

Web Site: http://www.itb.ie/Courses/bn009.htm

Emphasis: practical, hands on work

Coursework: CNC, CAD/CAM systems and projects

Rating: three courses in a mechatronics program that are based around practical applications and machine (tool) work. Very much technician oriented classes.

9. Boise State University

Web Site: http://coen.boisestate.edu/jgardner/Mech.htm

Emphasis: Seems more oriented towards practical applications

Project Examples: sumo robots, self contained vehicles that carry out some sort of intelligent activity (ie. move toward light or away from light)

Rating: senior undergrad/grad level course. Seems similar to many other university courses in that theory and practical applications are balanced, and an intelligent car is standard design project.

10. Santa Clara University

Web Site: http://mech143.engr.scu.edu/course.html

Emphasis: Oriented towards applications and lab work (75% of grade consists of labs and final project)

Project Examples: self contained cars that follow a “track” of electrical tape using optical devices

Rating: Designed for senior undergrads, but open to juniors, etc. Seems like a more basic mechatronics course. Course project seems typical of other courses.

MiniHW2_Mitchell

William Mitchell
MAE476 Mechatronics
Mini-assignment 2

	Microprocessor	Theoretical Emphasis	Practical Emphasis
Virginia Tech	Microchip PIC16F84	Not Much	High Emphasis in labs, and projects
Colorado State	PIC16F84 microntroller	Labs and projects High Emphasis	Little Emphasis
Carnegie Mellon University	68HC16 microcontroller	Balance between Emphasis	Balance between Emphasis
San Jose State University	Basic Stamp II	Emphasis in course material	Emphasis in projects
University of California Berkeley			Seems to be all Project based, and practical applications
Stanford	MicroCore-11	Projects did not focus on real applications	
Northwestern University	• 68HC11 • 68HC16 • Basic Stamp • Basic Tiger		Mainly project based with practical ideas

http://mechatronics.me.vt.edu/
http://www.engr.colostate.edu/~dga/me307.html
http://www.ece.cmu.edu/~fedder/mechatronics/Syllabus.html
http://www.engr.sjsu.edu/wdu/Mechatronics/Spring2002/index.htm
http://www-inst.eecs.berkeley.edu/~ee192/
http://design.stanford.edu/Courses/me118/me118.html
http://mechatronics.mech.nwu.edu/mechatronics/index.html

MiniHW2_Pateel

UNIVERSITY	SITE	CONTROLLER USED	THEORY	LABS/PROJECTS	REMARKS
Colorado State University	CSU	Microchip PIC 16F84	AC Circuits Passive High/Low filters Semiconductors Transistors:BJT's,fet'S Fourier series Frequency response/Bandwidth System response (0th, 1st, 2nd order systems) Op Amps/Digital electronics Design of logic networks,Flip flops Counters, timers , oscillators Micro controllers and PIC D/A-A/D Conversion Data acqusition,sensors Actuators, relays ,motors	Lab on DC motors and their control Strain gauges Signature analysis Piezo electric accelerometers	
University of Delware	UD	Blue Earth Micro, an 8087 micro with BASIC and assembler	Servo controllers and interface Op Amps Legged Motion reverse engineering 3 dof haptic display Theory of DC Motors Filters,Serial port Real time OS Kinematics dynamics and jacobian of 2 link robot	Product Dissection Technical paper presentation walking wheel chair Haptics project	

Virginia tech	VT	Microchip controller	PIC processor and assembly programming Power amplification A/DCONVERTER SENSORS(tachometers, encoders,infrared,ultrasonic.. dynamic Modelling Communications Control theory Controller design Actuators DC/AC Motors,Stepper motors Real time systems,PLC's		
The University of Utah	UT	Microcontroller Handy Board based on Motorola 68 HC11	Linear graphs Laplace transforms Transducers Transfer function Block diagrams $1^{st}/2^{nd}$ order response Signal flow graphs Steady state error Stability,root locus Bode plots, Nyquist plot Bode design Gian and phase margins	Lab on Computer data collection Linkage design Photo sensors Ultra sonic sensors Opamps Position and velocity sensors Skiing Robot	

Carnegie – Mellon University	CMU	Motorola 68HC16	Controls Motors Encoders Drivers Mechanisams-mobile platforms stair climbing Sensors IR Communication Signal conditioning Motion planning-cooperative robotics	Labs on Motor speed controller Ultrasonic tracker IRCommunication/tracker Matlab simulations of mechanical controllers Stair climbing Robot	
Pennsylvania State University	PSU	Basic Stamp II	RLC Circuits, Diodes Op –amps Active filters Electric motors Sensors A/D - D/A conversion Digital electronics Digital fourier transform PC Board fabrication DSP MEMS		
RPI	RPI		Physical/Mathematical modeling and analysis of Dynamic systems Analog and Digital control electronics Control sensors and Actuators Real time programming	Labs on: Digital electronics,A/D – D/A converters, micro controllers Thermal system closed loop computer temp control	

			Interfacing Sensors, Actuators and micro controllers/computers Advanced concepts	Pneumatic Servomechanisam Closed loop computer position control Magnetic levitation DC motor closed loop analog velocity control Stepper motor open loop position computer control no project	
University of California ,Berkelely	BERK	Motorola 68HC11	Motors /control MOSFET Optical encoder,magnetic Sensor analog design Software arch and debugging Filtering Path planning	Lab on: EM field sensing PID Control PI vel control Filters motors circuits… Race car	
MIT	MIT		Aliasing Quantization Electronic Feed Back Powe Amplifiers Digital Logic Encoder Interfacing Motor Control	Labs on Dspace Servo motor ctrl Brushless motor communication and ctrl Analog power amplifier design Signal processing	
	SJU	Basic stamp	LED’s Transistors	Labs on:	

MiniHW2_Pateel

			Filters servo basics microprocessors fundamentals sensors Op- Amps A/D – D/A conversion Digital electronics Motors	Servo basics wheel encoder LED's /Transistors A/D D/A conversion…	

BERK : http://www-inst.eecs.berkeley.edu/~ee192/
CMU : http://www.ece.cmu.edu/~fedder/mechatronics/Syllabus.html#description
CSU : http://www.engr.colostate.edu/~dga/me307.html
MIT : http://web.mit.edu/2.737/www/
PSU : http://www.me.psu.edu/rahn/me462/
UD : http://www.asel.udel.edu/robotics/mechatronics95/syllabus95.html
VT : http://www.mechatronics.me.vt.edu/
UT : http://www.mech.utah.edu/~me3200/
RPI : http://www.rpi.edu/~craigk/
SJU : http://www.engr.sjsu.edu/bjfurman/courses/ME106/ME106courseinfo.htm

