College of Engineering

Mechanical Engineering Department

Senior Design Project Handbook

Edited By

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Preface

This book is intended to provide some helpful information and reference material to students who are about to begin their senior design project course sequence.

The assistance of David North and Suzy Quinn DeJardin in providing the materials used in this book is greatly acknowledged.

Furthermore, I would like to thank the following student assistants for their continuous revision of the book, in particular, Mindy Kwan, Jenny Luu, Brissa Ortega and Greg Calimpong.
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Section 1

Senior Design Project
Senior Design Project

1.1 – Senior Design Project

Senior design project is a required two-semester long course sequence. This course is expected to help student incorporate what they have learned in various courses in the ME curriculum in order to ‘culminate’ their BSME degree.

Senior design project requires that a team of students work together to bring a concept into reality. In other words, a team is expected to design, develop, fabricate, assemble, and test a ‘product’ for functionality.

The senior design project could be in any of the following categories:

1. Industry sponsored
2. Laboratory experimental station
3. Professional society design competition
4. Team or individually sponsored

1.2 - Senior Design Project Funding

1. Industry sponsored project’s funding is expected to be provided by the sponsor in full for the materials, fabrication, assembly and test. The final project design is expected to be delivered to the sponsor unless the sponsor would want to donate it to the department.
2. Laboratory experimental station funding is to be provided by the department faculty following. The faculty member is expected to have received department approval prior to assigning the design project.
3. Mechanical Engineering/Professional society design competition project’s funding is to come from the sponsoring organization, donation and department reimbursement up to $50 per student per academic year.
4. Team or individually sponsored project’s funding may come from donations, team’s effort in raising funds, and department reimbursement.

1.3 - Team Formation

A design team requires individuals who could compliment each other’s strengths. A design project requires conceptual design brainstorming, computer aided design (CAD) drawings, clear communication among the team members and sponsors, fabrication and assembly skills, and finally functional test development and testing.

A team of three (3) members is ideal, however, a complex design project may require a larger group of team members.
Due to different personalities and individuals planning to work together as a team, conflict and confrontation are to be expected. Allow a trial period of at least three to four weeks before expecting to work effectively as a team. Teamwork requires synergy in working towards a common goal. Team members should trust and enjoy working with each other.

In general, a team needs a project manager who is the Liaison between the team, the faculty advisor and the project sponsor if any. The manager is further expected to work with team members is establishing project goals and objectives and to manage the team’s operation to achieve goals.

It is desirable for the team to elect a manager to serve throughout the design project. However, it is also possible for the team to rotate the position of the manager among the team members.

The manager is expected to inspire and organize others to work together to achieve a common goal. The manager is a role model and leads by example and exhibiting the following characteristics:

- Good interpersonal skills and willing to work with others,
- Good organizational skills and having the ability to identify team member’s strengths and capabilities,
- Good communication skills to clearly articulate what needs to be done,
- Ability to deal with problem team members by diagnosing the problem, suggest corrective actions, get agreement from the team members to resolve issues.

Member’s contributions are to be evaluated, recognized, and documented in order to reinforce team’s success leading to higher level of performance.

1.4 - Time Management

Effective time management is critical in helping to focus on short-term and long-term goals. It helps to separate urgent tasks from important tasks. The following are some proven methods:

- Write down your short-term and long-term goals,
- Keep a log of how you spend your time for a period of one week by dividing it into 30 minute increments,
- Classify your daily activities and prioritize based on
  1. Important and urgent
  2. Important but not urgent
  3. Urgent but not important
  4. Not important and not urgent
- Make a written plan daily for the tasks prioritized to achieve goals. Remember the 80/20 Rule: 80% of your positive result will come from 20% of your urgent and important tasks.
Section 2

Design and Design Process
2.1 - Design and Design Process

Design is the creation of a solution to a need identified by human beings. This solution may include hardware or software or even a process or a methodology to solve a need. In general, the term product is used to include hardware, software, process or a methodology.

2.2 - Design Process

The process starts with identifying a need; defining the problem to be solved; investigating the prior solutions, if any; developing a concept as the first solution to the problem; evaluating and make improvements to achieve the goal of creating a solution to the identified need.

2.3 - Invention and Innovation

Invention, in general, is the creation of something new that did not exist before. Invention requires funding to develop a new product through research, development, prototyping and early evaluation.

Innovation, is the process of creating wealth through marketing a product. Innovation will result in generation of funds.

