Computer Science Department
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ITE 505 Information Technology Capstone Project **3 cr.**

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Section	Time	Room	Final Exam
nn	days and times	location	date and time

Catalog description

A substantial project involving system design and implementation is carried out on an individual basis under the supervision of a faculty member. The specification for the capstone must have been completed in the prerequisite course ITE 501. A presentation of the completed project will be made to the department faculty and students; writing experiences will be used to develop skills in analysis and rhetoric. The course involves periodic meetings, group discussions (if appropriate), and individual conferences. Open only to Information Technology majors.
Prerequisites: ITE 501 and permission of the program coordinator/chairperson (as appropriate).

Course Sequence Goals

The purpose of this course *sequence* is to develop students' ability to construct (ITE 501) and implement (ITE 505) a proposal for a project in Information Technology. The goals of this sequence are:

G1: to develop an appreciation for the process of formulating a project for implementation;
G2: to develop the skills necessary to assess a project proposal for appropriateness and feasibility;
G3: to further develop the skills and knowledge necessary to propose, analyze, design, implement and verify system or software projects;
G4: to develop students' writing skills in the context of all aspects of the software engineering process;
G5: use written assignments and class discussion to teach students to write effectively for various purposes and audiences;
G6: to have students experience writing as a process;
G7: to give students experience in making and critiquing presentations.

Upon completion of the course sequence, a student will have demonstrated the ability to perform the activities and techniques necessary to identify a potential development target, developed a formal project proposal, researched and selected a project design / architecture, selected the tools utilized during implementation, and have implemented, verified and evaluated a solution.

Course Sequence Outcomes (Objectives)

Upon successful completion of the course sequence, students will have:

O1: demonstrated knowledge of the phases and workflows of the project development life cycle;
O2: demonstrated knowledge of the major process models used in the development of large-scale IT systems;
O3: demonstrated knowledge of the tools and techniques appropriate for implementation of the project, specifically including design/diagramming tools as appropriate for the

project;
O4: demonstrated knowledge of modern design paradigms;
O5: developed a plan for project implementation;
O6: presented and defended a project proposal and solution design to the department faculty and students;
O7: carried out an implementation plan, recording any deviations from the plan along with rationale and ramifications;
O8: demonstrated the ability to critically analyze materials ranging from project proposals to technical specifications to scholarly research and to express this analysis clearly in both spoken and written form for a variety of appropriate audiences;
O9: presented and defended a demonstration and analysis of a completed project to the department faculty and students;
O10: demonstrated an understanding of writing as a process by giving and responding to feedback and reflecting on his/her own writing processes.

Course Narrative

The Information Technology capstone project involves two courses: in ITE 501 Information Technology Capstone Project Specification students work with a project supervisor to select a project focus/topic, and then develop a formal project proposal that specifies: intended functionality of the project; student objectives; technical aspects of designing and implementing the project; project schedule and evaluation criteria; and a list of deliverables that will be produced at the end of ITE 505 Information Technology Capstone Project. In ITE 505, students implement the project proposed in ITE 505, following the requirements and schedule as specified and producing a journal of implementation activities along with a finished product.

The overarching goal of the ITE 501 / ITE 505 sequence is for students to experience all aspects of the development process from initial conception of intended functionality through to project completion. This experience ties together in one extended activity the research, procedural, and technical aspects of the Information Technology program of study, simulating the environment that students will be expected to be able to function in upon graduation. The procedural and research aspects are the focus of ITE 501, wherein a project is proposed, defined, and planned for; the technical aspects of implementing a project are experienced in ITE 505. Additional research may be required in ITE 505 as a result of the roadblocks detected during implementation, which may in turn require refinement of specified procedural aspects of the project.

Students are required to engage in writing activities throughout the course sequence. ITE 501 requires the development of project components intended to convey to potential *non-technically inclined* clients (ranging from owners to stakeholders to users) the proposed functionality of the project and to *technically inclined evaluators* a proposed solution, tools list, schedule, and evaluation criteria. The proposed solution must be accompanied by documentation of possible alternative strategies and justification of the selected solution.

