Course Syllabus and Notes

Prerequisites: ISyE 3044, 3103, and 3104

I. Course Objectives

Over a period of two terms, the Senior Design course sequence is intended to provide:

i) a problem analysis and system design experience similar to ISyE professional practice, and
ii) an opportunity to practice and perfect the skills of technical report writing and oral presentation.

By the time you complete senior design at the end of next Semester, you should have improved your skills significantly in the following areas:

1. Systems analysis and design including the ability to

   ▪ define a problem,
   ▪ identify and analyze relevant factors,
   ▪ develop a model of the problem,
   ▪ choose and apply appropriate methodologies and computational tools,
   ▪ generate and evaluate alternative approaches for accomplishing the desired objective, and
   ▪ design the needed system.
2. **Technical Writing**

You have chosen a field that demands effective written communication. Your skill in documenting the results of your work will determine to a large extent the value of that work.

In addition to developing good writing skills, you should explore the possibilities offered by computing and networked information systems. Subject to any constraints imposed by your company, you may want to publish appropriate reports on the World Wide Web, and use the Internet for communication and collaboration.

3. **Public Speaking**

It is not enough to do good work, you must also convince others, who may be apathetic or even antagonistic, that the work is good.

Your skill in clear, concise, and convincing presentation may make the difference between a successful project and fruitless effort.

4. **Team Work**

Life in the real world entails working together with people from different backgrounds, interests, styles, and temperaments. You will learn to cooperate with a diverse group of individuals and coordinate your activities with others in your group and your client, even when there are conflicting priorities. Successful groups learn to work harmoniously, complete the work on time, and prepare effective and well-written reports.

5. **Project and Time Management**

Interacting with a diverse group of individuals, completing your tasks satisfactorily and on time even as problems develop, and preparing various reports and presentations will sharpen your project and time management skills.

Use this opportunity to find out more about the kind of career you want and as a launch pad for that career.
This is a chance for you to find out about a prospective occupation or even a future employer. This is also an opportunity for future employers, customers or clients to find out about you. Even if you do not later work for your project company, your experience with them can help you get a good job and might help you do a good job.

This course provides an opportunity for you to learn about the business world. Keep your eyes and ears open to your company's culture. Find out how the company has distinguished itself from its competitors, how it projects itself externally and how it views itself internally.

To be successful in this course, your recommendations must be consistent with the company's strategy and culture. More than that, to be successful in your career, you must be sensitive to your employer's, your competitors' and your customers' corporate strategy and culture.

II. Faculty Advisors

After your team has a project definition (Report R1), you will be assigned a faculty advisor. You are responsible for keeping your advisor informed of your intentions and progress. You may, however, call upon any of us or any other faculty for advice and assistance. An automated mailing list has been created. Everyone in this class will be included in the mailing list.

III. Project Teams

The size of each project team will depend on the total number of students enrolled and the number of faculty assigned. Typically, the team size is around 6 student members.

Remember that in joining a team you are committing to carry your share of the responsibility and in asking someone to join your team you are accepting responsibility for the quality of his/her work. Your advisor is not responsible for browbeating laggards into shape. If your team members
do not carry their share of the load, you will have to carry it for them.

On August 19th, we expect you to submit the list of team members (names and phone numbers). Attach to this list (S1) a one-page resume for each member describing professional interests and experience (if any) together with a schedule of the courses being taken this semester. Designate one person to be the lead contact. The lead contact person must also e-mail to the faculty, in plain text (i.e., not Word or PDF), the list of team members with e-mail addresses.

**IV. Selecting a Company and Project**

Each team must identify an institution and a suitable project. Choose your institution and your project carefully. This is a strategic decision. Remember, this course offers a valuable opportunity to distinguish yourself. Do not throw it away by choosing a project haphazardly.