2.4 – Societal Impact on Engineering Design

The Engineering Code of ethics states that ‘engineers shall hold paramount the safety, health, and welfare of the public in the performance of their profession.’ The society has developed guidelines and rules that have important impact on engineering design such as occupational safety, and health, consumer rights, environmental protection and the freedom of information and public disclosure. The result of these societal concerns has increased the federal regulations and has placed strict directives on product and engineering design.

2.5 – Sustainable and Environmentally Responsible Designs

One major societal concern that places much greater constraints on engineering design involves sustainable and environmentally responsible product or process design. The characteristics of a sustainable and environmentally responsible design may require:

- Reduces use of energy and natural resources in its manufacture
- Manufactured without producing hazardous waste
- Avoids the use of hazardous materials
- Contains recycled materials
- Designed to be recycled
- Designed for easy disassembly
• Reduces product chemical emissions
• Reduce product energy consumption

The design with consideration on environmental issues is called sustainable development. Products designed to make them easier to use, recyclable, easy to disassemble, and to reuse is called Green Design. Green Design involves understanding of the environmental impact of products and processes over their life cycle.

2.6 – Globalization in Design

Globalization would require the application of technologies to innovate, manage information and to disseminate knowledge as a resource to enhance economic growth through engineering product design to benefit mankind. Products designed, manufactured, consumed and utilized for human use any place must conform to the engineering codes of ethics.
Section 3

Project Planning and Scheduling
3.1 - Importance of Planning

Planning consists of identifying the key activities in a project and ordering them in the sequence in which they should be performed. Scheduling consists of putting the plan into the time frame of the calendar. The design process generally is divided into the following phases.

- Feasibility study
- Preliminary design-the concept phase
- Detail design
- Production phase
- Operational phase

Usually, a detailed design review is conducted at the end of each phase to establish whether the results warrant advancing into the next phase. The alternatives may be to repeat the phase or abandon the project. Frequently, well-defined decision points or milestones are established partway through a phase in order to provide a target to strive for and a way to control the project.

3.2 – Project Scheduling

Scheduling consists of putting a plan into the time frame of the calendar with clearly identified milestones to be monitored. The major decisions that are made over the life cycle of a project fall into four areas:

Performance – The design must possess an acceptable level of operational capabilities,

Time – The design specifications and milestone related to the design need to be measured against a time schedule throughout the design, development, production and testing process,

Cost – The importance of cost in determining what is feasible and keeping it within approved limits is critical in design,

Risk – Acceptable levels of risk must be established for the performance, time, and cost as they need to be monitored throughout the project.

Assessment should be carried out to evaluate all these factors, performance, time, cost and risk and performance characteristics are usually the deciding parameters in making changes.

Section 4

Product Liability
4.1 - Definition

Product liability is the area of law in which the liability of designers, producers, distributors, and the end-user are of concern. They are defined as injuries or wrong to a person or personal property. The law of product liability is the almost universal adoption by the courts of the standard of strict liability. Under this theory of law the plaintiff must prove that: 1) the product was defective and unreasonably dangerous, 2) the defect existed at the time the product left the defendant’s control, 3) the defect caused the harm, and 4) the harm is appropriately assignable to the identified defect. Thus, the emphasis on responsibility for product safety has shifted from the consumer to the manufacturer of products.

A related issue is the use for which the product is intended. A product intended to be used by children will be held to a stricter standard than one intended to be operated by a trained professional. Under strict liability a manufacturer may be held liable even if a well-designed and well-manufactured product injured a consumer who misused or outright abused it.

4.2 - Goals of Product Liability Law

Product liability law evolved to serve four basic societal goals: loss spending, punishment, deterrence, and symbolic affirmation of social values. Loss spreading seeks to shift the accidental loss from the victim to other parties better able to absorb or distribute it. In a product liability suit the loss is typically shifted to the manufacturer, who theoretically passes this cost on to the consumer in the form of higher prices. Often the manufacturer has liability insurance, so the cost is spread further, but at the price of greatly increased insurance rates.

. It is important to recognize that under liability law the designer, not just the company, may be held responsible for a design defect. In extreme cases, the punishment may take the form of criminal penalties, although this is rare. More common is the assessment of punitive damages for malicious or willful acts. A third function is to prevent similar accidents from happening in the future, i.e., deterrence. Substantial damage awards against manufacturers constitute strong incentives to produce safer products. Finally, product liability laws act as a kind of symbolic reaffirmation that society values human safety and quality in products.

4.3 - Negligence

A high percentage of product litigation alleges engineering negligence. Negligence is the failure to do something that a reasonable man, guided by the considerations that ordinarily regulate human affairs, would do. In product liability law the seller is liable for negligence in the manufacture or sale of any product that may reasonably be expected to be capable of inflicting substantial harm if it is defective. Negligence in design is usually based one of three factors.