MiniHW2_Pateel

SAMEER S. PATWARDHAN
PERSON NUMBER: 30325980
EMAIL ID:SSP6@BUFFALO.EDU

No.	University Name	Micro-controller used	Theoretical Emphasis	Practical Emphasis	Distinguishing Features	Remarks
1	Virginia Technological University	PIC16F84 ADC0838 LMD18200T MAX237	Equal emphasis. Very good class notes. Excellent Programming and Interfacing topics.	Equal emphasis. Excellent topics and setup specially PID controller implementation, interfacing, open loop PWM, A/D echo to LED array.	TTL and CMOS logic implementation, Signal conditioning.	One of the very good courses, Excellent practical setup, and Very good system design examples.
2	Carnegie Melon University	MC68HC16	Matlab simulations. Very good class notes and controller theory Very good information about mobile platforms.	Equal emphasis. Specially signal conditioning,noise,motion planning,COBOT	Sensors: Ir, sonic, Xcell, gyro. Miniaturization/packaging, IR communication tracker. Lab Practical Exam.	Excellent control practicals, Very good programming and interfacing. one of the best courses.
3	MIT	IBM-PC	Equal emphasis. Special topics such as Signal processing, Analog feedback systems, Real time signal interfacing.	Equal emphasis. Excellent practical setup. Practicals on Interface programming, Data acquisition techniques.	DSP module Quantization Signal interfacing.	Very good course with more emphasis on electronics. Robotics interface would have

						helped a lot.
4	Rensselaer Polytechnic Institute	MC68HC 12	Equal emphasis. Excellent topic coverage and special topic on Dynamic Modeling.	Equal emphasis. Good topics and practical setup. Practical on Magnetic Levitation.	Real time programming, magnetic Bearing/ Levitation, Fuzzy logic control.	Excellent practicals with specially on Magnetic Levitation and fuzzy logic programming.
5	Pennsylvania State University	Basic X-24	Equal emphasis. Excellent topics with discrete digital control.	Equal emphasis. Very good practical topics and excellent interfacing and system simulations.	Electronic packaging module. Discrete digital control.	Very good course and one of the best courses. Very good Robotics information
6	University of Utah	Motorola 3479P, MC68HC 11	Equal emphasis. Robotics information included. Excellent topic coverage.	Equal emphasis. More emphasis on sensors and actuation.	Ultrasonic sensors, Position sensors, Velocity sensors, Photo sensors.	Excellent course provided with robotics information.
7	North-Western University	MC68HC 11 MC68HC 16	Excellent theory topics. Robotics theory included. Excellent sensor information.	Equal emphasis. Excellent electrical design practicals.	Closed loop control of Furby, Light sensors, Infrared sensors, Temperature sensors.	Excellent practical work with example of Furby closed loop control. One of the best courses.
8	Princeton University	MC68HC 12	Equal emphasis	Equal emphasis. More emphasis given on robotics,	Decision making, Neural	Very good Robotics practicals.

				Path control and decision making.	network modules	
9	Tennessee Technological University	MC68HC 12	Equal emphasis. More emphasis on electronics and Mechatronics system design.	Equal emphasis	Intelligent machines engineering interface	Inclusion of the Robotics module would have made it more informative
10	University of California at Berkley.	Siemens 167	More theory about sensors and actuation is required. Robotics module not included.	More emphasis on practicals.	Interface using C programming. Excellent practical setup, Control synopsis Kinematics simulations(Bicycle kinematics simulations)	Excellent practical setup but if provided with more theoretical information it will be great course.
11	San Jose State University	New Micros (NMI)microprocessor board with MC68HC 11	Equal emphasis. Theory have major portion related to motors. Robotics module is not included.	Equal emphasis. Good practical setup.	ICC11 software interface to drive microprocessor.	Good course. Robotics module would have made it more informative

Mini Assignment 2 – Mechatronics Courses in North American Universities

Universities in N.America	Microprocesors used	Theoritical Emphasis	Practical Emphasis(Labs/Projects)	Rating /Analysis
1. Georgia Institute of Technology ,Atlanta	16-Bit microprocessor	• 16-Bit microprocessor: introduction, hardware overview, programming, interrupts, on-chip subsystems, parallel I/O • Choice of embedded computers; choice of level of languages: assembly, high level, object oriented for real-time programming (such as C), Simulink • Analog and digital devices: Op-amp, ADC, DAC, and power transistors • Sensors, actuators, and their applications to intelligent manufacturing and mechatronic systems • Modeling and control of electro-mechanical systems • Modeling of various actuators: (DC motors, stepper motors, induction motors), and sensors (position, velocity, force, tactile, and ultrasonic)	Research Areas • Manufacturing and De-Manufacturing Automation • Vision-Based Motion Control • Design, Modeling and Control of Spherical Motors • Machine Vision • Live-Bird Handling	Good. There is a choice of level of languages unlike our course so should introduce this eg.C,object oriented programming which is easy to program than assembly level programming.
2. University of Waterloo, Canada		• Mechatronics Engineering • Structure and Properties of Materials • Experimental Measurement & Statistical Analysis • Sensors & Instrumentation • Actuators & Power Electronics • Electromechanical Machine Design • Review of modelling and approximation of dynamic systems. • Review of classical control theory. • Electronic realisation of control elements and compensations: ideal and real PID. • Elements of digital control theory: sampling theorem, z-transform and digital filters. • Review of computer	• The control of flexible arm robotic devices, through automated guided vehicles research, to application of CIM techniques for the textile industry.	Good The syllabus in here has covered various topics like Electromechanical Machine design separately so should include it in our course.

		interfacing, power amplifiers, sequential logic, encoders, and motor control. The course involves practical projects and significant laboratory usage.		
3.Kettering University, Flint, Michigan		• Introduction to microprocessors: • architecture • input / output interfacing • programming languages • terminology • Mechanism design with instrumentation Introduction to sensors / transducers • Signal conditioning circuits Advanced microprocessor functionality • Counters and timers • Interrupts • Special drivers (LCD, motor) Mechatronic system design: • Dynamic system analysis and integration • Systems models and governing relationships • Analogies and alternate models • Simulation technique • Mechatronic product identification and ideation	• Reverse Engineering (disassembly and analysis of commercially available mechatronic devices) • Introduction to Microprocessors - programming exercises • driving the LCD • monitoring battery power • smart switches Microprocessor I/O: Inputs • communicating with instrumented devices • parallel and serial communications Sensors and Signal Conditioning • A/D conversion • Microprocessor I/O: Outputs • driver circuits • Advanced Functions and Programming: Counters and Timersactuating devices • Advanced Functions and Programming: Con trol Algorithms Advanced Functions and Programming: Inte rrupts and Look-Up Tables	Good Has got a detailed introduction to Microprocessors and the advanced functionalities of it so maybe have a brief description of microprocessors to be included in the course.
4.Santa Clara University		• Basic Circuits Review • What's a Microprocessor? • Event Driven Programming • Digital Inputs • OpAmps	• Basic Circuits Reveiw and Intro to the Laboratory • Event Driven Programming • Analog Signal	Average. Has got the topics Event Driven Programming.