Student activities relating to Written Communication - Level III criteria are found throughout the course sequence and are intimately integrated into the learning process. All project proposals are evaluated based on formal assessment rubrics; students are given the opportunity to make multiple submissions of all project components and are strongly encouraged to submit multiple drafts of proposed functionality documents, with each submission receiving feedback from the instructor. Supervisor / student meetings provide multiple opportunities for students and the supervisor to review work and to discuss the principles underlying their writing efforts. Proposal and project components include a wide assortment of activities designed to assist students in selecting a project

process model and how the selected model will relate to project implementation.

The final grade for ITE 501 is determined by the formal project proposal, which is based on writing as it is commonly practiced within the field of information technology. The final grade for ITE 505 is determined by the evaluation schema defined in the ITE 501 proposal and always includes a significant percentage determined by the project journal, project documentation, and the materials produced in support of the completed project presentation.

Program Objective / Course Objective matrix (For ABET Accreditation Purposes)

(The following Matrix maps the Program Objectives for Information Technology Program outlined by Accreditation Board of Engineering Technology (ABET) with the Course Objectives. The check marks below the course objective represent that those course objectives accomplish specific program objectives set forth by ABET.)

Program Objective	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10
PO-A: An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline.	√	√	√	√	√	√	√		√	
PO-B: An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.	√	√	√	√	√	√	√	√	√	√
PO-C: An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.				√			√	√	√	√
PO-D: An ability to function effectively on teams to accomplish a common goal.										√
PO-E: An understanding of professional, ethical, legal, security and social issues and responsibilities.								√		√
PO-F: An ability to communicate effectively with a range of audiences.						√		√	√	√
PO-G: An ability to analyze the local and global impact of computing on individuals, organizations, and society.								√		√
PO-H: Recognition of the need for and an ability to engage in continuing professional development.		√	√	√			√		√	
PO-I: An ability to use current techniques, skills, and tools necessary for computing practice.		√	√	√	√	√	√	√	√	
PO-J: An ability to use and apply current technical concepts and practices in the core information technologies.		√	√	√		√		√	√	√

Program Objective	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10
PO-K: An ability to identify and analyze user needs and take them into account in the selection, creation, evaluation and administration of computer-based systems.		√	√	√	√	√	√	√	√	√
PO-L: An ability to effectively integrate IT-based solutions into the user environment.	√	√	√	√	√	√	√	√	√	√
PO-M: An understanding of best practices and standards and their application.	√	√	√	√	√	√	√	√	√	√
PO-N: An ability to assist in the creation of an effective project plan.	√	√	√	√	√	√	√	√	√	√

Note: All projects are expected and required to relate to the specific Program Objectives as indicated above. In addition, a specific project may relate to Program Objective PO-D depending on whether the project involves multiple students.

Topics

- requirements: **SIA1(2), SIA4(0.5), SP2(1)**
  - review of the initial phases of the development of a formal proposal
  - project planning
  - investigation of general needs
  - analysis of existing functionalities
  - proposal of a set of new/modified functionalities
- review of the systems integration process **SIA3(2)**
  - basic principles
  - components, interfaces, and integration
  - the development life cycle
- review, as necessary, of systems analysis techniques **SP2(1), SP1(0.5), SP2(0.5)**
  - information gathering
  - team communication
  - feasibility studies
- project management techniques **SIA4(1.5)**
  - roles and responsibilities for key project personnel and stakeholders
- overview of systems architecture **SIA7(1)**
  - for software projects, primary focus on ADTs, object recognition and specification, and file/database design (if appropriate)
  - for hardware projects, primary focus on system block diagrams, system circuit diagrams and wiring diagrams
- review of general implementation, acquisition, testing, and quality assurance **SIA2(2), SIA5(1.5)**
  - reliability
  - testing
  - verification
  - evaluation and benchmarking
- design, analysis, and documentation of: **SIA4(0.5),SIA6(0.5),SP6(1),SP3(1), SP4(1), SP1(1.5), SP5(1)**
  - project requirements
  - selection of project planning and management strategies

