Proposal for Connections: Systems

Contact Person: Dr. Mark Doggett, AMS Department, mark.doggett@wku.edu, 270-745- 6951

1. **What course does the department plan to offer in Connections?**
   AMS 368 – Problem Solving

   Which subcategory are you proposing for this course?
   Systems

2. **How will the Course meet the specific learning objectives of the Systems subcategory?**
   This course is an application-oriented introduction to problem-solving tools for the solution of practical problems. Focusing on developing qualitative and quantitative literacy and analytic skills, the emphasis will be on data analysis, graphic communication, and structured modeling applied to real problems.

   The overall goal of the course is to provide students with practical scientific problem-solving abilities while enhancing critical thinking. The primary mechanism will be the practice of scientific analysis on systemic problems. The secondary goals of the course will be to develop deeper understandings regarding the intended and unintended consequences of technology. Coursework projects will consider the problems associated with technological systems.

   AMS 368 will address the following outcomes:

   1. Analyze how systems evolve.

   Increase understanding of technological systems, their creation, and their evolution. How technological systems shape society and culture, and how culture is shaped by them.

   2. Compare the individual components to the analysis of entire systems.

   Develop a perspective on the characteristics and scope of technological systems. Help the student achieve a greater understanding of how the components of design, innovation, scientific process, and application influence the human condition within a regional and cross-disciplinary context.

   3. Evaluate how system level thinking can inform decision-making, public policy, and the sustainability of the system itself.

Present aspects of science, mathematics, and technological systems as culturally relevant. Contribute to the ability of students to ponder enduring questions of human meaning, perception of reality, and individual versus collective good, uncertainty, and doubt.

3. **Why should this course be in the Colonnade Program?**
   The integration of skills, knowledge, and ways of thinking must be grounded in the awareness of self and our deeply held assumptions of the world. For students, as well as knowledgeable professionals, the assessment of held beliefs is not adequately scrutinized. Rather, deeply held beliefs, culture, and personal assumptions are thought to be the core of who we are, and thus, are not generally subject to scientific analysis. Technological change is laden with social expectations and fears that are often rationalized based on core values and assumptions that are not subject to critical self-analysis. Consequently, many decisions regarding technology systems are made without examining the underlying view on which they were based. This course addresses this need through the introduction of real problems analyzed by student teams using structured thinking problem solving tools to create recommendations for sustainable change.

   Creating profound change requires investment of time, energy, and resources. Most would agree that this investment should focus only on areas that will result in the most benefit. Typically, this means establishing activities to address fundamental problems. Such change efforts do not approach these issues as a finite, but as difficulties symptomatic of deeper structural concerns. Senge, Kleiner, Roberts, Ross, Roth, and Smith (1999) suggested that the real problem in creating change is not the obvious need to fix something, but the forces that keep people from fixing the problem in the first place. The success of fundamental change depends on the ability of participants to rethink and clearly articulate their basic assumptions, purposes, and processes. Goldratt (1990) postulated that people are unable to solve problems because they have no method of verbalizing their intuition. Both Senge et al. and Goldratt agreed that lasting change results from a clear goal, a strategy, and the use of theory. More importantly, they agreed that participants in the change process must have a method and a structure to guide practice and support system goals.

4. **Please identify any prerequisites for this course.**
   No prerequisites beyond the requirements that students have taken 21 hours of Colonnade Foundation and Exploration courses before enrolling in a Connections course.

5. **Syllabus statement of learning outcomes for this course.**
   Upon successful completion of the coursework, students will be able to:

   - Develop critical thinking skills using a variety of structured methods
   - Practice both scientific and intuitive analysis on real-world problems
   - Critically assess and gain a deeper appreciation of the quality and validity of scholarly articles and resources written from a range of diverse viewpoints
   - Increase competency in developing sustainable solutions using multiple problem solving approaches
   - Build relationships and work effectively in groups within diverse communities while effectively negotiating and reducing conflict with others
   - Polish professional oral and presentation skills

6. **Give a brief description of how the department will assess the course beyond student grades for these learning objectives.**
   This course addresses the requirements for *Colonnade Connections Category: Understanding Individual and Social Responsibility* through use of various scientific analysis techniques and the exploration of real problems. The course requirements recognize the importance of structured scientific methods as investigative tools for exploration and the impact of science/technology on the human condition.

   1. Analyze how systems evolve. Project-based approaches are useful for assessing the planning, execution, and evaluation of dynamic problems that may have more than one solution. This objective will be assessed using two web based technical reports and a personal evaluation done by the student. Students will be asked to provide a summary of the problem's social/cultural impact over time with regard to system stakeholders.