		• Sensors • Digital Outputs & Power Drivers • DC Motors • Stepper Motors • A/D, D/A, Timers • Modular Software Design-Steps in Building a Routine, Characteristics of High-Quality Routines . • Noise, Grounding & Isolation • Power Supplies & Batteries • Intro to the Basic Stamp • HLL, Interpreters, Compilers & Assembly Language	Conditioning • DC and Stepper Motors	Programming, Noise,Grounding ,Isolation which is not in our course.
5. University of California, Berkley		• Design of robots and automated systems covering from the design of mechanical hardware to surrounding electronics and computer interface. • Basic kinematics and the robotic systems, design dynamics of robotic systems, hydraulic and pneumatic systems, electric actuators, power transmission, sensors, control and computer interfacing, applications to factory automation, manufacturing, hazardous environment, and human machine systems.	Research Areas • Robot design and control • Manufacturing process control • Human-machine systems • Motion control • Machine design • Computer software for real time control and diagnositics • Mechanical systems modeling, identification and control • Computer mechanics	Very Good Heavy emphasis has been laid on Robotics design and the research projects underway can be an inspiration for us to do something better
6.Colorado State University, Fort Collins	PIC Microcontroller	• Mechatronics and measurement systems • Electric circuit fundamentals: o V, I sources o Real vs. Ideal sources o Batteries o Passive components R, C, L in DC ckts • Ohms law, Kirkovs law • Series, Parallel Resistence Equivelents • Electrical Power • AC circuits introduction • RMS values • Transient/SS Ckt response • Passive High/Low Pass filters • Semiconductors: diodes, LEDs • More diodes • Transisters: BJTs, FETs	• Introduction - resistor codes, breadboard, soldering, and basic measurements • Instrument familiarization and basic electrical relations • The oscilloscope • Bandwidth, filters, and diodes • Transistor circuits • Operational amplifier circuits • Digital circuits - logic and latching • Digital circuits - counter and LED display + Bonus "Car Alarm" Lab • Programming a PIC Microcontroller • A/D conversion demonstration • Project "Microcontroller Based Mechatronic Design".	Good. Based on the same lines as ours.

		• Transistors as switches: Saturation and Cutoff • Operational amplifier o circuit analysis o applications • characteristics of real op amps • flip-flop applications • counters, timers, oscillators • microcontrollers and the PIC • PicBasic Pro • PIC examples • PIC interfacing • DC motor fundamentals • stepper motor control • More Sensors: Temperature and Stress/Strain • Thermal Couples, RTD... • strain gages • Wheatstone bridge • Controls: Sensors + Actuators + Controller • PIV Control Theory		
7.Carnegie Mellon University, Pittsburgh	68HC16 microcontroller	• Motors; encoders; drivers • Mechanisms; mobile platforms • Sensors; IR, sonic, xcell, gyro • IR communication; protocols • Signal conditioning; noise • Motion planning; cooperative robotics or Miniaturization/packaging	• Microcontroller Battery Meter • MATLAB Simulation of Mechanical Controller • Motor Speed Controller • Ultrasonic Tracker • IR Communication/Tracker • Project: “Stair Climbing Demonstration”	Good. The course is very focused on certain topics and maybe goes deep into them.Projects are worth looking into.
8.Virginia Tech University	VT 84 PIC processor	• VT 84, Analog and digital fundamentals • Microcontroller technologies and computer architectures • PIC processor • PIC assembly programming • Power amplification • Signal i/o, PIC A/D Converter • PIC C-programming • Sensors (Tachometers, pots, encoders) • Sensors (Infrared, Ultrasonic, Acc’s) • Dynamic Modeling • Control theory, PID review • Controller Design • Overview of actuators • PM DC motors, stepper motors • Active material actuators • AC motors, gear reducers • PLCs • Real-time systems	• Soldering video, VT84 board construction • H-bridge, PWM • A/D and D/A conversions • C-compliler mini-lab • A./D echo to LED array • Open-loop PWM code • PID servomotor code	Very Good There are topics like Real time Mechatronic Systems which should be included in our lab.

9. Stanford University, Stanford		• Microprocessors • Op-Amps • Sensors • Event Driven Programming • Digital Inputs • Digital Outputs & Power Drivers • DC Motors and Generators • Stepper Motors • A/D, D/A, Timers • Noise, Grounding & Isolation • Power Supplies & Batteries • Introduction to the Basic Stamp HLL, Interpreters, Compilers Preview and Assembly Language Communications, Serial and Otherwise	• Test Equipment and Analysis Tools • Analog Signal Conditioning • Event-Driven Programming: The CockRoach • DC & Stepper Motors	Good. The application of event driven programming in the lab is worth looking into and introducing it in ours
10. San Jose State University, San Jose,CA	68HC11-based controller	• Computer-aided dynamic system control analysis and design. • Application and integration of micro-controller for digital process and servo control. • Development of smart and intelligent products with micro-controller • Introduction of mechatronic systems. Combine hardware, software and system integration. • Basic circuits, logic gates, OpAmps, encoder/decoder, DC and stepper motor, A/D and D/A, C-language, interfacing and control.	Projects: • Low-Cost Profiler • Linear Encoder Interface for an Inkjet Printer • Load Port Micro-Stocker • Fuzzy Logic and Neural Networks in Control Applications	Good. Projects on Fuzzy Logic and Neural Networks in Control applications should be looked forward to be done in our course.

Mini-assignment 2

Vikranth B. Rao
2827-1509
MAE-476

Comparable Mechatronic courses in North America

University	Course	Address	Microprocessor used	Practical Emphasis	Theoretical emphasis
University of Pennsylvania	MEAM 410 Design of Mechatronic Systems	http://www.cis.upenn.edu/~jpo/Courses/MEAM410/#Course%20structure	BASIC Stamp	Practical emphasis through: .Homeworks-5 Labs Projects Final project	Topics in conceptual design, as well as to tools of optimization and the use of statistical descriptions of safety. Final exam.
Northwestern University	ME 333 Intro to Mechatronics	http://lims.mech.nwu.edu/~lynch/courses/ME333/2001/	Handy Board Single board computer	Completely practical class: Homeworks & Quizzes-25% Labs -25% Final Project-50%	Topics discussed in lecture. No final exam.
Stanford University	ME338 Intro to Mechatronics	http://design.stanford.edu/Courses/me338/	MicroCore-11 Single board computer	Practical emphasis on course learning through hand-on laboratory work. Students don't have to build everything from scratch. Lab exs – 4 Final design project.	Final exam.
University of Delaware	CISC 685 Mechatronics	http://www.cis.udel.edu/~chester/courses/685.html	PIC-16c876	Very practical with required assignments, presentations and final project. Final design	Practice balanced with theoretical perspectives. Tested by

