Chair: Tracy Christofero | **GC#6: Course Addition**

Request for Graduate Course Addition

1. Prepare one paper copy with all signatures and supporting material and forward to the Graduate Council Chair.
2. E-mail one identical PDF copy to the Graduate Council Chair. If attachments included, please merge into a single file.
3. ***The Graduate Council cannot process this application until it has received both the PDF copy and the signed hard copy.***

College: CITE | Dept/Division: Computer Science | Alpha Designator/Number: CS 512 | (●) Graded ( ) CR/NC

Contact Person: Dr. Venkat Gudivada | Phone: 304 - 696 - 5452

NEW COURSE DATA:

New Course Title: Embedded Systems

Alpha Designator/Number: CS 512

Title Abbreviation: Embedded Systems

(Limit of 25 characters and spaces)

Course Catalog Description: (Limit of 30 words)

The design of systems containing embedded computers. Micro-controller technology, assembly language and C programming, input/output interfacing, data acquisition hardware, interrupts, and timing. Real-time operating systems and application programming. Application examples.

Co-requisite(s): None | First Term to be Offered: Spring 2015

Prerequisite(s): CS 502 | Credit Hours: 3

Course(s) being deleted in place of this addition (*must submit course deletion form*): None

Signatures: if disapproved at any level, do not sign. Return to previous signer with recommendation attached.

Dept. Chair/Division Head _____	Date _____
Registrar _____	Date _____
College Curriculum Chair _____	Date _____
Graduate Council Chair _____	Date _____

Request for Graduate Course Addition - Page 2

College: CITE | Department/Division: Computer Science | Alpha Designator/Number: CS 512

Provide complete information regarding the new course addition for each topic listed below. Before routing this form, a complete syllabus also must be attached addressing the items listed on the first page of this form.

1. FACULTY: Identify by name the faculty in your department/division who may teach this course.

Dr. Venkat Gudivada, Jonathan Thompson, Dr. Paulus Wahjudi

2. DUPLICATION: If a question of possible duplication occurs, attach a copy of the correspondence sent to the appropriate department(s) describing the proposal. Enter "***Not Applicable***" if not applicable.

Not Applicable

3. REQUIRED COURSE: If this course will be required by another deparment(s), identify it/them by name. Enter "***Not Applicable***" if not applicable.

Not Applicable

4. AGREEMENTS: If there are any agreements required to provide clinical experiences, attach the details and the signed agreement. Enter "***Not Applicable***" if not applicable.

Not Applicable

5. ADDITIONAL RESOURCE REQUIREMENTS: If your department requires additional faculty, equipment, or specialized materials to teach this course, attach an estimate of the time and money required to secure these items. (Note: Approval of this form does not imply approval for additional resources.) Enter "***Not Applicable***" if not applicable.

The existing 21 kits consisting of the ChipKIT circuit board and accessories. No additional resources are required.

6. COURSE OBJECTIVES: (May be submitted as a separate document)

See attached syllabus

7. COURSE OUTLINE (May be submitted as a separate document)

See attached syllabus

8. SAMPLE TEXT(S) WITH AUTHOR(S) AND PUBLICATION DATES (May be submitted as a separate document)

See attached syllabus

9. EXAMPLE OF INSTRUCTIONAL METHODS (Lecture, lab, internship)

Lecture, lab, design and simulation/programming problems.

Request for Graduate Course Addition - Page 4

10. EXAMPLE EVALUATION METHODS (CHAPTER, MIDTERM, FINAL, PROJECTS, ETC.)

Term paper, design/simulation/programming problems, midterm exam, final exam.

11. ADDITIONAL GRADUATE REQUIREMENTS IF LISTED AS AN UNDERGRADUATE/GRADUATE COURSE

Graduate students will spend more effort on a research-oriented term paper. Furthermore, graduate students will complete more substantial design/simulation/programming problems.

12. PROVIDE COMPLETE BIBLIOGRAPHY (May be submitted as a separate document)

See attached syllabus.

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Please insert in the text box below your course summary information for the Graduate Council agenda. Please enter the information exactly in this way (including headings):

Department:
Course Number and Title:
Catalog Description:
Prerequisites:
First Term Offered:
Credit Hours:

Department: Weisberg Division of Computer Science

Course Number and Title: CS 512: Embedded Systems

Catalog Description: The design of systems containing embedded computers. Micro-controller technology, assembly language and C programming, input/output interfacing, data acquisition hardware, interrupts, and timing. Real-time operating systems and application programming. Application examples.