The undergraduate office maintains a file in which you will find letters from a few companies specifically requesting senior design groups. You may also find projects listed at Available projects are listed at [http://www.isye.gatech.edu/seniordesign](http://www.isye.gatech.edu/seniordesign)

The faculty advisors (and other ISyE professors) may have information about other possible projects.

Be creative in your search for projects. Consider less traditional areas of endeavor, e.g.,

- Hospitals
- State and local governments (e.g., the police department)
- Banks
- Charitable or non-profit organizations

Once you have identified an organization, you need to contact an appropriate person within the organization. As a rule of thumb, it is better to reach too high into the management of the organization than too low. Higher-level executives will have greater perspective, broader authority and easier access. Be extremely
circumspect in all your communications. Initially, you will not know the corporate culture, so it is best to tread lightly and be extremely polite. You are not under any obligation to accept a project, but be sure not to leave any loose ends. If you decide not to take a project be sure to thank -- in writing -- everyone you contacted and politely explain that you have found something else.

When you think you have found a suitable project, prepare a description of the firm and a definition of the proposed project and submit it for approval. This is Report R1, due on September 4, 2003. See the attached Class Schedule. In fact, we expect you to turn in descriptions of two separate projects: one clearly identified as the primary project, and the other as a back-up or secondary project. (You are encouraged to flesh out your ideas with the faculty advisors if you believe that you have a really good project.)

We expect you to spend at least 6 hours on this project work each week for the next two terms. That comes to about 200 hours for each team member or 1,200 hours for each team. This represents about 50% of one full-time working year. A junior industrial engineer costs approximately $70,000/year including benefits, etc. Your efforts should add at least about $35,000 value to your company. Clearly, this should be the absolute lower limit of the value of your contribution to the organization. If you view the time spent as the equivalent of a consultant's time over the same period, worth about $2,000 per day, the value comes to about $300,000. In most cases, it is not unreasonable to expect this much saving to the client as a result of your project.

Please use these figures to help you choose your project.

V. Reports

V.1 General Guidelines

All reports must be submitted on paper, following the guidelines published on the course web pages. In addition, ‘softcopy’ reports must be submitted as LaTeX or MS Word files, and as PDF files or as self-contained html archives.
While you may identify the clients by name on paper copies, please use fictitious names on soft copies, as suggested in the on-line guidelines.

**Your advisor may also require on-line progress (weekly) reports, as specified via e-mail and/or web pages.**

### V.2 Project Definition and Proposal

Attached are guideline formats for Report 1, Project Definition, and Report R2, Project Proposal. Your proposal will be regarded as a "contract", and you will be expected to perform minimally as promised both by your company and by your faculty advisor.

### V.3 Other Reports

The **Interim Report (R3)** is a record of progress during the first semester. This report must be self-contained, starting with a brief description of the problem and the company background. You should describe the data collected, the methodology employed in your work, preliminary analysis, results and conclusions, and plans for the next semester.

In **Report R4, Alternatives, Tentative Results and Conclusions**, you will list alternative approaches to the problem in sufficient detail so that your client can assess the different possibilities.

The **Final Report (R5)** must be comprehensive and self-contained. A reader must be able to get a complete picture of the problem and what you have done over the two semesters to solve the problem. Note that both reports R4 and R5 are usually due in the 2nd semester in ISyE 4105.

### VI Relationships with Companies

The project will require considerable time and effort from employees of your company. This represents an expense (investment) to them. Nevertheless, companies participate in these projects for at least three reasons:

- they expect to receive valuable assistance,
- to express good will toward Georgia Tech and its students, and
to promote your education so that industry may benefit from more capable and better-educated young engineers.

ISyE project teams must behave professionally and reinforce that feeling of good will.

Students are not allowed to receive compensation for work done in ISyE 4104--5. Companies may, if they wish, provide assistance in the form of photocopying and typing services, and in some cases, supplies and travel expenses.

We recommend that you give your company a copy of this entire handout as a way of educating them on the course and our expectations of both you and them. You may also want to give them the URL for the course.