				project designed to compete.	three mid terms and a final exam.
BYU	EET 548 Mechatronics	http://class.et.byu.edu/eet548/	Handy Board Single board computer	Design, engineering and programming skills emphasized. Final project involved class competition. Labs, homeworks and final competitive project.	Theory stressed in conjuction with practice with a goal of developing real-world problem solving skills. Mid-term and comprehensive final exams.
Santa Clara University	Mech 143 Intro to Mechatronics	http://mech143.engr.scu.edu/	Atmel Atmega 163 processor	Structural lab assignments, presentations, and open-ended final project. Emphasis on hands-on approach.	Designed as introductory course to mechatronic concepts. Concepts presented in lecture and tested thru midterm and a final.
North Carolina State University	MAE 534	http://www.mae.ncsu.edu/courses/mechatronics/archive.htm#Course%20Materials		Completely practical oriented. Hands-on experience stressed. Quizzes 15 Assignments Final project.	No final exam.
California Polytechnic Institute	ME405-Mechatronics	http://www.calpoly.edu/~jridgely/	Motrorola 6802	Homeworks Lab exercises and reports	Two mid terms and a final exam
Georgia Institute of Technology	ME 6405 Introduction to	http://www.me.gatech.edu/me/	BASIC Stamp	Even distribution between lab and lecture	Concepts and theoretical

	Mechatronics			instruction. Practical lab instruction provided through Lab assignments and a final group project.	instruction provided in lecture. Two mid terms.
Masachussets institute of Technology	2.737 Mechatronics	http://www.mit.edu/afs/athena/course/2/2.737/www.spring97/	IBM-PC as the controller.	Completely lab oriented. Five labs and a final design project. Final project open ended.	Lecture material targeted towards providing the material for doing the labs.

Assignment 2

Mechatronics in other Parts of North America

Uma Shankar Sharma
Usharma2@buffalo.edu

There are many Universities in North America offering a course in Mechatronics. Some of them are

- UC Berkeley http://robotics.eecs.berkeley.edu/
- Virginia Tech http://mechatronics.me.vt.edu
- Rensselaer http://www.rpi.edu/~craigk/coursework.html
- Clemson University http://ece.clemson.edu/crb/
- Kettering University http://www.kettering.edu/~jhargrov/mechatrn/mechatrn.htm
- PennStateUniversity http://www.me.psu.edu/lamancusa/mechatronics/advmech.htm
- San Jose University http://www.engr.sjsu.edu/bjfurman/courses/ME106/
- NorthWestern University http://othello.mech.nwu.edu/mechatronics/
- University of Utah http://www.mech.utah.edu/~me3200/
- Santa Clara University http://screem.engr.scu.edu/mech143/course.html

Virginia Tech	Emphasis is more on Microcontroller operation, interfacing, and programming	•Students solder, test, and program microcontrolled digital PID motor controller •PIC16C84 microcontroller •LMD 18200 motor driver •ADC 0838 Serial SA A/D converter	Overall the course is very good with lots of good project being done in the past
Kettering University	Students has to devote lot of time working on the projects.	In the Mechatronics Lab we can find experiment stations, each with a PC, a Toshiba TLCS-900H "microprocessor trainer and evaluation board", and interface boards.	The course at this university is good too, everything taught from the basics.
PennState University	Course Objectives is to develop a thorough understanding of mechatronic system design (including cost analysis) and to build a working prototype of an intelligent product	The lab has Pentium PC 350 MHz, ProtoBoard Basic Stamp II Activity Board and power supply BSII Manual, processor, interface cable, carrier board ,PIC Programmer	Course at this university emphasizes about 75% on the lab and project. Also The website provides lot of links that one should look into.
University of Utah	They emphasizes more on control engineering part of Mechatronics.	The handy board used for the lab is based on Motorola 68hc11 microprocessor	The course is divided into mechatronics I and II, offered in fall and spring session.

Rensselaer	They give a good emphasis on the control engineering section of mechatronics.	The lab has a two person mechatronics station having BlueEarth 8051 BASIC Embedded Microcontrollers, digital oscilloscope and other related equipments	The course is offered in a Mechatronics Studio which is configured with an HP Vectra VL MT Series 4 5/100 PC running Windows 95 with an HP-1B interface connecting it to the instruments
NorthWestern University	Theory Covers lot of basic, and is self study course	Their lab uses The Handyboard 68HC11, 68HC16, Basic Stamp, Basic Tiger PLC's, PLA' The Servo-to-Go Board as an interface.	Overall the course is more or less lab oriented with lot of emphasis being given on lab and projects
Colorado State University	The Course at this university begins from the very basic which is good for Beginners (Others will have a chance to review)	Their Lab uses PIC16F84 microcontroller	Course offered at this university is good too, they also give lot of emphasis on the basics, lab and project
UC Berkeley	Lab oriented course and every individual has to do their own project	Siemens 167 CPU is being used in the lab. Some car kits, motors, servos purchased from tower hobbies are used for their projects	The class project is to design racing robots which can follow an embedded wire over a curving and self-crossing path at speeds greater than 3 meters per second.

San Jose University	Lectures are intended to provide the fundamental concept in mechatronics and practical familiarity with common element making up the mechatronics system	New Micros 68HC11 microcontroller being used with Basic stamp II	Course require a project to be submitted at the end of the semester. Some of the information has been adapted from the Stanford SPDL web page .
Santa Clara University	Introduces technologies involved in mechatronics (Intelligent Electro-Mechanical Systems) and the techniques necessary to apply this technology to mechatronic system design	Uses Motorola HC11 Basic Stamp II	The course is offered through the Smart Product Design Lab in the Stanford University Department of Mechanical Engineering, Design Division. Overall materials for the course is well presented

Institution	Course Title	Contents and Materials
University of California, Berkeley, CA	Graduate concentration in Mechatronics for Mechanical Engineering graduate students	• Theoretical emphasis on robot design and control, Manufacturing Process Control, MEMS, etc. • Practical emphasis on ▪ Intelligent robotics ▪ Mechanical phenomena relevant to the computer industry. ▪ Feedback control systems for mechatronic systems. ▪ Software for real-time control.
Georgia Tech, Atlanta, GA	ME 6405 – Introduction to Mechatronics	• Teaches the application of both analog and digital devices to mechatronics. • Modeling and control of electro-mechanical systems and components like actuators, sensors, etc. • Real-time programming using various languages. • Practical emphasis on Motorola MC68HC11 16-bit microcontrollers, real-time control using pulse-width modulation and interrupts.
University of Pennsylvania, Philadelphia, PA	MEAM 410 – Design of Mechatronic Systems	• Uses the Basic Stamp II microprocessor • Theoretical emphasis on the electro-mechanical system design and the use of microprocessors including instrumentation, sensing, actuation, micro-processors and control theory. • Practical content – unknown
Penn State University, Philadelphia, PA	ME 597 – Advanced Mechatronics	• Uses the Basic Stamp II and PIC microprocessors. • Theoretical focus on Sensors, Motion Control, Microcomputer Architecture, PIC processors, etc. • Practical training includes ▪ Digital I/O with Basic Stamp and PIC ▪ Analog Input ▪ Motion Control with DC servo motors ▪ System Simulation
University of Maryland, College Park, MD	ENME 489L – Mechatronics	• Microprocessor used is the Motorola 68HC11. • Theoretical focus on Controller I/O, real-time software, controller architecture, power systems, motor drives, sensors, etc. • Practical emphasis on motor drives and sensors, control of mills and lathes, real time control, etc.
Kettering University, Flint, MI	ME 480 – Applied Mechatronics	• Course based around the Toshiba TLCS-900h CPU. • Theoretical emphasis on microprocessors, instrumentation, sensors, transducers, actuators, mechatronic system design, etc. • Practical emphasis on programming sensors, transducers, instrumentation, etc.

