

# SYST 620 / ECE 673

## DISCRETE EVENT SYSTEMS

Fall 2015

Department of Systems Engineering and Operations Research  
George Mason University

This course is designed as a broad introduction to modeling and analysis of discrete event dynamical systems. Discrete event systems (DES) are introduced as a class of dynamic systems. A review of concepts from Discrete Mathematics, that are relevant for DES modeling, is done to prepare students for more in-depth study of DESs. This review includes a short introduction to topics in Graph Theory and then illustrates how these are used within dynamic systems modeling.

Topics include Condition/event systems; Place/transition nets; Colored Petri nets; Reachability graphs; State Space analysis and Invariant analysis, Temporal and stochastic time issues in Petri nets, and Stochastic Petri nets. Applications of the theory to modeling and simulation, executable models of architectures, and to systems engineering problems.

**Instructor:** Prof. Abbas K. Zaidi  
SEOR, Nguyen Eng. Room 2237  
Ph: 703 993 1774  
[szaidi2@gmu.edu](mailto:szaidi2@gmu.edu)

**Office Hours:** Monday and Wednesday 5:00 – 7:00 PM and by appointment via phone/email (preferred)

**Teaching Assistant:** TBD

### Class Information:

**When:** August 31 – December 21, Fall 2015

**Where:** All course communication will be done via the Blackboard system. Students are expected to have access and be able to use the system before classes start. Blackboard is accessible via MyMason portal at <https://mymasonportal.gmu.edu/>. Instructions for using the Blackboard system are provided on the Help button at the top right of the portal page.

### Learning Objectives & Outcomes

The ability to effectively apply the concepts of discrete event systems modeling and analysis on real life systems by identifying the appropriate modeling abstraction for the system under study, formulating the analysis questions of interest, selecting the suitable analysis method for the study, and employing the state-of-the-art software tools/techniques to carry out the tasks.

By completing this course a student should be able:

- To classify a given system as a discrete event system
- To identify a suitable abstraction for modeling the system
- To model the system using Colored Petri Nets at the desired level of abstraction with temporal and stochastic issues addressed in the model (where applicable).
- To execute the model in simulation
- To analyze the structural and behavioral properties of the model

## **Student Evaluation Criteria: Homework 50%, Midterm 25%, Project 25%**

The following scale can be used by students for self-assessment. The instructor may relax the grading scheme for final grade assignment.

<b>94-100</b>	<b>A</b>
<b>88-93</b>	<b>A-</b>
<b>83-87</b>	<b>B+</b>
<b>77-82</b>	<b>B</b>
<b>70-76</b>	<b>B-</b>

## **Attendance and Participation Requirements**

There are no specific attendance and participation requirements, other than the following:

- Midterm Examination on October 21, 2015, from 7:20 pm to 10:00 pm.
- Final Project Presentation on December 16, 2015, from 7:30 pm to 10:30 pm. It is compulsory for all students to participate in this session.

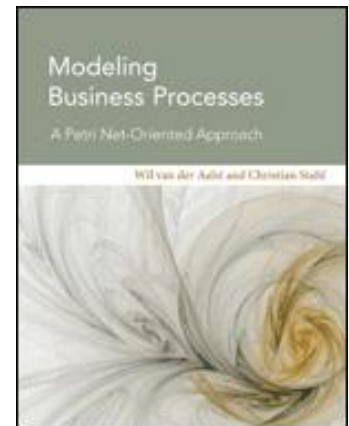
## **Other Course Policies**

- There are no provisions for late submission of work and/or make-up examinations.
- In case of an emergency that prevents a student from submitting required work before the deadlines or taking an examination, the student must inform the instructor at the earliest via email or telephone. Such situations will be addressed on a case by case basis. (Instructor's contact information)
- No points will be awarded if homework is turned in after solutions have been posted.
- Religious observances are one common example of events that might impact students' activities. Students are responsible for planning ahead. Please, refer to the GMU's calendar of religious holidays.
- All academic policies as given in the Honor System and code will be strictly followed. These are available [here](#).
- The GMU's student privacy policy is in place for this course. It is available [here](#).
- All general policies defined in the University Catalog are in place for this course. These are available [here](#).
- George Mason University is an Honor Code university. See the Office of Academic Integrity website for a full description of the honor code and the honor committee process.

## Reading and Reference Materials

### A. Required Text

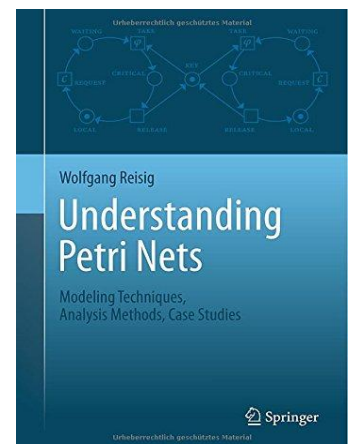
Modeling Business Processes – A Petri Net-Oriented Approach  
W.M.P. van der Aalst and C. Stahl,  
The MIT Press, 2011  
(ISBN-13: 978-0-262-01538-7)



### B. Recommended Text

Understanding Petri Nets: Modeling Techniques, Analysis Methods, Case Studies  
Wolfgang Reisig  
Springer; 2013 edition  
(ISBN-13: 978-3642332777)

*Recommended as a reference handbook*



### C. Additional Materials

Handouts/Lecture notes and all supplementary material are included in each weekly module.