- That the manufacturer’s design has created a concealed danger.
- That the manufacturer has failed to provide needed safety devices as part of the design of the product.
• That the design called for materials of inadequate strength or failed to comply with accepted standards.

Another common area of negligence is failure to warn the user of the product concerning possible dangers involved in the product use. This should take the form of warning labels firmly affixed to the product and more detailed warnings of restrictions of use and maintenance procedures in the brochure that comes with the product.

4.4 - Strict Liability

Under the theory of strict liability it is not necessary to prove negligence on the part of the manufacturer of the product. The plaintiff need only prove that 1) the product contained an unreasonably dangerous defect, 2) that the defect existed at the time the product left the defendant’s hands, and 3) the defect was the cause of the injury. The fact that the injured party acted carelessly or in bad faith is not a defense under strict liability standards. More recently the courts have acted so as to the require the manufacturer to design his product in such a way as to anticipate foreseeable use and abuse by the user.

The criteria by which the defective and unreasonably dangerous nature of any product may be tested in litigation are:

• The usefulness and desirability of the product
• The availability of other and safer products to meet the same need
• The likelihood of injury and its probable seriousness
• The obviousness of the danger
• Common knowledge and normal public expectation of the danger
• The avoidability of injury by care in use of the warnings
• The ability to eliminate the danger without seriously impairing the usefulness of the product or making the product or making the product unduly expensive.

4.5 - Design Aspect of Product Liability

Court decisions on product liability coupled with consumer safely legislation have placed greater responsibility on the designer for product safety. The following aspects of the design process should be emphasized to minimize potential problems from product liability.

• Take every precaution that there is strict adherence to industry and government standards. Conformance to standards does not relieve or protect the manufacturer from liability, but it certainly lessens the possibility of product defects.
• All products should be thoroughly tested before being released for sale. An attempt should be made to identify the possible ways a product can become unsafe, and tests should be devised to evaluate those aspects of the design. When failure modes are discovered, the design should be modified to remove the potential cause of failure.
• Make a careful study of the system relations between your product and upstream and downstream components. You are required to know how malfunctions upstream and downstream of your product may cause failure to your product. You should warn users of any hazards of foreseeable misuses based on these system relationships.

• Documentation of the design, testing, and quality activities can be very important. If there is a product recall, it is necessary to be able to pinpoint products by serial or lot number. If there is a product liability suit, the existence of good, complete records will help establish an atmosphere of competent behavior. Documentation is the single most important factor in winning or losing a product liability lawsuit.

• The design of warning labels and user instruction manuals should be an integral part of the design process. The appropriate symbols, color, and size and the precise wording of the label must be developed after joint meetings of the engineering, legal, marketing, and manufacturing staffs. Use international warning symbols.

4.6 - Business Procedures to Minimize Risk

In addition to careful consideration of the above design factors, there are a number of business procedures that can minimize product liability risk.

• There should be an active product liability and safety committee charged with seeing to it that the corporation has an effective product liability loss control and product safety program. This committee should have representatives from the advertising, engineering, insurance, legal, manufacturing, marketing, materials, purchasing, and quality-control departments of the corporation.

• Insurance protection for product liability suits and product recall expenses should be obtained.

• Develop a product usage and incident-reporting system just as soon as a new product moves into the marketplace. It will enable the manufacturer to establish whether the product has good customer acceptance and detect early signs of previously unsuspected product hazards or other quality deficiencies.

Section 5

Ethics
5.1 - Definition and Background

Ethics are the principles of conduct that govern and individual or a profession. They provide the framework of the rules of behavior that are moral, fair, and proper for a true professional. A code of ethics serves to remind individuals how important integrity is in a self-regulating profession. It lays out the issues that are deemed most important in the collective wisdom of the profession. By publishing and enforcing a code of ethics, the profession serves notice that its ethical precepts are to be taken seriously.

Most professional societies have adopted their own codes, and Accreditation Board for Engineering and Technology (ABET) and National Society of Professional Engineers (NSPE) have adopted broader-based but not universally accepted ethical codes.