University of Waterloo, Ontario, Canada	Inter-disciplinary program by the departments of Computer Science, Electrical Engineering and Mechanical Engineering, providing a 'Mechatronics' option for under-graduate students.	• Focus on robotics on automation, neural prosthetics, micro-electro mechanical systems (MEMS), etc.
Ohio State University, Columbus, OH	Inter-disciplinary graduate concentration offered by the EE, CS and ME departments.	• Based on the Texas Instruments TMS320LF2407 microprocessor. • Focus on power electronics control, control of motor drives and electric machine modeling and control.
Virginia Tech, Blacksburg, VA.	ME/ECpE 4734	• Based on the PIC processor • Concentration on microcontroller technologies and computer architectures, signal I/O, A/D conversion, sensors, amplification, PIC C and assembly programming, real-time systems, motor control, etc. • Practicals focus on exercises like servomotor control, using LED arrays for output, DC motor control, etc.

MECHATRONICS

MAE 576

Assignment 2

Mechatronics Courses Evaluation

Srinivas SUNDARAGOPAL

http://buffalo.edu/~ss258/ ss258@buffalo.edu 3045-9561

MiniHW2_Sunderagopal

Univ, course and url	Web			Course Content	Practicals /Labs	Software / Microprocessor	Projects	Comments /Innovative Ideas	Useful references for visitors
	Lectures	Archives	Resources						
1. Rating 6.0 University of Waterloo Microprocessor Systems and Interfacing for Mechatronics Students **[Link]**	Avl.	Avl.	Avl.	**Microprocessor architecture and interfacing, communications**, buses, memories, peripheral connections, parallel, serial, analog interfaces, data communications, testing and debugging, device drivers.	Unable to access	Lab available with instructors ——— No specifics	Unable to access	Use of newsgroups for course information and a technical forum	Most pages secure, unable to access
2. Rating 8.0 Stanford University Introduction to Mechatronics **[Link]**	Avl.	Avl.	Avl.	Op Amps, Sensors, Event Driven Programming, Digital Inputs/Outputs, Sensors, ADC, DAC, Timers, Basic Stamp, Interpreters/Compilers/ Assembly Language	**[Link]** Smart Product Design Laboratory (SPDL)	Unable to access	**[Link]** Full-contact, head-to-head, score-or-be-scored-upon competition was the theme for all. Competitors play an end against each other and the player with the highest score at the end of the match wins. Navigating up to the target in the center of the House was the aim. For details of project, click on link on top	Projects hosted on web	Links to many vendors, archives of projects give a good insight of research.

3. Rating 8.5 Northwestern Univ. Introduction to Mechatronics **[Link]**	Not Avl.	Avl.	Extensively Avl.	**Microprocessor-controlled** **electromechanical systems**. Furby encoder and home switch, Op amps, STG Cards, sensors, Digital design, Downloading program to IC, stepper motors, motor sizing, Electrical noise, isolation, grounding, shielding, Digital circuit design, Interfacing sensors and actuators to PC, Dissection of commercial mechatronic product	Mechatronics Design Laboratory **[Link]**	C No specifics, Extensive use of HandyBoard	**[Link]** **Pinball Foosball:** a foodball like game using HandyBoard, bunch of laser/detector pairs, **A Myogenically Controlled Game:** surface based EMG electrodes placed on each player's bicep controls golf balls, **3-D Tic Tac D'oh!:** 3D game of Tic Tac Toe, with moving parts and gaming with computer **Blender Splendor:** a blender/mixer that makes drinks **Olympic Ski Jump Coin Dispensing System:** Change Dispenser. **Gopher Madness:** Laser Pointing game	Students are required to develop a web site for the project, giving them scope for creativity and giving access to the world of the projects to learn how-to's more extensively.	Good collection of background material for anyone interested in mechatronics, with a good collection of links for reference. Also has a collection of ideas for projects.
4. Rating 6.0 Lafayette College Control Systems and Mechatronics **[Link]**	Not Avl	Avl	Avl	Implementation of open loop PLC relay ladder logic, electronics and closed loop analog feedback controllers and response of dynamic systems. Digital Logic, PLC, Sensors, Actuators, System Dynamics, Transfer Functions and Block Diagrams, Principles of Feedback Control, Frequency Response Analyses For Control System Design	Dynamic Systems, Controls, and Mechatronics Laboratory	CC Primer, Mathcad No specifics	Not available	More emphasis on Control Systems than on core Mechatronics	MathCad and CC Primer Tutorials built by the Department

5. Rating 8.0 San Jose state university Fundamentals of Mechatronics **[Link]**	Avl	Avl	Avl.	Microprocessor fundamentals I/O ports,digital I/O, basic stamp programming, Sensors ,Op amps, conditioning ADC and DAC ,digital electronics, logic IC's motor action, DC motors Motor sizing, stepper motors	Mechatronic Engineering Laboratory	ICC111 Compiler ——— Basic Stamp	Not available	Discussion forum for technical questions/answers	Good tutorial listing for basic to expert electronics.
6. Rating 6.5 Carnegie Mellon University Mechatronic Design **[Link]**	Not Avl.	Not Avl.	Not Avl.	68HC16 microcontroller, basic controls, motor drives, mechanisms, sensors, IR communications, and motion planning.	Advanced Mechatronics Laboratory **[Link]** Robotics Institute **[Link]**	MATLAB ——— 68HC16	Not available	-	Not much
7. Rating 7.5 Santa Clara University **[Link]**	Avl.	Avl	Extensively Avl.	Intelligent Electro-Mechanical Systems: ADC, DAC, Op-amps, filters, power devices, software program design, event-driven programming, hardware and DC Stepper Motors, solenoids and robust sensing.	Specialised Mechatronics lab with Atmel Developers Kit	C, C++, ELEN 50 Atmel AVRStudio, Atmel AVRStudio, AVR-GCC, PonyProg2000, MTTTY Terminal Program ——— Atmel AVR	**Funny Car:** car that was self contained (no power supplies) and capable of navigating track **Future Farmers of America**: Fully autonomous racecar, capable of navigating an 18-foot long track marked with black non-reflective tape sensed by IR.	Web pages for projects, archived for reference	Detailed material/links for electronics segment in use, Archived web pages of projects

