ISYE 4112 Workflow Design for Manufacturing and Service

Credit: 3-0-3

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Prerequisite(s): ISYE 3030 Basic Statistical Method and ISYE 3232 Stochastic Process, Prerequisite with concurrency ISyE 3133 Engineering Optimization

Catalog Description
Introduction to the modeling, analysis and design of workflow systems in manufacturing systems and service systems such as healthcare systems, banks, service centers and warehouses.

Text
Douglass Bodner, Ying (Laura) Li, Damon Williams and Chen Zhou "Workflow Design in Manufacturing and Service Systems," Electronic book, available in TMS.

References
1. *Production and Operations Analysis*, Steven Nahmias, 5th edition, Irwin, 2005 (supported by additional references wherever necessary, typically provided to the students through the "Reserves" system of the campus library).
2. *Factory Physics*, 3rd Edition, by Wallace J. Hopp, Mark L. Spearman.
3. *Warehouse & Distribution Science*, Release 0.98, John Bartholdi, III, Steven Hackman, free download at https://www.warehouse-science.com/

Course Description: This course is to develop models for the design, operation and analysis of workflow systems in factories, service systems and warehouses. We will discuss key performance indicators (KPIs), decision variables and the parameters that impact the performance of the workflow systems. We will develop symbolic and mathematical models that are based on probability, statistics, queuing, News Vendor and optimization. The KPIs in workflow systems include cycle or response times, throughput, work-in-process (WIP), costs due to setup, holding and uncertainty, or delays. The first part of the course focuses on modeling the dynamics in workflow system. The second part is to design the control of the workflow systems through planning, scheduling or pull control systems. The third part is to apply the flow models to warehouses and distribution centers with the addition of key spatial indicators in space utilization and travel.

Course Outcomes: At the end of this course, the students will be able to:
1. describe the factors that impact the operations of workflow systems;
2. describe the important performance objectives or KPIs and their relationships;
3. apply symbolic and mathematical workflow models to describe workflow systems;
4. identify and determine decision variables to develop alternative designs;
5. use software tools in solving workflow problems;
6. work in teams effectively;
7. understand the social, environmental and economic impact of workflow systems.

Topical Outline

Topic	Weeks
Deterministic workflows, closed and open, cycle times, throughput, WIP, Little's Law	2
Variability, CV, Poisson flows, non-Poisson flows, interruptions, variability propagation, buffers, variability reduction, pooling	3
MRP, explosion Calculus, lot-sizing, EOQ, Wagner Whitin optimization, capacity constraint, optimization model, finite production rate, shared resources, costs	3
Scheduling, dispatching rules, line balancing	1
Warehouse and Distribution centers, spatial efficiency; space utilization, travel and layout	1
Unit load or unit load operations, ABC analysis, case picking forward reserve,	2
Broken case, batching, zoning, technologies, summary	2
Total	14

The relationship between course outcomes and BSIE Student Outcomes

Course outcome \ Program Outcomes	**1. identify, formulate solve engg prob by engg, sci & Math**	**2. produce solutions consider public health, safety, welfare, global, cultural, social, environ & economic**	**3 communicate with a range of audience**	**4 recognize ethical & professional responsibilities, make informed judgement consider resolutions in global, economic, environ and societal context.**	**5. effective on a team provide leadership, collaborative and inclusive envirn, plan tasks & meet objectives**	**6. develop and conduct experiment, analyze and interpret data & use engineering judgement to draw conclusions.**	**7. acquire and apply new knowledge using appropriate learning strategies**
1. describe the factors that impact the workflow systems	H						
2. describe the KPIs	H						
3. apply symbolic & mathematical models	H						
4. identify and determine decision variables to develop designs		H					
5. use software tools		M	M		M		M
6. work in teams							

7. understand the social, environmental and economic impact		M		M			

Evaluation of the important outcomes
Course outcomes 1, 2, 3 and 4 will be assessed based on direct questions on final exam or final project.