- intellectual property consideration
- assessment of project quality: selection of and evaluation against appropriate style rules for code and documentation
- test cases as use case diagrams and/or scenarios and/or stories and/or automated test cases

Student Experiences

The primary goal of ITE 501 is to guide students through the process of designing a detailed proposal for a software- or hardware-system project and specifying its implementation requirements at a level appropriate to the proposed project. Students will choose an application arena of sufficient complexity so as to necessitate a non-trivial solution to the problem of designing and implementing a solution for the project. The selected topic area will then be studied through research and discussion. After a thorough analysis of the functionalities required by the proposed project, students will develop and present to the project supervisor various data modeling and system architecture possibilities: the possibilities will be iteratively discussed with and evaluated by the faculty supervisor, leading to a final document that:

- describes the functionalities of the proposed system in clear, concise and non-technical terms;
- specifies the tools necessary to implement a solution;
- defines a high-level design architecture for a solution;
- specifies important developer-designed objects required to represent the application area;
- describes the implementation techniques that are appropriate for manipulating the objects;
- presents an implementation schedule;
- presents a mechanism for determination of the final grade for ITE 501.

The finished ITE 501 proposal will be presented to department faculty and to the department at large at the end of the semester (typically on Reading Day).

The (pass/fail) grade for ITE 501 will be based on the final proposal document (in particular on the analysis of the required functionalities, the scope of the project, and on the appropriateness of any proposed design(s)) and the quality of the presentation and defense of the proposal. The finalized document will act as the contract document for the project that is to be implemented in ITE 505.

In ITE 505, students will implement the project as specified by the proposal created in ITE 501 by following the specific project plan and schedule. **Any changes to the ITE 501 proposal document must be documented, in writing, by the student and approved by the supervising faculty member and the department Chairperson, and must be accompanied by a detailed explanation of the rationale for the changes and an assessment of the impact on the project.** The final grade for ITE 505 is determined by the evaluation mechanism specified in the ITE 501 proposal.

Course Sequence Objective / Assessment Mechanism matrix

	Proposal			
	Problem Specification	Proposed Solution Design	Proposed Implementation Techniques and Tools	Presentation
O1	√	√	√	√
O2	√	√	√	√

O3	√	√	√	√
O4	√	√	√	√
O5	√	√	√	√
O6	√	√	√	√
O7	√	√	√	√
O8	√	√	√	√
O9	√	√	√	√
O10	√	√	√	√

	Completed Project				
	Specification Component(s)	Implementation Component(s)	Result Analysis Component(s)	Documentation Component(s)	Presentation
O1	√	√	√	√	√
O2	√	√	√	√	√
O3	√	√	√	√	√
O4	√	√	√	√	√
O5	√	√	√	√	√
O6	√	√	√	√	√
O7	√	√	√	√	√
O8		√	√	√	√
O9		√	√		√
O10	√	√	√	√	√

ITE 501 Information Technology Capstone Project Specification

Requirements for the Specification of the Capstone Project

First: the onus of picking a topic, developing a proposal and completing the proposal is on the student (or group of students). The supervising faculty member is available for consultation and suggestions, but the student(s) are responsible for "making things happen". Students should not expect specific assigned homework, regular meetings (as in the traditional two or three times a week) and/or tests or quizzes during ITE 501.

Second: ITE 501 and ITE 505 are only offered on a Directed Study basis. In order to register for *any* Directed Study (including ITE 501 and ITE 505), students must fill out a Directed Study Registration form (available from the Registrar's Office or the department office). The signatures required include those of the supervising faculty member and the department chairperson. Once the form has been completed, it is the student's responsibility to submit the form to the Registrar's Office. Note that the requirement of the Directed Study form makes it impossible to register for ITE 501 or ITE 505 online via Navigator.