   2. Compare the study of individual components to the analysis of entire systems. Application of rigorous thinking tools supports both deductive and inductive reasoning such that systems can be dissected as well as integrated. This objective will be evaluated using four structured tool sets and a technical analysis of the assigned problem findings. Students will address the interaction of the problem's components within the technological system.

   3. Evaluate how the system level thinking can inform decision-making, public policy, and/or the sustainability of the system itself. Scholarly activity demands dissemination and scrutiny. Public review of current and proposed systems is valuable for continuous improvement and best practice. This objective will be assessed via public colloquium

and the final web-based technical report. The students will recommend specific changes to address the systemic problem(s) and provide methods for ensuring their solutions are sustainable over time.

7. **Please discuss how this course will provide a summative learning experience for students in the development of skills in argumentation and use of evidence.**
   - Students will conduct three technical analyses on assigned problems using (1) problem description and definition, (2) hypotheses, (2) preliminary results and findings. These analyses are for validating the scientific approach prior to solution selection.
   - Four sets of visual modeling problem solving tools that help students describe, analyze, and critically evaluate the problem. These assessments demonstrate competency in the use of structured and scientific methodologies that provide logic for problem description, analysis, evaluation, and presentation.
   - One public colloquium geared for interested students, faculty, and the community. Student presentations demonstrate oral competency and the ability to articulate clearly a problem and a sustainable solution.
   - Each project group will perform a post-mortem assessment that evaluates and reflects on the process and their level of performance. The purpose of group reflection is to assess internal effectiveness, collaboration, and cooperation in a collegial setting.
   - Two web-based, iterative, technical reports that describe the problem in detail, assess critical features, cite current research, provide findings, suggest solutions, and make recommendations based upon scientific evidence and the problem solving tool sets. The reports demonstrate competency in writing skills using technical formats for public consumption and critique.

8. **How many sections of this course will your department offer each semester?**
   Initially one section of this course will be offered every semester.

9. **Please attach sample syllabus for the course.**

References

Goldratt, E. M. (1990). *What is this thing called theory of constraints and how should it be implemented?* New York: North River Press.

Senge, P., Kleiner, A., Roberts, C., Ross, R., Roth, R., & Smith, B. (1999). *The dance of change: the challenges of sustaining momentum in learning organizations*. New York: Doubleday.

Problem Solving
AMS 368
Course Syllabus

A. Mark Doggett, Ph.D.
270-745-6951
mark.doggett@wku.edu

Catalog Description

This course is an application-oriented introduction to basic analytical tools for the solution of practical problems. Focusing on developing qualitative and quantitative literacy and analytic skills, the emphasis will be on data analysis, graphic communication, and simple experiments applied to real problems.

Course Description

This three-unit course engages interdisciplinary problem solving among students of varied backgrounds, interests, and expertise. Students will develop mutual trust, collaboration, and effective solutions to real problems. This course will increase analytical, social, emotional, political, communicative, and technical skills. Students will learn to assess critically social, technical and systems perspectives. Students will draw upon their previous learning and knowledge to recommend viable solutions to a variety of problems while developing an appreciation for diverse perspectives.

I. Overview and Course Goals

The overall goal of the course is to provide students with practical scientific problem-solving abilities while enhancing thinking skills in the context of the community. The primary mechanism is the practice of scientific analysis on real-world problems. The secondary goal of the course is to develop deeper understandings regarding the intended and unintended consequences of technology. Coursework projects will consider the problems associated with technological systems.

- Analyze how systems evolve.
    - Test held assumptions regarding problems
- Compare the individual components to the analysis of entire systems.

    - Apply linear and non-linear thinking skills to well-defined, ill-defined, or complex problems
- Evaluate how system level thinking can inform decision-making, public policy, and the sustainability of the system itself.
    - Recognize the value of scientific discourse through the analysis of multiple, diverse, and often contradictory viewpoints

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II. Course Objectives

Upon successful completion of the coursework, students will be able to:

- Develop critical thinking skills using a variety of structured methods
- Practice both scientific and intuitive analysis on real-world problems
- Critically assess and gain a deeper appreciation of the quality and validity of scholarly articles and resources written from a range of diverse viewpoints
- Increase competency in developing sustainable solutions using multiple problem solving approaches
- Build relationships and work effectively in groups within diverse communities while effectively negotiating and reducing conflict with others
- Polish professional oral and presentation skills

III. Course Policies

Participation:
This course is delivered using a structured, face-to-face format of scheduled class meetings consisting of lecture, guided discussion, individual or group activities, presentations, and writing assignments. Students are expected to spend time outside of class for research, data collection, analysis, ad hoc meetings or discussions, report generation, and preparation of formal presentation packages.