8. Rating 7.0 University of Pennsylvania [Link] Design of Mechatronic Systems	**Not Avl.**	**Not Avl.**	**Avl. Web page** **[Link]**	**Electro-mechanical design, use of microprocessors: instrumentation, sensing, measurements, actuation and actuator dynamics, analog and digital interfacing, basic control theory**.	**Avl, with emphasis on manufacturing/machining segment also**	**MATLAB, Pro Engineer** ——— **Basic Stamp**	**Not available**	**-**	**Good reference and manual links**
9. Rating 8.5 Berkeley University of California Mechatronic Design Laboratory **[Link]**	Not Avl.	Avl.	Avl.	Motor, Motor Control, C167 IO, PWM, H Bridge, power MOSFET, optical encoder, magnetic sensor, A/D, analog design velocity sensing, steering/D.T. control/periodic, power-on boot, Flash, _ltering, Hardware and Software Robustness, Mechatronic system Examples	Mini Car Development Kit.	MATLAB ——— C167CR	The class project is to design racing robots which can follow an embedded wire over a curving and self-crossing path at speeds greater than 3 meters per second.	Motivation for students taking the course is the Natcar Design Contest	Good links and material focusing on automated vehicles, car design notres, equipment and Siemens CPS notes, interface instructions, Natcar videos, rules and details about the competition
10. Rating 9.0 Virginia Tech **[Link]**	Not Avl	Avl	Avl	VT 84, Microcontroller, PIC, Signal I/O, PIC ADC, Power Amplification, Sensors, Dynamic Modelling, Communications, Control Theory, PID, Controller Design, Actuators, PM DC motor, stepper motors, Active material actuators, AC motors, gears reducers.	VT Mechatronics Lab	C, Assembly, MPLAB, PICC Lite ——— PIC16F84 processor, VT84 prototyping board	**[Link]** **Auto Etch-A-Sketch:** Draws images that are stored in the PIC **Auto Video Stabilizer:** Camera Stabilizer for biplanar autonomous vehicle, giving it fixed frame of reference	Short Video clips with explanatory audio for all projects available on the web	Comprehensive material and guidelines for course

MiniHW2_Sunderagopal

							Automatic Card Dealer: Automatically deals cards for as many number of cards for a given number of players **Automatic Golf Ball Tee:** Automatically Loads golf ball and waits for the ball to be hit. **Drinking Cup Stabilizer:** Tilts board and prevents water from spilling from the board. **Glass Bottle Sorter:** Sorts bottles of different colors Light Follower: Car that follows light rays		

Click **[Link]** while pressing on **Ctrl** to reach the web page linked.
Avl - Available
Not Avl - Not Available

MiniHW2_Sunderagopal

Comprehensive summary of links of interest:

1. **University of Waterloo**
   http://www.pads.uwaterloo.ca/ece324/

2. **Stanford University**
   http://me118.stanford.edu/
   http://design.stanford.edu/spdl/
   http://me118.stanford.edu/html/materials.html

3. **Northwestern Univ.**
   http://lims.mech.nwu.edu/~lynch/courses/ME333/2001/
   http://mechatronics.mech.northwestern.edu/mechatronics/
   http://lims.mech.northwestern.edu/~design/mechatronics/2002/

4. **Lafayette College**
   http://ww2.lafayette.edu/%7Eseelerk/me479/479home.php

5. **San Jose state university**
   http://www.engr.sjsu.edu/bjfurman/courses/ME106/

6. **Carnegie Mellon University**
   http://www.ece.cmu.edu/~fedder/mechatronics/Syllabus.html
   http://www-2.cs.cmu.edu/afs/cs.cmu.edu/project/chimera/www/aml.html
   http://www.ri.cmu.edu/

7. **Santa Clara University**
   http://mech143.engr.scu.edu/
   http://www.me.psu.edu/lamancusa/mechatronics/advmech.htm

8. **University of Pennsylvania**
   http://www.cis.upenn.edu/~jpo/Courses/MEAM410/

9. **Berkeley University of California**
   http://www-inst.eecs.berkeley.edu/~ee192/

10. **Virginia Tech**
    http://mechatronics.me.vt.edu/
    http://mechatronics.me.vt.edu/projects_spring_02/spring02projectsummary.html

A Sample and Comparison of Mechatronics Courses in North America

Course Name	Website	Microprocessor	Theory	Lab/Projects	Sequence/Other courses
Fundamentals of Mechatronics	http://www.engr.sjsu.edu/bjfurman/courses/ME106/	Basic Stamp	Analog electronics, digital electronics, sensors, actuators, and micro controllers	9 Labs and a final project. Labs done in groups of 2, but indivual reports are submitted.	A Capstone course plus graduate work in Mechatronics System Design/Engineering
Applied Mechatronics	http://www.kettering.edu/~jhargrov/mechatrn/me-480.htm	Not listed	Microprocessors, mechanism design with instrumentation,sensors and transducers, signal conditioning, actuators, mechatronic system design	8 lab exercises	Undergraduate course in Mechatronic Product Development as well as graduate work
Robotics and Mechatronics	http://www-srac.rutgers.edu/~mavro/robot/course.htm	Not listed	Kinematics, dynamics,control, planning, Actuators and Sensors, Data Acquisition	1 Computer Project, 1 Technical Paper Presentation, 1 Research project	Additional courses in Robotics include: Mechanical Control Systems, and Advanced Design of Mechanisms
Mechatronics and Measurement systems	http://www.engr.colostate.edu/~dga/me307.html	PIC microcontroller	Basic analog circuits, basic digital circuits, data acquisition, sensors, motors, actuators, PIV control theory	12 labs	
Microcomputer Applications (Mechatronics)	http://www.me.psu.edu/lamancusa/mechatronics/ME462.htm	Basic Stamp II	Bad link- no information	7 labs	
Mechatronic Design	http://www.ece.cmu.edu/~ece778/index.html	68HC16	Mobility, DC PM motors, H-bridge drivers, power electronics, microcontroller, A/D conversion, Infrared communication, motion planning, cooperative robotics, microsensors, microactuators	The course is based on one large project	Graduate work
Mechatronics	http://www.egr.msu.edu/classes/me456/radcliff/	Basic Stamp	What is a microcontroller, Industrial control, Robotics	Mini Labs with larger projects interspersed	
Intro to Mechatronics	http://me118.stanford.edu/	Motorola 68HC11	Basic Circuits Review, Op Amps, Sensors, Event Driven Programming, Digital Inputs, Digital Outputs & Power Drivers, DC motors, A/D, D/A, timers, software design, modular code, Noise, grounding & isolation, power supplies, Advanced programming, communications	4 labs and a final project	
Introduction to Mechatronics	http://www.stthomas.edu/technology/GRSYLB/mmse710.htm#crsdesc	Not listed	Mathematical models-systems, mathematical models-Signals, System Analysis-Theory and Practice, Real world examples of mechatronic systems, Digital Control systems, advanced topics-algorithms and hardware,	No labs, 1 term paper	

Comments:

Most courses seem to touch on the same main topics, such as digital circuits, sensors and actuation, and programming a microcontroller. On the other hand the extent to which the courses cover basic analog circuits and signal manipulation is quite varied. Some courses spend more time on the basics, while other assume the information is known. Some courses seem to also include material that is typically covered in the Instrumentation and Computing course at UB. It is also very evident that the Basic Stamp is the leading microcontroller that is used in this type of course.