Proposed projects for ITE 501/505 must involve the design and implementation of a moderate-to-large system or software project. Proposals should adhere to the following general guidelines:

- Proposed projects should be primarily applications-oriented and non-trivial in nature; projects must exhibit algorithmic complexity and/or research into area(s) new to the student, and may not be simply "output generators";
- The main focus of the project must draw upon one or more upper-level (above ITE 310)

courses, utilizing and possibly extending information (algorithms, structures, methodologies, etc.) acquired in such courses, and will preferably involve integration of concepts and technologies presented in multiple courses;

- A faculty supervisor must agree to monitor the student's progress and to provide a *limited* amount of technical implementation support. During ITE 501 the supervisor will provide guidance for the student in choosing a topic, designing the proposal, determining appropriate components for the final report and presentation, and creating a proposal presentation; during ITE 505 the supervisor will provide guidance and *limited* technical assistance with implementing the project, and with creating a suitable presentation of the completed project.
- Once a supervisor has been selected and a topic / application area agreed upon, the student must prepare a formal proposal detailing the specific requirements and expectations of the project. **The proposal must include the following components** (explained in more detail below). Proposals lacking any of the following components will not be scheduled for presentation.
  - ☐ Cover Page
  - ☐ Student Objectives
  - ☐ Problem Specification
  - ☐ Benchmark Specifications
  - ☐ Tools List
  - ☐ Solution Processes and/or Design
  - ☐ Time Schedule
  - ☐ Grading Scheme
  - ☐ List of Deliverables
  - ☐ Presentation (must be in "presentation format", e.g., Microsoft Office PowerPoint, OpenOffice, Impress, Prezi, etc.)

Cover Page

Center the project title on the page. Place the name(s) of all student participants under the title. Place the name of the faculty supervisor and the presentation date in the bottom right corner.

Student Objectives

State what your personal goals and objectives for the project are, that is, state in general terms what you hope to accomplish by completing your proposal and project, and then state the specific new skills and/or skill enhancements you expect to demonstrate via your project. Examples include "experience with advanced database design concepts", "experience with the complete life cycle of a project, from initial fact-finding and problem specification all the way through to implementation, verification and documentation", "ability to install, configure and use MySQL".

Problem Specification

Describe in clear *non-technical* language what the project will attempt to do: focus on the project's ***functionality*** and ***not*** on the *technical* aspects of its implementation. Explain any terms that may be unknown to a reader unfamiliar with the specific subject area of the proposal. Any use of technical vocabulary and concepts (terminology unlikely to be familiar to an audience not trained in Information Technology) is very strongly discouraged. Focus on *what* the project will accomplish, that is, on the functionalities that it will support. The problem specification should be one to two pages in length; anything longer than two pages tends to be either too detailed or too ambitious for a single-semester implementation. Group projects may need to exceed the two-page limit.

Tools List

List any and all tools that may be used in developing a solution to the problem. Tools include (but are not limited to):

- any software or hardware that will be used at any stage of the process, including (but not limited to) program language(s), IDEs, APIs. CASE environments, operating system(s), communication protocols, general productivity tools, FPG kits, hardware controller, cameras, etc.;
- algorithms and/or data structures, *if beyond those implemented as part of previous coursework*.

If evaluation and selection of tools is part of project implementation, state so explicitly *as part of the problem specification*; include a list of potential candidates and specify the criteria to be used in selecting specific tools.

Solution Design

Provide a high-level (architectural, abstract) design of the proposed solution. Begin with a graphic showing the relationship(s) amongst the major solution components. For each of the components, describe the design of the solution in a format appropriate to the subject area (e.g., ER diagrams for database-centric projects, UML diagrams (class, activity, interaction and/or use-case) for large-scale software projects, etc.). Each component of the design must be accompanied by a brief paragraph describing the responsibility (intended functionality) of the component.