Ethics is based on moral philosophy. While it is not possible to develop a single comprehensive moral principle that can provide guidance in solving all ethical dilemmas, it is possible to lay a set of moral values for personal behavior:

- Respect the right of others
- Be fair
- Do not lie or cheat
- Keep promises and contracts
- Avoid harming others
- Prevent harm coming to others
- Help others in need
- Obey all laws

An engineer in a design situation potentially can be faced with ethical situations. Ethical situations in engineering generally fall within the following general situations:

- Loyalties between two groups
- Duty to general public versus right of employer
- Issues of recognition for performance
- Falsification of experimental data
- Issue of differing standards of morals in different parts of the world

An important ethical situation which periodically attracts wide attention is whistleblowing. Whistleblowing refers to making a public accusation about misconduct within an organization. In the usual case the charges are made by an employee or former employee who has been unable to obtain the attention of the organization’s management to the problem. Generally, it is morally permissible for engineers to engage in whistleblowing when the following conditions are met:

- The harm that will be done by the product to the public is considerable and serious.
- Concerns have been made known to their superior, and getting no satisfaction
from their immediate superior, all channels have been exhausted within the corporation, including the board of directors.

- The whistleblower must have documented evidence that would convince a reasonable impartial observer that his or her view of the situation is correct and the company position is wrong.
- There must be strong evidence that releasing the information to the public would prevent the projected serious harm.

Clearly a person engaging in whistleblowing runs considerable risk of being labeled or charged with disloyalty, and possibly being dismissed. Federal government employees have won protection under the Civil Service Reform Act of 1978.

5.2 - Codes of Ethics of Engineers

It is generally conceded that an individual acting on his or her own cannot be counted on to always act in a proper and moral manner. Creeds and codes attempt to complete the guidance needed for an engineer to do the correct thing. A creed is a statement or oath, usually religious in nature, taken by an individual.

The fundamental principles require that engineers uphold and advance the integrity, honor, and dignity of the Engineering profession by:

- using their knowledge and skill for the enhancement of human welfare;
- being honest and impartial, and serving with fidelity the public, their employers and clients, and
- striving to increase the competence and prestige of the engineering profession.

A code is a system of non-mandatory canons of personal conduct. A canon is a fundamental belief that usually encompasses several rules.

5.3 - Purpose of A Code of Ethics

Fundamental to ethical codes is the requirement that engineers render faithful, honest, professional service. In providing such service, an engineer must represent the interests of his employer or client and, at the same time, protect public health, safety, and welfare. Ethical guidelines can be categorized on the basis of who is affected by the engineer’s actions-the client, vendors and suppliers, other engineers, and the public at large.

5.4 - Ethical Priorities

While it is impossible to use a single decision-making process to solve every ethical dilemma, it is clear that ethical considerations will force an engineer to subjugate his or her dealing with others need to be considered in the following order from highest to lowest priority:

- Society and the public
• The law
• The engineering profession
• Other involved engineers
• the engineer’s client
• the engineer’s firm
• the engineer personally

5.5 - Dealing with Client and Employers

The most common ethical guidelines affecting an engineer’s interactions with his or her employer (the client) can be summarized as follows: An engineer should not accept assignments that he or she does not have the skill, knowledge, or time to complete.

• The client’s interests must be protected. The extent of this protection exceeds normal business relations and transcends the legal requirements of the engineer-client contract.
• The engineer must not be bound by what the client wants in instances where such desires would be unsuccessful, dishonest, or unethical.
• Confidential client information remains the property of the client and must be kept confidential.
• An engineer must avoid conflicts of interest and should inform the client of any business connections or interests that might influence his or her judgment.
• The engineer must freely and openly admit to the client any errors made.

5.6 - Dealing with Suppliers

Engineers routinely deal with manufacturers, contractors, and suppliers. In this regard, engineers have great responsibility and influence. An engineer will often have an interest in maintaining good relationships with suppliers since this often leads to future work. Nevertheless, relationships with suppliers must remain highly ethical. The ethical responsibilities relating to suppliers are listed here:

• The engineer must enforce the plans and specifications (i.e., the contract documents) but must also interpret the contract documents fairly.
• Plans and specifications developed by the engineer on behalf of the client must be complete, definite, and specific.
• The engineer must not accept or solicit gifts or other valuable considerations from a supplier during, prior to, or after any job. An engineer should not accept discounts, allowances, commissions, or any other indirect compensation from suppliers, contractors, or other engineers in connection with any work or recommendations.
5.7 - Dealing with Other Engineer

Engineers should try to protect the engineering profession as a whole, to strengthen it, and to enhance its public stature. The following ethical guidelines apply:

- An engineer should not attempt to maliciously injure the professional reputation, business practice, or employment position of another engineer.
- Subject to legal and proprietary restraints, an engineer should freely report, publish and distribute information that would be useful to other engineers.

5.8 - Dealing with and affecting the Public

The relationship between an engineer and the public is essentially straightforward. Responsibilities to the public demand that the engineer place service to mankind above personal gain. Furthermore, proper ethical behavior requires that an engineer avoid association with projects that are contrary to public health and welfare or are of questionable legal character.