#### Technical Help for Blackboard & Online Tools

- For Supported Web browsers (see [Blackboard Support](#))
- Log into Blackboard Courses (use <http://mymason.gmu.edu> , select the Courses Tab)
- Frequently Asked Questions (see [Blackboard Student Support](#))
- For all technical issues regarding Blackboard, see [Courses Support](#), Blackboard Help, and Blackboard Tutorials.
- If you still have questions, complete the Courses Support Contact Us Form for assistance with Blackboard.
- For technical questions regarding computer networking, see [IT Services](#) for Students. If you still have questions, email [support@gmu.edu](mailto:support@gmu.edu) or call (703) 993-8870.

**Hardware/Software Requirements**

A major portion of this course requires students to implement dynamic models using some CPN Tools software. This software will be introduced in-class and information to download them will be provided via Blackboard. Students are required to have the software ready for use on their individual computers for the homework assignments and for the final project.

## Weekly Schedule (subject to change as course progresses)

- The following table gives an overview of the entire course with important dates for examinations and presentations highlighted.
- A student needs to follow the links to the weekly modules to access all the course material including instructional videos, lecture notes, reading material, and assignments.
- The assignment submission must be done in the 'Assignment' Section in each weekly module before the deadline.

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## COURSE OUTLINE

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Week	Lecture Topic(s)	Workshop Topic
(Aug 31 – Sep 06)	1. Introduction & Review of Concepts	
(Aug 07 – Sep 13)	2. Petri Net Basics	CPN Tools Tutorial I
(Sep 14 – Sep 20)	3. Petri Net Classes & Definitions	CPN Tools Tutorial II
(Sep 21 – Sep 27)	4. Towards Colored Petri Nets	CPN Tools Tutorial III
(Sep 28 – Oct 04)	5. A Detailed Colored Petri Net Model	
(Oct 05 – Oct 11)	6. Petri Nets with Time	CPN Tools Tutorial IV
(Oct 12 – Oct 18)	7. Formal Definition & CPN ML	
(Oct 19 – Oct 25)	<b>8. Midterm Exam (Oct 21 @ 7:20 pm)</b>	
(Oct 26 – Nov 01)	9. Hierarchical Petri Nets	CPN Tools Tutorial V
(Nov 02 – Nov 08)	10. Behavioral Properties of Petri Nets	CPN Tools Tutorial VI
(Nov 09 – Nov 15)	11. State Space Analysis	CPN Tools Tutorial VII
(Nov 16 – Nov 22)	12. Stochastic Time & Simulation Based Analysis	CPN Tools Tutorial VIII
(Nov 23 – Nov 29)	<i>No Class (Thanksgiving Recess)</i>	
(Nov 30 – Dec 06)	13. Structural Methods	
(Dec 07 – Dec 13)	14. Review & Engineering Applications of Petri Nets	Demonstration of Models
(Dec 14 – Dec 20)	<b>15. Student Project Presentations (Dec 16 @ 7:30 pm)</b>	

## **Academic Integrity**

GMU is an Honor Code university; please see the Office for Academic Integrity for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification.

## **Disabilities Statement**

If you have a documented learning disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with Office of Disability Services (SUB I, Rm. 4205; 993-2474;<http://ods.gmu.edu>) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

## **Mason Diversity Statement**

George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.

An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals. Diversity is broadly defined to include such characteristics as, but not limited to, race, ethnicity, gender, religion, age, disability, and sexual orientation. Diversity also entails different viewpoints, philosophies, and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds and practices have the opportunity to be voiced, heard and respected.

The reflection of Mason's commitment to diversity and inclusion goes beyond policies and procedures to focus on behavior at the individual, group and organizational level. The implementation of this commitment to diversity and inclusion is found in all settings, including individual work units and groups, student organizations and groups, and classroom settings; it is also found with the delivery of services and activities, including, but not limited to, curriculum, teaching, events, advising, research, service, and community outreach.

Acknowledging that the attainment of diversity and inclusion are dynamic and continuous processes, and that the larger societal setting has an evolving socio-cultural understanding of diversity and inclusion, Mason seeks to continuously improve its environment. To this end, the University promotes continuous monitoring and self-assessment regarding diversity. The aim is to incorporate diversity and inclusion within the philosophies and actions of the individual, group and organization, and to make improvements as needed.

## **Student Support Resources on Campus**

Resources that you may find helpful may be found at:

<http://ctfe.gmu.edu/teaching/student-support-resources-on-campus/>