Prerequisites: CS 502

First Term Offered: Spring 2015

Credit Hours: 3.0

Marshall University Syllabus

Course Title/Number	Embedded Systems/ CS 512
Semester/Year	Spring/2015
Days/Time	Monday, Wednesday/2:00 - 3:30
Location	Gullickson Hall Room 211
Instructor	Jonathan Thompson
Office	GH205C
Phone	304-696-6349
E-Mail	thompsonj@marshall.edu
Office/Hours	MWF 11:00 - 1:00
University Policies	By enrolling in this course, you agree to the University Policies listed below. Please read the full text of each policy by going to www.marshall.edu/academic-affairs and clicking on "Marshall University Policies." Or, you can access the policies directly by going to http://www.marshall.edu/academic-affairs/?page_id=802 Academic Dishonesty/ Excused Absence Policy for Undergraduates/ Computing Services Acceptable Use/ Inclement Weather/ Dead Week/ Students with Disabilities/ Academic Forgiveness/ Academic Probation and Suspension/ Academic Rights and Responsibilities of Students/ Affirmative Action/ Sexual Harassment

Course Description: From Catalog

The design of systems containing embedded computers. Micro-controller technology, assembly language and C programming, input/output interfacing, data acquisition hardware, interrupts, and timing. Real-time operating systems and application programming. Application examples. PR: CS502

Course Student Learning Outcomes

The table below shows the following relationships: How each student learning outcomes will be practiced and assessed in the course.

Course Student Learning Outcomes	How **students will practice** each outcome	How **student achievement of each outcome will be assessed** in this course
Students will be able to critically analyze and evaluate an embedded system design and implementation	In-class exercises, guided group discussions	Research oriented term paper
Students will be able to describe the principles of Embedded Systems and the tradeoffs which guide the hardware-software partitioning of any design	In-class exercises, guided group discussions, low-stakes homework assignments	Programming assignments, design projects, and exams
Students will be able to design and implement computer hardware and software for real-time embedded systems	In-class exercises, guided group discussions, low-stakes homework assignments	Programming assignments, design projects, and exams

Required Texts, Additional Reading, and Other Materials

Required Text

Marilyn Wolfe. *Computers as Components, 3rd Ed*. Morgan Kaufmann, 2012, ISBN 9780123884367

Additional Reading

None

Other Materials

STM32F407VG MCU Discovery Kit Tools http://www.st.com/web/catalog/tools/PF252419

Course Requirements / Due Dates

- Midterm exam: 25-Feb-15
- Term paper due: 27-Apr-15
- Final exam: 04-May-15 from 12:45 - 2:45

Graduate Level Requirements

CS512 includes additional assignments and a term paper that are not expected of students enrolled in CS412.

Grading Policy

Activity	Weight
Design/simulation/programming problems	10%
Design projects	20%
Term paper	20%
Midterm exam	20%
Final Exam	30%

The course grade is awarded based on the following scheme:

Score	Letter Grade
≥ 90	A
≥ 80 & < 90	B
≥ 70 & < 80	C
≥ 60 & < 70	D
< 60	F

Attendance Policy

Attendance will be taken at the start of class. Only university excused absences will be accepted.

Course Schedule

Weeks 1-2	Embedded computing Instruction Sets
Week 3 - 4	ARM Processor Instruction Set CPUs
Week 5 - 6	Computing Platforms Program Design
Week 7 - 8	Program Analysis Midterm exam
Week 9 - 10	Real-Time Operating Systems Power Optimization Strategies
Week 11 - 12	Requirements Analysis and Specifications System Analysis and Architecture Design
Week 13 - 14	Multiprocessors Networks and Distributed Systems
Exam Week	Final exam

Bibilography

[1] Peter J. Ashenden. *Digital Design (Verilog): An Embedded Systems Approach Using Verilog*. Morgan Kaufmann, 2008

[2] Barr and Massa. *Programming Embedded Systems, 2nd Ed*. O'ReillyMedia, 2006.

[3] Moshe (Maury) Bach et al. "Analyzing Parallel Programs with Pin". In: Computer 43 (2010), pp. 34–41.