- An engineer must consider the safety, health, and welfare of the public in all work performed.
- When an engineer issues a public statement, he or she must clearly indicate if the statement is being made on anyone’s behalf.
- An engineer must keep his or her skill at a state-of-the-art level.
- An engineer should develop public knowledge and appreciation of the engineering profession and its achievements.
- An engineer must notify the proper authorities when decisions adversely affecting public safety and welfare are made.

5.9 – The American Society of Mechanical Engineering Code of Ethics

Code of ethics of the American Society of Mechanical Engineers (ASME) contains the following fundamental canons:

- Engineers shall hold paramount the safety, health, and welfare of the public in the performance of their professional duties.
- Engineers shall perform services only in areas of their competence.
- Engineers shall continue their professional development through their careers and shall provide opportunities for the professional and ethical development of those engineers under their supervision.
- Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest or the appearance of conflicts of interest.
- Engineers shall build their professional reputation on the merit of their service.
and shall not compete unfairly with others.

- Engineers shall associate only with reputable persons or organizations.
- Engineers shall issue public statements only in an objective and truthful manner


Section 6

Intellectual Property and Patents
6.1 – Intellectual Property

Intellectual Property (IP) is a collection of legal rights that protect ideas, creations and inventions. These creative and original ideas can be protected with patents, copyrights, and trademarks within the broad area of property law.

6.2 – Patents

Patents are granted by a government and give an inventor the right to prevent others from making, using or selling the invention. There are three types of Patents:

- **Utility Patents** are granted for invention of new and useful processes, products, manufacture and decomposition of matter. The term of a utility patent is 20 years from the date of filing the application.
- **Design Patents** are granted for new, original and ornamental (as opposed to functional) designs. The term of a design patent is 14 years from the date the patent is issued.
- **Plant Patents** are granted for distinct and new varieties of plants including hybrids and newly joined seedlings or plants found naturally in an uncultivated condition. The term of a plant patent is 20 years from the date of filing the application.

These are three general criteria for granting a patent:

- The invention must be new or novel
- The invention must be useful
- The invention must not be obvious to a person skilled in the art covered by the patent.

6.3 – Copyrights

Copyright protects its owner the exclusive right to express, publish and sell an original written or artistic work, software to reproduce, distribute, modify and publicly perform and display such works. A copyright must be registered with the Copyright Office in order to bring a copyright infringement lawsuit and to protect against a claim of innocent infringement by someone who copies or uses the work without the copyright owner’s permission. The copyright becomes effective when the original work is registered for the life of the author plus 70 years.

6.4 – Trademarks

Trademarks are any names, words, or symbols that is used by a company to identify and
distinguish them from the products or services of others. The right to use trademarks is obtained by registration and extends indefinitely as long as the trademark is used.

6.5 – Trade Secrets

Trade secrets are any confidential information not known to the public in the industry such as technological information or strategic information, product design, process information, computer programs, business plans and financial information, customers lists and survey, that the owner uses in business to create an advantage over competitors who do not have the trade secret. In order for the trade secret to be protected, the subject matter of a trade secret must be unknown to the general public. A trade secret is legally protectable for as long as it remains secret. If a trade secret is licensed to another party, the owner may charge a royalty for as long as it is used by the licensee.

If the subject of a trade secret is also patentable invention, the owner has the choice of either maintaining it as a trade secret or obtaining a patent for it. Once the patent is issued, the invention is protected for 20 years from the date the patent application is filed, even if the invention is independently discovered by others.

6.6 – Patent Search

Compare the invention with earlier inventions or methods of doing the same thing and decide if the invention has advantages that make it marketable. Make sure that the invention is practical and marketable. Conduct a preliminary patent search for the most closely related prior-art patents or publications at www.uspta.gov

Compare the invention with the patents and publications found in the search and determine if the invention has non-obvious, new and valuable features.

6.7 – Patent Record Keeping and Diligence

Draw sketches and write a description of the invention as soon as the invention is first conceived. Have a trustworthy individual who is not a co-inventor but does understand the invention, and is not under any obligation not to divulge the invention read and sign as a witness a dated drawing and/or description of the invention.

Section 7

Economic Analysis and Terminologies
7.1 – Engineering Economy

Engineering economy is a methodology that promotes rational decision making about the investment of money at various periods of the time towards realization of certain amount of profit. The engineering economic analysis requires consideration of taxes, determination of taxable income, allowance for depreciation, and a realistic allowance for inflation.