No.	University	Course Content	Analysis	Rating(out of 10)
1	North Carolina State University	Programming in C, analog circuits and electronic components, logic gates, introduction to microprocessor architecture, sensors and actuators, A/D and D/A conversions, real-time programming concepts, direct digital control implementation, and principles and tools of mechanical design, namely CAD and solid modeling.	This is the course content for the course Mechatronics Design. Added to this the university also provides courses for: 1) **Instrumentation and Sensors** 2) **Microcontrollers and Embedded Systems** 3) **Control of Mechatronics Systems** The course content is challenging, with a lot of emphasis placed on practical experience.	9
2	Johns Hopkins University	Introduction to modeling and use of actuators and sensors in design of mechatronic systems. Electric motors, pneumatic, hydraulic actuators, solenoids, micro-actuators, position and proximity sensors. Microprocessor control, final project to build a microprocessor controlled robot.	Added to this students also learn topics such as forward and inverse kinematics, trajectory generation, robot motion planning.	7
3	University of Utah	Fundamentals of digital-to-analog and analog-to-digital circuits, relays, stepper motors, and digital switches. Interfacing digital and analog circuits to computers and Microcontrollers. Apply modeling, sensors, and actuators to feedback control systems. Microcontrollers are used to implement control systems in laboratory projects.	Normal course content.	6

4	Virginia Tech.	VT 84, Analog and digital fundamentals. Microcontroller technologies and computer architectures. PIC processor. PIC assembly programming. Power amplification. Signal i/o, PIC A/D Converter. PIC C-programming. Sensors (Tachometers, pots, encoders) Sensors (Infrared, Ultrasonic, Acc's) Dynamic Modeling. Communications. Control theory, PID. Controller Design. PM DC motors, stepper motors. Active material actuators	Has a very comprehensive course. Use VT84 prototyping board and Microchip PIC16F84 processor.	7
5	Michigan State University	Identify mechatronic components as multiports; describe the basic function of a variety of mechatronic components; Model mechatronic systems by applying classical methods (e.g., free-body diagrams, circuit laws) and multiport methods to generate multiport graph models; and use hierarchical modeling techniques. Formulate system equations from multiport models. Interpret aspects of system behavior. Simulate system behavior and interpret results. Use appropriate software to model mechatronic systems	Very theoretical course content, modeling of mechatronic systems is taught, making it interesting.	7

6	San Jose State University	Introduction to mechatronic systems. Basic electronic circuits, logic gates, op-amps, encoders/decoders, DC and stepper motors, A/D and D/A conversion, C programming, interfacing, and control. Combining hardware and software into integrated mechatronic systems. Hands-on laboratory practice.	Normal course content.	6
7	Simon Fraser University	Practical concepts of assembly language such as programming, digital device interfacing, and hardware/software interfacing. Assembler concepts; micro-controllers; the hardware/software interface. Elements of VHDL programming. Motorola Evaluation Board (EVB): layout and architecture. Motorola HC12 microprocessor	Use Motorola HC12 microprocessor.	8
8	University of Detroit, Mercy	Intro to mechatronics: Overview of what a mechatronic system is and its key components. Sensors and transducers: Discussion of selected types of sensors and their operation. Digital principles: Digital logic and microcontroller fundamentals. Electronics: Signal conditioning/amplification, analog-to-digital and digital-to-analog conversion. Instrumentation and control: Basic principles of instrumentation, feedback control theory. Actuators: Overview of electric motors and other types of actuators	Normal course content	6

		for mechatronic systems, mechanical devices for power transmission. Dynamic modeling and synthesis of electro-mechanical systems: Use of bond graphs as a system modeling platform, analysis and design of a system for performance.		

Details of other Mechatronic Courses in North America

1. University : Stanford University

   Course: ME118/318

   Microprocessor: 8 and 16 bit microprocessor by Microchip, Motorola.

   Theoretical Aspects Covered:
   - Basics of Mechatronics
   - Basic Circuit review
   - Sensors
   - Event Driven Programming
   - Digital Inputs
   - DC Motors
   - Stepper Motors
   - A/D D/A Timers
   - Introduction to Basic Stamp
   - HLL, Interpreters, Compliers and Assembly Language

   Lab work conducted:
   - Test Equipment and Analysis tools
   - Analog Signal conditioning
   - Event Driven Programming
   - DC and Stepper Motor

   Web Link: http://design.stanford.edu/spdl/

2. University : Northwestern University

   Course: ME 333

   Microprocessor/Microcontrollers: 68HC11, 68HC16.

   Theoretical Aspects Covered:
   - What is mechatronics? Example systems and architecture. Basic circuits review: current and voltage sources, resistance, capacitance, inductance, constitutive laws, Kirchoff¹s current and voltage laws.
   - Basic nonlinear elements: diodes and transistors
   - Single-board computers, the Handy board, creating and downloading a program in IC.
   - Stepper motors.

- Electrical noise, isolation, grounding, shielding.

Lab work conducted:

- The Furby (motor control).
- The Furby (encoder and home switch).
- The Handy board single-board computer.
- Sensors.
- Actuators.

Projects:

- Pinball Foosball
- A Myogenically Controlled Game
- 3-D Tic Tac D'oh!
- Blender Splendor
- Olympic Ski Jump Coin Dispensing System
- Easy Money :
- Gopher Madness :

Web Link: http://lims.mech.northwestern.edu/~lynch/courses/ME333/2002/

3. University : University of Minnesota

   Course: ME 5231

   Microprocessor: Not known.

   Theoretical Aspects Covered:

   - Introduction and Representation of Numbers
   - Branching, Looping, and Indirect Addressing , TMS 32010 Programming Examples
   - Lecture: Analog Interfacing, Quantization, Sampling and Aliasing, Digital Filters
   - Control of a Servomotor
   - Closed-Loop Computer Control, PID Control

   Lab work conducted:

   - Microprocessor Programming (Lab 1)
   - Introduction to Analog Interfacing
   - Digital filters
   - Closed-Loop Computer Control

Web Link: http://www.me.umn.edu/courses/me5231/

4. University : Purdue University

   Course: ME 597G

   Microprocessor: Not known.