[4] Jean-Loup Baer. *Microprocessor Architecture: From Simple Pipelines to Chip Multiprocessors*. Cambridge University Press, 2010.

[5] Kevin J. Barker et al. "Using Performance Modeling to Design Large-Scale Systems". In: Computer 42 (2009), pp. 42–49.

[6] Peter Barry and Patrick Crowley. *Modern Embedded Computing*. Morgan Kaufmann, 2012.

[7] Randal E. Bryant and David R. O'Hallaron. *Computer Systems: A Programmer's Perspective*. Addison-Wesley, 2010.

[8] Roger D. Chamberlain et al. "Auto-Pipe: Streaming Applications on Architecturally Diverse Systems". In: Computer 43 (2010), pp. 42–49.

[9] Committee on Modeling, Simulation, and Games; Standing Committee on Technology Insight– Gauge, Evaluate, and Review; National Research Council. The Rise of Games and High Performance Computing for Modeling and Simulation. http://www.nap.edu/catalog.php?record_id=12816: National Academies Press, 2010.

[10] Richard C. Detmer. *Introduction to 80x86 Assembly Language and Computer Architecture*. Jones and Bartlett, 2009.

[11] Carl Hamacher et al. *Computer Organization and Embedded Systems*, 6th Ed, McGraw-Hill Higher Education, 2012

[12] David Harris and Sarah Harris. *Digital Design and Computer Architecture*. Second. Elsevier Science & Technology, 2012.

[13] John Hennessy and David Patterson. *Computer Architecture: A Quantitative Approach*. Fifth. Elsevier Science & Technology, 2011.

[14] Terence Kelly et al. "Eliminating Concurrency Bugs with Control Engineering". In: Computer 42 (2009), pp. 52–60.

[15] Edward Lee and Sanjit Seshia. *Introduction to Embedded Systems, A Cyber-Physical Systems Approach*, 2011 (http://leeseshia.org/)

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[17] Noam Nisan and Shimon Schocken. *The Elements of Computing Systems: Building a Modern Computer from First Principles*. The MIT Press, 2005.

[18] Tammy Noergaard. *Embedded Systems Architecture*, 2nd Ed, Elsevier Science, 2013

[19] Linda Null and Julia Lobur. "MarieSim: The MARIE computer simulator". In: J. Educ. Resour. Comput. 3 (2003).

[20] James K. Peckol. *Embedded Systems: A Contemporary Design Tool*, John Wiley & SOns, 2008

[21] Rover, D.T.; Mercado, R.A; Zhao Zhang; Shelley, M.C.; Helvick, D.S., "Reflections on Teaching and Learning in an Advanced Undergraduate Course in Embedded Systems," Education, IEEE Transactions on , vol.51, no.3, pp.400,412, Aug. 2008

[22] David Russell. *Introduction to Embedded Systems*, 2010

[23] Sagniovanni-Vincentelli et al. *Embedded Systems Development: From Functional Models to Implementations*, Springer, 2013

[24] Ronald Sass. *Embedded Systems Design with Platform FPGAs*, Elsevier Science, 2010
[25] Jon Stokes. *Inside the Machine: An Illustrated Introduction to Microprocessors and Computer Architecture*. No Starch Press, 2006.
[26] Jonathan W. Valvano. *Embedded Microcomputer Systems: Real Time Interfacing*, Cengage Learning, 20112
[27] Jonathan W. Valvano. *Embedded Systems: Introduction to Arm® Cortex(TM)-M Microcontrollers (Volume 1)*, 2nd Ed, CreateSpace Independent Publishing Platform, 2012
[28] Jonathan W. Valvano. *Introduction to Embedded Systems: Interfacing to the Freescale 9S12*, Cengage Learning, 20120
[29] Shuangbao Paul Wang and Robert S. Ledley. *Computer Architecture and Security: Fundamentals of Designing Secure Computer Systems*. John Wiley, 2013.
[30] Elecia White. *Making Embedded Systems,* O''Reilly Media
[31] Graham R. Wilson. *Embedded Systems and Computer Architecture*, Elsevier Science, 2002
[32] Marilyn Wolfe. *Computers as Components, 3rd Ed*. Morgan Kaufmann, 2012
[33] Han Wuang. *Embedded System Design with C805*, Cengage Learning, 2009
[34] Karim Yaghmour et al. *Building Embedded Linux Systems*, 2nd Ed, O'Reilly Media