One major principle of engineering economic analysis is to determine the profitability of a product. The decision to invest is a product is based on the following criteria:

- Profitability Analysis – This analysis is carried out to estimate how rewarding the idea might be.
- Financial Analysis – This analysis deals with all aspects of the business related to generation of the initial funds, expenses associated with the operation of the business, depreciation of the business assets, and the income generated due to sale of products or services.

7.2 – Profitability

Profitability is evaluated based on the following methods:

- Rate of Return
- Payback

Such evaluation requires some mathematics and definitions commonly used in engineering economy analysis.

7.3 – Mathematics of Time Value of Money

Following definitions and equations are essential in understanding engineering economy.

7.4 – Present Value

Present value is the present sum of capital defined by:

\[ P \]

7.5 – Future Value

Future value is the expected sum of capital to be generated over a period of \( n \) years at an
interest rate \( i \) given by:

\[
F = P(1 + ni)
\]  
Eq. 1

7.6 – Discounted Rate

Discounted rate is the worth of a future value \( F \) back to the present time

\[
P = \frac{F}{(1+ni)}
\]  
Eq. 2

7.7 – Compound Interest

Compound interest is added to the initial capital and paid at end of the first period:

- 1\(^{st}\) period \( F_1 = P + iP = P(1 + i) \)
- 2\(^{nd}\) period \( F_2 = P(1 + i) + iP(1 + i) = P(1 + i)^2 \)
- 3\(^{rd}\) period \( F_3 = P(1 + i)^2 + iP(1 + i)^2 = P(1 + i)^3 \)
- \( n^{th} \) period \( F_n = P(1 + i)^n \)  
Eq. 3

The future value, \( F_n \), based on an initial present value, \( P \), over a period of \( n \) years at an interest rate \( i \) is given by

\[
F_n = P(1 + i)^n = P(F/P, i, n)
\]  
Eq. 4

7.8 – Cash Flow Diagram

Cash flow diagram is a pictorial presentation of the cash inflows and the cash outflows over a period of time shown by:

The cash inflows are shown by vertical arrows of certain magnitude (reflecting dollar value) above the time-axis, while the cash outflows are shown as vertical arrows pointing downward below the time-axis.

\[
Net \ cash \ flow = cash \ inflows - cash \ outflows
\]
7.9 Future Value Based on Annual Investment

The future value based on an annual investment of $A$ over a period of $n$ years at a rate of $i$ is given by:

$$ F = A(1 + i)^{n-1} + A(1 + i)^{n-2} + \cdots + A $$  \hspace{1cm} \text{Eq. 5}

For example for $100$ annual investment over 3 years at a rate of 3% yields

<table>
<thead>
<tr>
<th>Year</th>
<th>$A$ (1 + .03)</th>
<th>$A(1 + .03)^2$</th>
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<tbody>
<tr>
<td>Year 1</td>
<td>$100$</td>
<td>$101.03$</td>
</tr>
<tr>
<td>Year 2</td>
<td>$100$ (1 + .03) = $101.03$</td>
<td>$106.09$</td>
</tr>
<tr>
<td>Year 3</td>
<td>$100(1 + .03)^2$ = $106.09$</td>
<td>$307.12$</td>
</tr>
</tbody>
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$$ F = 100(1 + .03)^2 + 100(1 + .03) + 100 = 307.12 $$

Note that this concept of future value is based on an annual investment and is different than that of the compounded future value.

The general term for the future value is given by:

$$ F = \frac{A[(1+i)^n-1]}{i} $$  \hspace{1cm} \text{Eq. 6}

This equation can be written in the general engineering economy term as:

$$ F_n = A(F/A, i, n) $$  \hspace{1cm} \text{Eq. 7}

and alternatively, the annual investment $A$ required to generate a future value $F$ is given by

$$ A = F \left(\frac{i}{[(1+i)^n-1]}\right) $$  \hspace{1cm} \text{Eq. 8}

and in its general engineering economy format as:

$$ A = F(A/F, i, n) $$  \hspace{1cm} \text{Eq. 9}

where $(A/F, i, n)$ is called the sinking fund factor. Combining Eq. 3 and Eq. 6 would provide a relation between the present value $P$ based on an annual investment $A$ over $n$ years at an annual interest rate of $i$, given as:

$$ P = A \frac{(1+i)^n-1}{i(1+i)^n} = A(P/A, i, n) $$  \hspace{1cm} \text{Eq. 10}

From Eq. 10, the annual investment $A$ can be determined:

$$ A = P \frac{i(1+i)^n}{(1+i)^n-1} = P(A/P, i, n) $$  \hspace{1cm} \text{Eq. 11}
In Eq. 11, the term \((A/P, i, n)\) is called the capital recovery factor. Eq. 11 can be used to determine the annual payment \(A\) required to return an initial investment \(P\) plus interest at a rate of \(i\) over \(n\) years.