Benchmark Specifications

Benchmarks must be defined which will allow progress in the project to be monitored and documented. The benchmarks must be objective, readily measurable, and must clearly relate to one or more components of the solution design.

Time Schedule

Establishing a timetable and agreeing on a reasonable rate of progress on the project is the joint responsibility of the student(s) and the faculty supervisor. List the major components/benchmarks from the previous two steps in the order in which it is anticipated they will be completed. Indicate which (if any) are dependent on earlier steps, and which (if any) can be worked on simultaneously (Gant or PERT charts may be appropriate). Include approximately how much time each component should take (in days or weeks): the total amount of time allocated should be approximately 14 weeks.

Grading Scheme

Possibilities include allocating a percentage of the grade to each of the components / benchmarks of the project, or specifying the set of benchmarks representing progress of the project and awarding a final grade based on how many of the benchmarks have been reached *and documented*. Use the **Time Schedule** list as a reference for the components / benchmarks. The supervisor must approve the final grading scheme. Note that the presentation of the completed project must be allocated 10% of the final grade for ITE 505.

Deliverables

The specific list of deliverables will vary from project to project. Typical deliverable components include, *but are not limited to*, the following. Note that all projects must include the components presented in **boldface**.

Not all components will be included in all proposals; additional components may be required at the discretion of the supervisor, based on the nature of the proposed project. ***Note that the following list is of components that are to be delivered upon the completion ITE 505, not ITE 501.*** *In ITE 501, you are* ***listing (specifying)*** *what* ***will be*** *included in the completed package.*

- **original proposal and presentation file(s) (from ITE 501)**
- **amendments to the proposal (approved by the project supervisor)**
- system architecture diagram(s) (UML, DFD context, etc.), enhanced with details determined during

implementation

- **appropriately commented source code**
- **documentation of project functionality (test results, screenshots, video capture of project execution, etc.)**
- **sample output (screen shots and/or reports)**
- user's manual
- **executables and/or projects**
- **presentation documents (used to support the presentation of the completed ITE 505 project), including any presentation file(s)**
- **project journal: a narrative of the progress of the project, in clear, concise English, including any problems encountered and how said problems were addressed**
- **project *post mortem*: a summary of what was learned from the project and (based on that experience) discussion of how various aspects of the project might have been approached differently**
- a **list of what areas of the proposal (if any) were not completed, including reasons why**
- **presentation of the completed project (PowerPoint format), including screenshots of the functioning project**

Additional components may be required at the discretion of the supervisor, based on the nature of the proposed project.

Presentation

A slide show-based presentation of the proposal must be created, reviewed by the faculty supervisor, and presented to the department. The presentation must be a *summary* of the proposal, *not* a duplicate of it. In particular, the Project Specification and Solution Design components of the formal project proposal will always need to be summarized / condensed; the remaining components can sometimes be copied out of the proposal and pasted into the presentation, but will usually also require summarization. There are no set limits on the number of slides - however, note that you will have no more than 15 minutes in which to make your presentation and respond to questions and comments, so the presentation itself should be limited to 10-12 minutes.

A copy of the completed proposal must be submitted to the faculty supervisor *at least one week* ***before*** *the last day of classes for the semester*; hardcopies must be provided for each faculty member of the department on Presentation Day. The student is responsible for distributing the copies to faculty. The student(s) will present the finished proposal to the department possibly on Presentation Day (typically on the Reading Day, which immediately precedes the final exam period) or the day finalized by the department chairperson for that semester. Final approval takes the form of a grade of "Pass". Non-approval of a proposal (a grade of "Fail") will be transmitted to the student(s) by the faculty supervisor, accompanied by a detailed analysis of why the proposal was rejected. Rejected approvals may be re-submitted for consideration during the next semester.