   Theoretical Aspects Covered:

   - Diodes and Transistors
   - Combination Logic Design
   - Synchronous Sequential Logic Design
   - D/A and A/D conversions
   - Embedded systems
   - Register Transfer Logic
   - Actuators
   - Power Amplifier
   - Optical Transducers

   Lab work conducted: Not known (requires login-password)

   Projects:
   - IR Tracking Monster Truck
   - IR Tracking Rapid Firing Tank
   - Gun Turret
   - Target tracking Tank
   - Wall Tracker
   - Speed Trap Police Car
   -

   Web Link: http://tools.ecn.purdue.edu/~me588/

5. University : Colorado State University

   Course: ME 307 Mechatronics and Measurement System

   Microprocessor: PIC16F84 microcontroller (18 pin DIP with Flash/EEPROM reprogrammable memory)

Theoretical Aspects Covered:

- Electric circuit fundamentals
- AC circuits introduction
- Semiconductors: diodes, LEDs
- Transistors: BJTs, FETs
- Measurement system characteristics
- Operational amplifier
- Digital electronics
- Number codes: Binary, Decimal, Hex
- combinational logic
- microcontrollers and the PIC
- digital to analog, analog to digital conversion
- Sensors: Temperature and Stress/Strain
- Controls: Sensors + Actuators + Controller
- etc

Lab work conducted:

- Introduction - resistor codes, breadboard, soldering, and basic measurements
- Instrument familiarization and basic electrical relations
- The oscilloscope
- Bandwidth, filters, and diodes
- Transistor circuits
- Operational amplifier circuits
- Digital circuits - logic and latching
- Programming a PIC Microcontroller
- A/D conversion demonstration
- Strain gage demonstrations and analysis
- Vibration measurement with an accelerometer

Projects: No Link

Web Link: http://www.engr.colostate.edu/~dga/me307.html

6. University : North Carolina State University

   Course: MAE 534 Mechatronic Design

   Microprocessor: not known, site is password protected

Theoretical Aspects Covered:

- Programming in C for embedded systems
- analog circuits and electronic components
- logic gates
- introduction to microprocessor architecture
- sensors and actuators
- A/D and D/A conversion and data acquisition
- sensor interfacing and signal conditioning
- real-time programming concepts
- intelligent control fundamentals
- direct digital control implementation
- principles of mechatronic design synthesis and components analysis

Lab work conducted:

- Laboratory work and small projects will be assigned to help solidify learning throughout the course such as programming, working with microprocessors, and interfacing sensors and actuators. In addition, teams will work on a final design project that is of reasonable complexity. The teams will design, build, and demonstrate their solution to the assigned problem. A laboratory kit will be available for off campus students to purchase.

Projects: password protected

Web Link: http://courses.ncsu.edu:8020/mae534/lec/001/course_info.html

7. University : San Jose State University

Course: ME 106

Microprocessor/Microcontroller: 68HC11, PIC microcontroller.

Theoretical Aspects Covered:

- Introduction to mechatronics, review of basic electronics
- RC filters
- Diodes, transistors
- Microprocessor fundamentals, I/O ports
- Digital I/O, Basic Stamp intro
- Programming the Basic Stamp
- Sensors, terminology, fundamental
- Operational amplifiers
- Comparators, Signal conditioning

- Digital electronics, basic logic
- 5 Logic gates, logic IC's
- Drive system inertia calculation
- Special topics in mechatronics

Lab work conducted:

- Introduction to the Mechatronic Engineering Lab
- RC Filter and Basic Stamp Intro Lab
- Photo resistor, LED, and Transistor Lab
- Digital I/O Lab
- Interfacing a Servo to the Basic Stamp Lab
- Wheel Tachometer/Encoder Lab
- Printer Carriage Motion Control Lab
- Electronic Scale Lab

Web Link: http://www.engr.sjsu.edu/bjfurman/courses/ME106/index.htm

8. University : Virginia Tech

Course: ME 4734

Microcontroller: PIC microcontroller

Theoretical Aspects Covered:

- Analog and digital fundamentals
- Microcontroller technologies and computer architectures
- PIC assembly programming
- Power amplification
- Signal i/o, PIC A/D Converter
- Sensors (Tachometers, pots, encoders Infrared, Ultrasonic, Acc's)
- Overview of actuators
- PM DC motors, stepper motors
- Real-time systems

Lab work conducted:

- A./D echo to LED array
- Using a Cross Compiler
- Open-loop PWM code
- PID servomotor code

Projects:

- Autonomous Space Game
- Smart Guitar Tuner

- Automatic Window Blinds
- Automatic Fishing Reel
- Coin Sorter/Counter
- Golf Putt-ing Assistant
- Single Player Hockey Game
- Smart Light Seeker
- Joystick Controlled Milling Machine
- Music Controlled Strobe Lights
- Smart Pill Dispenser
- Mine Sweeper
- Smart Train Turntable
- VT Seeker Autonomous Vehicle

Web Link: http://mechatronics.me.vt.edu/home.html

9. University: Rensselaer Polytechnic Institute

   Course: Mechatronics

   Microprocessor: 8 bit Microcontroller from Microchip

   Theoretical Aspects Covered:
   - Mechatronic System Design Principles (discussed throughout the course)
   - Physical / Mathematical Modeling and Analysis of Dynamic Physical Systems
   - Control System Design; Analog-Control and Computer-Control Implementation
   - Analog and Digital Control Electronics
   - Control Sensors and Actuators
   - Interfacing Sensors, Actuators, and Microcontrollers/Computers
   - Real-Time Programming
   - Advanced Concepts (e.g., magnetic bearings/levitation, fuzzy logic control, active materials as sensors and actuators)

   Lab work conducted:
   - Analog Electronics
   - Digital Electronics, A/D and D/A Converters, Microcontrollers
   - Thermal System Closed-Loop Computer Temperature Control
   - Pneumatic Servomechanism Closed-Loop Computer Position Control
   - Stepper Motor Open-Loop Position Computer Control
   - DC-Motor Closed-Loop Analog Velocity Control
   - Magnetic Levitation

Web Link: http://www.rpi.edu/~craigk/

10. University : University of Pennsylvania

Course: MEAM 410 Design of Mechatronic System

Microprocessor: not known

Theoretical Aspects Covered:

- The first part of the course will focus on electro-mechanical design and the use of microprocessors. Topics to be covered in this section include: instrumentation, sensing, and measurements; actuation and actuator dynamics; analog and digital interfacing; micro-processor technology and programming; basic control theory, including linearization and stability; and advanced materials. The second part of the course will introduce students to topics in conceptual design, as well as to tools of optimization and the use of statistical descriptions of safety

Lab work conducted:

- BASIC Stamp Part I
- BASIC Stamp Part II
- Reconstructing Super Stiquito + Construction (just) Stiquito
- Stiquito Olympics

Web Link: http://www.cis.upenn.edu/~jpo/Courses/01c_MEAM410/labs.html