INSTITUTE OF TECHNOLOGY
UNIVERSITY OF WASHINGTON, TACOMA

SYLLABUS
11/28 /07

TCSS 371A
MACHINE ORGANIZATION
Fall 2007

Class Times: 10:30 – 12:45 MW - PNK 131
Supporting Laboratory: CP 206D

Instructor:	***Professor Larry A. Crum***
E-mail:	**lcrum@u.washington.edu**
Phone:	**(253) 692-5866**
Office:	**Cherry Parkes 224**
Office Hours:	**MW 9:30 - 10:20 ; TTH 3:30 - 4:20; and by Appointment -** ***Appointment recommended for all times.***
Text:	**Introduction to Computing Systems, From Bits & Gates to C & Beyond** ***Yale N. Patt & Sanjay J. Patel*** **McGraw Hill, ISBN 0-07-246751-9** **Website: http://www.mhhe.com/patt2**

TCSS 371 Machine Organization Catalog Course Description:
Develops the hardware basis for computing systems and relationship between hardware and software. Covers number representations, digital logic, machine organization, instruction set architecture, and assembly language. Includes an introduction to high-level languages and the translation of such a language into machine instructions. (5 credit hours)
Prerequisites: College-level physics, TCSS 142.

Simulator:
Logic Works™ 5 Interactive Circuit Design Software, Capilano Computing, Pearson Prentice hall, 2004

References:
Digital Design: Principles and Practices Package (4th Edition), John F. Wakerly**,** Prentice hall, 2005
The Art of Electronics (2nd Edition), Paul Horowitz and Winfield Hill, Cambridge press, 1989

Overview:
TCSS371 provides a look under the hood of digital computers, with a motivation to make you a stronger programmer, and provide foundations for software/hardware systems design.
It provides:

- An introduction to the basic hardware and organization of computers,
- An understanding of the relationship between hardware and software,
- An appreciation and insight into the power, constraints, and options that support robust and efficient computing system design, and
- An introduction to the foundations for computer architecture and embedded computing.

Grading:
Midterms (40%) Final Exam (25%), Homework (15%), Laboratory (15%), Class Participation (5%)

Characteristics of an A student – Work is outstanding in quality, and shows unusual insight and creativity. It is consistently presented very clearly and professionally. (S)he contributes to the understanding of others.

Characteristics of a B student – Work done is complete, predominance of it is correct, and it is well presented.

Characteristics of a C student – Work is basically complete and correct, and it is presented coherently. The student is prepared to use the material in the next course but will likely need more study in the area.

Plagiarism:

Students are encouraged to collaborate regularly with colleagues to gain a deep understanding of the material, and to gain insight on options for problem solutions. Solutions submitted are to display individual knowledge and accomplishment. A*ny significant contribution in a submission must be acknowledged and the responsible student or source given due credit.* See http://depts.washington.edu/grading/issue1/honesty.htm

Laboratory:

We will complete approximately three hands-on projects in our laboratory (CP 206D). You will have access to the lab anytime of your choosing. **See Laboratory Etiquette reference.**

Schedule (Subject to Minor Adjustment):