Projects may be disallowed for insufficient technical content, duplication of current or previous projects, or insufficient background on the part of the student. It may be necessary to postpone a project to a future semester due to unavailability of a faculty supervisor. A student may not register for ITE 505 until a grade of Pass has been achieved for ITE 501.

Final reminder: the onus of picking a topic, developing a proposal and completing the formal proposal in a timely fashion is on the *student* (or group of students). The supervising faculty member is available for consultation and suggestions, but the *student(s)* is/are responsible for "making things happen" at all stages of the proposal development process. Students should not expect standard course ingredients such as specific assigned homework, regularly scheduled

meetings and/or tests or quizzes.

ITE 505 Information Technology Capstone Project

Requirements for the Implementation of the Capstone Project

Students must have completed ITE 501 and must fill out a Directed Study Registration form in order to register for ITE 505 (note that this is the same form that was filled out for ITE 501 - it *does* have to be filled out again for ITE 505). Note that since completion of ITE 501 does not take place until the end of the semester (after the formal presentation of the proposal), ITE 505 *cannot* be registered for during regular advising / pre-registration. **Registration for ITE 505 *must* take place through the Registrar's Office (Navigator cannot be used to register for directed study courses)**. Note that the signatures required include those of the supervising faculty member and the department chairperson.

Once work has begun on a project, modifications to the original proposal may be found necessary. ***Any such modifications must be justified and submitted, in writing, to the faculty supervisor, and subsequently approved by the faculty supervisor before being implemented.***

Establishment of the timetable for the project and agreement on a reasonable rate of progress *was* (note the use of past tense!) the joint responsibility of the student(s) and faculty supervisor in ITE 501 when the project proposal was formalized. During ITE 505 it *is* (note the use of present tense!) the responsibility of the *student(s)* to maintain this rate of progress and meet the agreed-upon deadlines. Direct supervision of the project by the faculty supervisor is minimal - there are no regularly scheduled lectures as in most academic courses. Students may consult with the supervisor for suggestions as to how to approach an unexpected problem or where to go to find technical support; students should *not* expect the faculty supervisor to assist *directly* in debugging code or to provide detailed technical assistance. Inadequate progress on the part of any student may, at the

discretion of the supervisor, result in a failing grade for that student.

*One week **before** the last day of classes for the semester* the student(s) must submit to the faculty supervisor all required deliverables for review:

- the original proposal, as approved by the Directed Study Committee;
- any modifications or extensions to the original proposal as approved by the faculty supervisor and the Directed Study committee;
- a narrative of the progress of the project, in clear, concise English, including any problems encountered and how said problems were addressed;
- required deliverables (deliverable components as specified in the final approved proposal from ITE 501)
  - **in particular, the PowerPoint presentation of the completed project (PowerPoint format) must be provided to the supervisor for review *well before Presentation Day***
- a summary of what was learned from the project and (based on that experience) discussion of how various aspects of the project might have been approached differently;
- a list of what areas of the proposal (if any) were not completed, and why.

Once the deliverables have been approved by the supervisor, all deliverables must be burned to CD/DVD, with two (2) copies submitted to the supervisor on Presentation Day. In addition, printed copies of the project presentation (including screen shots) must be made available to all department faculty members attending Presentation Day.

Student Experiences by Course Outcome (Objective) matrix

student outcome / experience (e.g. presentations, tests, lab reports, writing projects, discussions, performances, etc.)	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10
initial project research	√	√			√	√	√	√		√
functional requirements specification	√	√			√	√	√	√	√	√
potential solution research, analysis, selection	√	√	√	√	√	√	√	√	√	√
development of project schedule, benchmarks, and evaluation criteria	√	√	√		√	√	√	√		√
project implementation	√	√	√	√	√	√	√	√		√
project journal	√	√		√	√	√	√	√	√	√
project *post mortem*	√	√	√	√	√	√	√	√	√	√
proposal and project presentations	√	√	√		√	√	√	√	√	√

Bibliography: Highly variable, dependent upon application area selected by student.