Once again, settle all contacts you make with prospective firms. Once you decide on your project, write the other firms you have contacted to inform them that you will be unable to work with them, and thank them for the cooperation and time they have given you.

VII. Act as Professionals

You should function as if you were an employee reporting to your faculty advisor and to your corporate contact. You should however remember that you are not an employee of the Company and therefore not entitled to any benefits typically accorded such employees. Among others, you should:

- Keep your client's best interests as your paramount concern.
- Apply the proper tools and methodologies thoroughly, accurately, honestly, and in a manner appropriate for the task at hand.
- Dress neatly and appropriately for the occasion.
- Always be prompt and punctual.
- Write clearly and type all reports.
Include a title page, table of contents, letter of transmittal, references and page numbers in long reports.

Use drawings that are neat, clean, properly titled, and scaled.

Keep a copy of everything you give your faculty advisor or client.

Keep well-organized records of all your work.

Date all your reports and correspondence.

Use correct names (and titles where appropriate).

Appropriately acknowledge everyone who assisted you in your efforts.

Be honest in your dealings with colleagues, clients, and faculty.

VIII. The Challenge of Design

The Senior Design sequence is probably the most valuable course in the curriculum. It is also one of the most difficult. Your problems will not be clearly defined, relevant data will be unavailable or hard to obtain, the proper analysis techniques may not be apparent, solutions will not be exact, and you will disagree about the right course of action. After working two months on a project you may discover you are on the wrong track and that the real problem lies elsewhere. You should generally try to avoid this unpleasant experience.

This is your challenge. You will face situations unlike those presented in textbook examples. You will need to recall material from the many courses you have taken at Tech and your faculty advisor will expect you to demonstrate competence in all of them. On top of this, you will have to learn new material not covered in your courses, outside your advisor's areas of expertise.
Above all, you will be evaluated on how effectively you work, not how hard you work. Your contribution will be measured in terms of the value it adds to the project, not in terms of the hours you spend on it. So, you must not only work hard, you must also work smart.

**IX. Grading**

Generally, your faculty advisor prefers to assign the same grade to everyone in your team. However, it is not uncommon to assign different grades depending on the individual contributions and as determined by your Advisor. Typical factors determining your grade include:

a) The value your project has added and the professional level of your results. Your faculty advisor will elicit your corporate contact's opinions of this.

b) The quality of your presentations.

c) The quality of written reports, including all reports submitted on-line.

d) How well you conform to the published guidelines for your reports, e-mail correspondence, and on-line submissions.

e) Your attendance and participation during class presentations, meetings with your advisor and group members.

Note that it is very important that your reports and presentations be of the highest quality possible, so spend the time and effort to do these well. We anticipate that you will invest nearly one third of your time preparing reports and presentations.

**X. Information for Sponsors**

**X.1 The Senior Design Sequence**

For many years all senior students in the School of Industrial and Systems Engineering have culminated their undergraduate educational experience with the seven to
nine-month (two semester) sequence of senior design courses ISyE 4104--5.

Many enterprises as well as non-profit organizations, mainly in the greater Atlanta area, have cases that can be successfully studied and solved by a small group of industrial engineering students working for experience and academic credit instead of money. Our hundreds of “satisfied customers” include a majority of the well-known businesses in the Atlanta area, and other enterprises such as hospitals and various local city and county government departments.

Student groups work as unpaid outside consultants satisfying their interest in a real world design experience. They work on well-defined, specific design activities. Each group member spends approximately 200 hours on the project over the course of seven to nine months. This effort is focused on resolving a specific problem or completing a specific project and is not intended for carrying out day-to-day operations.