Assignments should be submitted on or before the due dates to ensure full credit. Assignments that are submitted late are subject to a reduction of points unless arrangements are made prior to submittal.

Academic Honesty:
All Western Kentucky University policies are in effect. All work must reflect professional citation standards. Students who present the words, ideas, or expressions of another person in any

form and claim them as their own are practicing plagiarism. Cheating will not be tolerated. The claim of ignorance is no excuse.

Methodology and Structure:
Student teams will select a problem of interest from the list provided by the instructor or suggest other problems. Teams will perform research, collect data, and perform a thorough analysis on the problem using accepted scientific approaches. The analyses will include a review of scholarly sources. Literature reviews must be from original research rather than secondary sources and stated hypotheses must be supported. Depending on the problem, teams may seek outside expertise local community partners, scientists, interested individuals, or decision-making bodies. For example, certain problems could be addressed adequately using the library combined with interviews of local experts, chapters of professional organizations, or decision-making associations or councils. Potential outside experts should be identified at the start of the project.

The analysis of data should be from original published peer-reviewed work. Other sources should be explicitly identified and used with caution. Teams will be expected to gather information that reflects a *range of viewpoints* and evaluate critically the integrity of the selected documents. Students should be able to provide a sound explanation for its consideration and merit. Original data may include information collected in the community or on campus as long as the methodology is sound and adheres to scientific principles. Students are responsible for generating the content for their assigned problem; the instructor will serve as the guide for acceptable methodologies and will provide a framework for evaluating the integrity of sources. Guest speakers may be scheduled to speak on topics of relevance.

Each student team will define and communicate the problem using visual graphic displays such as relational logic diagrams, system networks, decision matrices, or coordinate maps as described in the assigned readings. It is important to be able to frame the problem from a scientific perspective, but be able to communicate the problem using the non-technical language. As such, you will be expected to be grounded in the science of the assigned problem, yet have the ability to communicate clearly with non-scientific people from diverse backgrounds.

Techniques for developing and creating solutions are not limited and may incorporate various creative or intuitive thinking techniques. However, final solutions must be verifiable through scientific means.

Each team will present the defined problem, their methodology, findings, and conclusions at the end of the semester via public colloquium. Interested community members and problem stakeholders will be invited to attend and provide comments. Each team will write a detailed technical report to the pertinent decision-making body and post it to the web.

Potential topical areas include:

- Biotechnology
- Medical and Health technology
- Power, Transportation, and Energy Technology
- Environmental Technology
- Information and Communication Technology
- Manufacturing Technology
- Construction Technology
- Technology and Society

V. Grades

The grading for the course is as follows:

Item	**Percent**
Analysis Tool Sets 1-4 (10% each model)	40
Colloquium Presentation	20
Web-based technical reports (5% and 10%)	15
Post-Mortem Project Assessment (5%) & Personal Evaluation (10%)	15
Quizzes	5
Technical Analyses	5
TOTAL	100

Forty percent of your individual grade is based upon your mastery of the analysis tool sets. *Ten percent of the grade is based on your individual effort and effectiveness as assessed by your team member peers*. Five percent of the grade is based upon your quiz scores. The remaining portion of the grade is based upon the overall performance of the team with regard to the scientific analysis of the problem (5%), the quality of the web-based reports (15%), thoroughness and professionalism of presentations (20%), and post mortem project assessment (5%). Individual grades will be based upon a combination of team scores and individual scores.

It is expected that student will spend a total of between 120-135 hours of effort (or 8 to 9 hours per week) outside of the classroom for research, analyses, team meetings, class preparation, and subject study.

Estimated Time Breakdown

Activity	Hours
Class Meetings	45
Readings	45
Report & Presentation Development	20
Web Site Posting	20
Tool Set Development	20
Problem Observation & Analysis	30
Total Hours	180

Grading Policy:
You will be able to track your grade points via Blackboard throughout the course. The grading scale is as follows: A = 90%-100%; B = 80%-89%; C = 70%-79%; D= 60%-69%; F = 0%-59%. You will know in advance the standards and expectations for all assignments. Each student is responsible for:

- Adhering to all team and project commitments
- Completing outputs as assigned by the team per the syllabus or as negotiated with the instructor
- Committing to a high level of professional development, scientific rigor, and cooperative learning

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VI. Reading and Texts:
Students will be assigned readings from a variety of textbooks and articles.

Specific chapters or pages will be assigned for learning the visual tools and mechanisms for defining, describing, analyzing, and presenting problems. Excerpts from the texts will be available.