### 7.10 - Rate of Return

Rate of return on the investment (ROI) is the simplest measure of profitability. This may be based on:

- Net annual profit before taxes
- Net annual profit after taxes
- Annual cash income before taxes
- Annual cash income after taxes

The rate of return is generally expressed as percent.

Consider the following:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial capital investment</td>
<td>$300,000</td>
</tr>
<tr>
<td>Life cycle</td>
<td>5 years</td>
</tr>
<tr>
<td>Operational expenses</td>
<td>$30,000</td>
</tr>
<tr>
<td>Net profit after taxes in 6 years</td>
<td>$120,000</td>
</tr>
</tbody>
</table>

\[\text{Annual net profit} = \frac{$120,000}{5} = $24,000\]

\[\text{ROI} = \frac{24,000}{300,000 + 30,000} = 7.27\%\]

### 7.11 – Payback

Payback is the period of time necessary for the cash flow to fully recover the initial capital investment.

<table>
<thead>
<tr>
<th>Year</th>
<th>Product 1</th>
<th>Product 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-$100k</td>
<td>-$100k</td>
</tr>
<tr>
<td>1</td>
<td>$50k</td>
<td>$0</td>
</tr>
<tr>
<td>2</td>
<td>$30k</td>
<td>$10k</td>
</tr>
<tr>
<td>3</td>
<td>$20k (payback)</td>
<td>$20k</td>
</tr>
<tr>
<td>4</td>
<td>$10k</td>
<td>$30k</td>
</tr>
<tr>
<td>5</td>
<td>$0</td>
<td>$40k (payback)</td>
</tr>
<tr>
<td>6</td>
<td>$0</td>
<td>$50k</td>
</tr>
</tbody>
</table>

Net after 6 years $10k $50k

Product 1 is paidback in 3 years (initial capital of $100k is recovered). Product 2 is paidback in 5 years (initial capital of $100k is recovered). Perhaps in the long run, Product 2 is more profitable.

7.12 - Depreciation

Depreciation is an accounting expense accounted for due to wear and tear, and the eventual obsolescence of capital equipment or assets. It is an expense that is deducted from gross income or profit in doing business.

\[ \text{Taxable income} = \text{Income} - \text{Expenses} - \text{Depreciation} \]

7.13 – Straight-Line Depreciation

Most common method to account for depreciation is the straight-line depreciation. In this method, an equal amount of money is depreciated annually given by:

\[ \text{Depreciation} = \frac{C_i - C_s}{n} \]

where \( C_i \) is the initial cost

\( C_s \) is the salvage value

\( n \) is the number of useful years

7.14 – Book Value

The book value is the anticipated ‘salvage’ value of an asset if a shorter term is used to
determine the depreciation of that asset given by:

\[ B_j = C_i - \frac{j}{n}(C_i - C_s) \]

Where \( B_j \) is the book value at the end of \( j^{th} \) year.

7.15 – Inflation

Since engineering economy deals with financial decision making related to the future flow of money, it is important to consider inflation in the total analysis. Inflation is defined by inflation rate \( f \). Inflation is measured by the change in the Consumer Price Index (CPI) as determined by the US Department of Labor, Bureau of Labor Statistics. CPI varies throughout the country.

Another method to determine the inflation rate is based on the Annualized Return Rate (ARR) defined as follow:

\[ \text{Annualized Return Rate} = \left( \frac{\text{current value}}{\text{original value}} \right)^{\frac{1}{n}} - 1 \]

Both CPI and ARR are expressed in percent and CPI is generally the most commonly used inflation rate.

In general, there are two different interest rates used in engineering economy:

- Ordinary or inflation-free interest rate \( i \) presented so far
- Market interest rate \( i_f \) which takes into account the inflation rate \( f \), also called inflated interest rate.

Recall from Eq. 3 given by:

\[ F = P(1 + i)^n \]

The present value could be calculated based on the ordinary or inflation-free interest rate as

\[ P = \frac{F}{(1 + i)^n} \]
Alternatively, the present value could be calculated based on the inflated interest rate as:

\[ P = \frac{F}{(1 + i_f)^n} \]

where \( i_f = i + f + if \)

### 7.16 - Taxes

Engineering economy analysis requires serious consideration of various taxes applied in running a business. There are four major taxes:

- **Property Taxes** – Such taxes are based on the value of the ‘property’ or ‘assets’ owned by the corporation such as land, building, capital equipment and inventory.
- **Sales Taxes** – These taxes are imposed on the sale of a product but not a service. If the corporation sells its products through a retail, distribution or a third party, then the corporation is exempt from paying such taxes.
- **Excise Taxes**: These taxes are applied on the manufacture of certain products such as gasoline, tobacco, and alcohol.
- **Income Taxes**: This is the tax that corporation or an individual is expected to pay on the corporate profit or personal income.