X.2 What the Sponsor Does

The first step is for the sponsor to identify a need or opportunity. For example, one year, Rich's felt their delivery truck fleet could have better maintenance scheduling; Coca Cola has often been a consistent sponsor and has benefited from several design groups, for instance to help reduce waste in their syrup manufacturing and packaging operations, and to improve the efficiency and increase sales for several of their fast food customers; Delta Air Lines, another frequent sponsor, has used our senior design groups to streamline their engine maintenance, and to study the operations of their partner regional airlines; a senior design team helped Sun Trust Bank to do a systematic study of their in-store branches and suggested significant improvements; another team developed and implemented a comprehensive database system for maintaining all electronic equipment for the Atlanta Police Department; when General Electric was evaluating a move to a larger warehouse for their regional operations, a senior design team worked with GE and vendors and helped develop a comprehensive strategy for their transition; and
Rollins Security found their service people could travel a lot less if their trips were better scheduled. Grady Memorial Hospital found that its emergency services department could shorten waiting time of patients and personnel while improving the quality of their patient care through better scheduling and facility layout.

A significant share of senior design projects comes from non-profit organizations. For over three decades, senior design teams have done numerous projects for area hospitals and health care institutions. Their results have been employed in improving health care delivery systems in these organizations. A list of past clients include CityCares, Project Read, Hands on Atlanta, Dekalb Medical Center, Piedmont Hospital, Southwest Community Medical Center, and SciTrek.

When students contacted these entities, they found enthusiastic potential sponsors. Students and the organizations find the experience worthwhile and rewarding.

ISyE students are well prepared to design maintenance schedules, routing and delivery systems, warehouse and emergency room layouts and materials handling systems, waste control programs, and requirements and specifications for information systems including web design. They can apply operations research, simulation, statistics, human systems engineering and other technical tools to a wide variety of problems, and they can back up their design choices with thorough economic analysis.

The steps in participating are:

- Meet with the student group to explore possibilities, and determine, loosely, what kind of beneficial project could reasonably be performed by a neophyte consulting group of industrial and systems engineers—usually six students working for about 200 to 300 hours, each, over two semesters.

- Assign a responsible technical or managerial person to give the group guidance operations and economic information, and plant access. During the two semesters, this person will
probably spend two or three hours a week interacting with group members.

- Arrange for an appropriate management level representative to receive and consider the group's formal proposal (R2, 2 months), interim report (R3, 3 months), tentative results and conclusions (R4, 6 months) and final design (R5, 7/8 months).

- Participate in evaluating the students' work and provide timely feedback.

**XI. Accessing the project reports on the World Wide Web**

The syllabus and the up-to-date course and presentation schedules are available on the web. Whenever possible, and depending on the type of projects and clients, we intend to publish the student reports on the World Wide Web to help the students develop on-line publishing skills and to help future students become familiar with the senior design process. Because of the use of fictitious names, information that identifies the clients will not be present on these reports.

We emphasize that this will only be done with the sponsor's consent, and the sponsor can refuse on-line publication for any reason.
XII. Reports

XII.1. Guidelines for Report 1: Project Definition

ISyE 4104B  Fall 2003. Profs. Esogbue and Erera

Description

- Cover Page
- Team number
- Team member names
- Organization name
- Organization business address
- Main contact person name
- Main contact person position
- Main contact person telephone number
- Main contact person e-mail address

Description of the organization

Where is the organization's headquarters? What kind of business is the organization in? How many people does it employ? Other measures of size, for example annual revenues, market share, annual profits, etc. Similar information about the department you will work with directly.
Description of problem symptoms

Be careful to describe a problem, not a solution. For example, “The department needs a new conveyor system” is a poor problem description. A better description would explain the difficulties leading to the conclusion that the company needs a new conveyor system.

- Design objective

Describe what you hope to accomplish for the company. Be careful not to get locked into foregone conclusions. For example, “Identify the new conveyor system to Purchase” is a poor design objective -- a better resolution of the problems may simply involve clever adjustments to the existing system. On the other hand, be sure to have clear, attainable objective: “Solve the company's problems” is not a good design objective either.