- Senge, P. Roberts, C., Ross, R., Smith, B. & Kleiner, A. (1994). *The fifth discipline fieldbook*. New York: Doubleday.
- Flood, R. L. (2002). *Rethinking the fifth discipline: Learning within the unknowable*. New York: Routledge
- Kim, D. H. (1993). *Systems archetypes I: Diagnosing systemic issues and designing high-leverage interventions*. California: Pegasus Communications
- De Bono, E. (2009). *Six thinking hats*. New York: Viking Press
- Scheinkopf, L. J. (1999). *Thinking for a change*. Boca Raton, FL: St Lucie Press
- Dettmer, H. W. (2007). *The logical thinking process: A systems approach to complex problem solving*. Milwaukee: ASQ Press
- Brassard, M. (1989/1996) *Memory jogger plus*. Salem, NH: GOAL/QPC.

Overview of the Scientific Method http://invsee.asu.edu/scimethod/scimethod.htm
Scientific Thinking and the Scientific Method http://www.freeinquiry.com/intro-to-sci.html
Steps in the Scientific Method http://www.ldolphin.org/SciMeth2.html

Critical Evaluation of Resources
http://www.lib.berkeley.edu/TeachingLib/Guides/Evaluation.html

Critically Analyzing Information Sources
http://www.library.cornell.edu/olinuris/ref/research/skill26.htm

Suggested List of Evaluation Criteria for Web Site Resources
http://lib.nmsu.edu/instruction/evalcrit.html

History, Theories, Facts, and Myths about Science
Goodstein, David (2000) How Science Works. In *Reference Manual of Scientific Evidence* (2nd ed.) Federal Judicial Center
http://www.fjc.gov/public/pdf.nsf/lookup/sciman00.pdf/$file/sciman00.pdf

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VII. Planned Course Schedule

Week	Topic/Goal	Readings	Class Activity	Activities/Assignments
1	Introduction/ course goals & objectives	Assigned web readings	Lecture Discussion	Group formation Problem selection

	The scientific approach/ scientific perspective			
2	Intro to visual displays and system archetypes	Book excerpts Senge Kim Flood	Lecture Discussion	Build system archetypes Problem descriptions Quiz #1
3	Preliminary research/ develop an informed perspective Data collection/creating reference lists	Senge Kim Flood Assigned web readings	Critical assessment of scientific articles and resources	Research, references and literature review
4	Introduction to thinking tools Objective analysis/ develop factual perspective	De Bono Assigned web readings	Lecture Discussion Thinking tools practice	Tool Set #1 Archetypes Technical Analysis 1: Description & Definition Initial reference list Quiz #2
5	Data collection/ original research/ service learning Perception surveys/using	De Bono Assigned web readings	Lecture Discussion Thinking tools practice	Initial observations, interviews, or surveys

	intuitive analysis Critical analysis/ critical thinking			
6	Constructive analysis/positive speculation Creativity/lateral thinking	De Bono Assigned web readings	Lecture Discussion Thinking tools practice	Quiz #3
7	Strategic planning/ implementation	De Bono Assigned web readings	Thinking tools practice Team progress reports	
8	Mid-semester progress & reporting		Mid-semester evaluation Team progress reports	Tool Set #2 Thinking Tools Technical Analysis 2: Hypothesis Final reference list Quiz #4
9	Introduction to logic maps/ tool set #4 Sufficient cause and necessary condition/ develop rigor of assessment	Scheinkopf Dettmer Assigned web readings	Build effect-cause-effect diagrams Build necessary condition diagrams	Diagrams, Maps, & Matrices Team report preparation
10	Describe current reality/ communicate scientific	Scheinkopf Dettmer Assigned web	Build current reality tree diagrams Build	Web Technical Report (First Version) Quiz #5

	understanding Assess trade-offs/ practice negotiation	readings	evaporating cloud models	
11	Create future state/ test assumptions	Scheinkopf Dettmer Assigned web readings	Predict outcomes Discussion	Assessment/ reflection and preparation of scientific data
12	Organizing data /natural groupings Developing links/ multi-directional thinking	Brassard Assigned web readings	Build affinity KJ diagrams Build relationship maps	Tool Set #3: Logic Diagrams Quiz #6
13	Prioritization and Decision making Assessment of progress/web-based technical science reporting	Brassard Assigned web readings	Build decision matrices	Tool Set #4: 7MP Tools
14	Assessment of progress/ test assumptions/ service learning Professional written, oral, and presentation skills		Team report preparation	Technical Analysis: Results and findings Quiz #7
15	Polish professional presentation skills Public forum		Preparation Public dissemination	Web Technical Report (Final Version) Colloquium

				Presentation
Finals Week	Project and team evaluation/ scientific perspective		Learning assessment	Post Mortem Assessment

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