Week	Topics Covered	Preparations for Class (Chapters)	Homework/Projects (Homework due Monday after assignment)
1: Sep 26	Introduction & Course Overview	1, 2.1-2.4, 2.7.3-2.7.4	HW 1 - 1.3, 5, 10, 12, 15, 18 2.2, 4, 8, 10, 11, 13, 43, 48
2: Oct 1 **Oct 3**	Bits, Data Types, & Operations Logic Circuits	2.5-2.6, 2.7.1-2.7.2 3.1-3.3	HW 2 - 2.18, 20, 21, 30, 38, 40, 52, 54 3.2, 5, 6, 7, 8, 11, 16, 18, 23, 44
3: Oct 8 **Oct 10**	Combinational Logic & Memory Sequential Circuits & State Machines	3.4 - 3.5 3.6	HW 3 - 3.22, 24, 26, 33, 34, 35 3.27, 42, 43 *Lab Project 1*
4: Oct 15 **Oct 17**	Organization & Instr Set Arch (ISA) **Midterm (Chapters 1 thru 3)**	3.7, 4	HW 4 - 4.4, 5, 7, 8, 14, 16ab
5: Oct 22 **Oct 24**	LC-3: Operate & Data Move Instruc Control Instructions	5.1-5.3, Appendix *a* 5.4-5.6, Appendix *c*	HW 5 - 5.4, 5, 7, 9, 13, 14, 17, 19 5.23, 24, 31, 32, 33, 40 *Lab Project 2*
6: Oct 29 **Oct 31**	Machine Language Programming, LC-3 Assembler/Sim / Debugging	6 *LC-3 Simulator*, 15	HW 6 - 6.4, 6.7, 6.10, 6.11
7: Nov 5 **Nov 7**	Assembly Language Programming Assembly language I/O Programming	7 8	HW 7 - 7.3, 4, 5, 13, 18 8.3, 8, 9, 10, 11, 12, 16 *Lab Project 3*
8: Nov 12* **Nov 14**	*Veterans Day - No Class* Assembly Subroutines and Stacks	9, 10	HW 8 - 9.1, 2, 6, 13, 16; 10.1, 4, 6, 14
9: Nov 19 **Nov 21**	**Midterm (Chapters 4 thru 10)**		
10: Nov 26 **Nov 28**	Introduction to C Language C Compiler, C Functions	11-13, Appendix *d* *C to LC-3 Compiler*, 14	HW 9 - 11.5, 9, 10; 12.1, 5, 18, 19; 13.1,5, 6, HW 10 - Y (attached), X (attached)
11: Dec 3 **Dec 5**	C Pointers & Arrays, C Recursion Wrap-up and Review	16, 17	HW 11 - 14.7, 15 16.7, 8, 11 (HW 11 Not to be turned in)
12: Dec 10 **Dec 12**	*No Class Scheduled* **Final Exam 10:30 – 12:45**		

Safety Escorts: Safety escorts are available to accompany you to your vehicle 24 hours a day, 7 days a week. Call Campus Safety at **2-4416** from a campus phone, and **253-692-4416** from a non-campus phone.

Reporting Emergencies: From campus phones, report emergencies by dialing **9-911** and state the T-number that is on a sticker on the phone; from non-campus phones dial **911**. Building location numbers are posted on all buildings. For assistance with non-emergencies call Campus Safety at **2-4416** from a campus phone, and **253-692-4416** from a non-campus phone.

Emergency Procedures: In case of emergency, follow your professor's instructions. When an alarm sounds, evacuate the building immediately. MATT, CP, WG, GWP, and BB buildings assemble in the Cragle Parking Lot south of the library. BHS, WCG, and DOU buildings assemble near the transit station next to the Pinkerton Building on Broadway (across from Spaghetti Factory). Pinkerton occupants go to the convention center parking lot north of Pinkerton. For more information about emergency procedures and information, please go to: http://www.tacoma.washington.edu/safety/

Disability Support: If you would like to request academic accommodations due to a temporary or permanent disability, contact Lisa Tice, Manager for Disability Support Services (DSS) in the Mattress Factory Bldg, Suite 206. An appointment can be made through the front desk of Student Affairs (692-4501), or by phoning Lisa directly at 692-4493 (voice) or 692-4413 (TTY), or by e-mail ltice@u.washington.edu. Appropriate accommodations are arranged after you've conferred with the DSS Manager and presented the required documentation of your disability to DSS.

Homework Problem Y :

Develop an interrupt program to service the keyboard using interrupts. The interrupt vector for Keyboard interrupts is x80 (location x180). Begin the program with a message to the console. Then arm the keyboard for interrupts (bit 14 is the interrupt enable bit, bit 15 is the done bit) and go into an endless loop. Finally read and echo an endless string of characters from the keyboard using your interrupt routine. Store any registers you use in your interrupt routine on the stack and reload them before returning from the interrupt.

Homework Problem X :

1) Compile the following C program into LC-3 code:

```
#include <studio.h>
int Multiply(int b, int c);
int d = 3;
int main()
{
   int a,b,c;
   int d = 4;

   a = 1;
   b = 2;
   c = d + Multiply (a, b);
   printf("%d %d %d %d/n", a, b, c, d);
}
int Multiply(int b, int c)
{
   int a;
   a = b * c;
   return a;
}
```

2) Show the memory map for this program.
3) Show the run-time stack just before the function call is made
4) Show the run-time stack just before the first C statement in the function is executed
5) Show the run-time stack just before the function return
6) Show the run-time stack after the function return
7) Show what is printed.
8) Enter your LC-3 code into the simulator and verify your answers.