- Anticipated Design Tools

In the light of the above-identified problems, what specific ISYE tools/methodologies do you envisage as being particularly relevant to the resolution of the company’s problem? For example, operations research-scheduling, simulation, quality control, logistics, layout, etc.
Detailed outlines for this report often result in similar-looking proposals, few of which are very good. This is obviously undesirable. Therefore, we offer below broad guidelines that you can adapt for your specific project.

Whenever you write anything, be sure to have an audience in mind. For whom are you writing this report? Identifying your audience for this report is a bit challenging. In fact you are writing to two very different audiences: your corporate contact (first) and your faculty advisor (second). This causes some peculiar difficulties. For example, although your corporate contact knows more about the company than you do, your faculty advisor does not. On the other hand, while your faculty advisor may be very familiar with some of your proposed methods, your corporate contact may not be. You should include all the information for both audiences, but organize it so that each reader may easily find the material of interest to her.

When you describe the organization, for example, write to your faculty advisor, but remember that your corporate contact will be looking over your shoulder. When you describe your methods, on the other hand, write to your corporate client, but remember that your faculty advisor will be looking over your shoulder.

Once you have identified your audience, you need to figure out what you want to tell them and how you are going to say it. This is the hard work of writing. You must organize your thoughts and pick your words so your ideas are clear and easy to follow. If your ideas are not clear or you do not have any ideas at all, your writing will be difficult to follow. Conversely, if your writing is difficult to read.

So, to the heart of the matter. Your proposal should be accompanied by a cover letter to your corporate contact thanking him/her for suggesting the project and indicating your desire to work on it. In a sense this letter is a formal request for your contact to
accept your proposal as a binding contract. You are bound
to do the work described in the proposal and your
contact is bound, albeit with less dire consequences to
him/her if he/she fails, to provide the support you
specifically request.

The proposal, then, must accomplish two things:

- It must spell out your expectations from the
  company (Be sure to discuss these with your
  contact before putting them in the proposal.) and

- It must spell out what the company can expect
  from you in return.

After the cover letter, you should probably include a
project summary that provides a one or two page overview of
the project intended for, say, higher level executives who
are interested, but do not have time to read the whole
proposal. We recommend that you include an executive
summary in all of your reports.

The proposal should include a description of the
organization you are working with (for the faculty advisor)
and a brief description of Senior Design (so the company
knows what this is all about). Your description of the
organization should focus on the department with which you
will be working. It is instructive to include an
organization chart.

Next, describe the problem in some detail. Provide
quantitative evidence of its magnitude and significance
whenever possible. At this point you are ready to describe
what the company can expect from you. Begin with a very
brief **objective**, but follow this up with any supplemental
information necessary to delineate the project. Include a
detailed description of your “**deliverables**”. For example,
will you be delivering production code, a working system,
a prototype or specifications? Will you provide a method to
solve the problem whenever and wherever it arises or will
you simply solve the present problem?

Estimate the likely benefits to the company.
Remember these should be worth around $35,000, **but do not promise what you cannot deliver**. In fact, you want to avoid
the tragedy that will certainly arise if the company
expects more than you give.
Provide evidence that you know how to accomplish all that you promise. Use your qualifications to accomplish this purpose. Describe the specific steps you will take and give a credible schedule and management plan of when you will complete them.

Describe what you expect from the company. Be sure to discuss each item in detail with your contact before you include it in the proposal. Try to anticipate the kinds of assistance and information you will need and the form you will need it in. Do not get caught in the position of needing key information to complete your project only to discover half way through that it simply is not available!

In summary, your proposal should include:

- A cover page
- A cover letter
- A project summary/Abstract
- A description of the company and of senior design
- A description of the problem
- A description of the project objectives
- A description of the deliverables and estimates of their value
- A description of what specific steps you plan to take (methodology)
- A project management plan and schedule
- A description of what you will require from the company
Designate your team’s lead contact with an *.

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Will all team members enroll in ISyE 4105 during next Semester?

Be sure to attach resumes and current schedules.