Section 8

Project Presentation
8.1 - Oral Presentations

Impressions and reputations (favorable or unfavorable) are made most quickly by audience reaction to an oral presentation. There are a number of situations in which you will be called upon to give a talk. Progress reports, whether to your boss in a one-on-one situation or in a more formal setting to your customer, are common situation in which oral communication is used. Selling an idea or a proposal to your management budget committee or a sponsor is another common situation. In the more technical arena, you may be asked to present a talk to a local technical society chapter or present a paper at a national technical meeting.

Oral communication has several special characteristics: quick feedback by questions and dialogue; impact of personal enthusiasm; impact of visual aids; and the important influence of tone, emphasis, and gesture. A skilled speaker in close contact with an audience can communicate far more effectively than the cold, distant, easily evaded written word. On the other hand, the organization and logic of presentation must be of a higher order for oral than for written communication. The listener to an oral communication has no opportunity to reread a page to clarify a point. Many opportunities for noise exist in oral communication. The presentation and delivery of the speaker, the environment of the meeting room, and the quality of the visual aids all contribute to the efficiency of the oral communication process.

8.2 - Developing a Presentation Outline

In order to organize a logical flow of ideas designed to tell a complete story it is important to develop an outline for each presentation. The outline also serves as a checklist for items that appear in the slides. This checklist prevents the presenter from omitting important ideas as he or she becomes immersed in the details of designing the slides.

To develop an outline, transform the earlier questions into headings for the outline, then follow two steps. First, construct a general outline: write the answers to the questions as the key ideas of a presentation, organized under their corresponding headings. Then expand the general outline into a detailed outline that contains all the specific items can then be placed on the slides.

The purpose of the general outline is to collect and organize the answers to the audience’s questions as the key ideas of a presentation. The following headings can be used to organize the key ideas:

- Title
- Presentation Outline
- Introduction
- Goals and Objectives
- Methodology / Approach
- Analysis / Experiment
- Details of the work
• Results / Discussion
• Conclusions
• Future work

8.3 - Guidelines For Making Presentation

*Important note:* Individual instructors may have their own specific requirements regarding the number of presentations, their format, method of delivery, and grading, so check with your instructor before preparing your presentation.

The following are some guidelines and general grading criteria regarding project presentations. Presentations are part of the course requirement.

• All presentations should be limited to 15 minutes followed by a 5 minute question- and-answer period.

PRESENTATION #1 (15 minutes maximum including 5 minutes for questions and answers).

This presentation should include:
• Project introduction, background, and goals
• State-of-the-art review
• Functional specification
• Concepts and concept selection
• Review of schedule and milestones
• Future work to be done

PRESENTATION #2 (15 minutes maximum including 5 minutes for questions and answers).

This presentation should include:
• Project introduction (brief)
• Describe the work completed
• Review of project schedule
• Cost Analysis
• Any anticipated problems, outside contacts, etc.
• Future work to be completed

PRESENTATION #3 (15 minutes maximum including 5 minutes for questions and answers).

This presentation should include:
• Project introduction (brief)
• Describe the work completed
• Future work to be completed
• Review of project schedule (include next semester plans)

ADDITIONAL COMMENTS

• All presentations should include about 5 to 7 overhead transparencies and be prepared professionally. (The rule of thumb is approximately 2 minutes per slide).

• Ask your instructor about the format of the presentation: i.e., whether only one person in the group should make the presentation with recognition and introduction of other group members, or all group members should participate in each presentation.

• It is highly recommended that the presenter use a pointer.

In general, your presentation will be graded using the following criteria:

• Compliance with time-limit
• Compliance with all the guidelines as outlined above
• Quality of overhead transparencies and visual aids
• Quality of presentation (loud and clear, substance, interaction with audience, etc.) Check with your instructor for more specific information on presentation grading.

HELPFUL HINT

A day or two before your presentation, go through a dry run using your group members as audience. This will give you confidence and a good estimate of the time it takes to present the material.
Section 9

Project Report
9.1 - Writing the Technical Report

In no other area of professional activity will you be judged so critically as your first technical report. The quality of a report generally provides an image in the reader’s mind that, in large measure, determines how you will be perceived as an engineer. A good job of report writing cannot disguise a sloppy investigation, but even excellent engineering may not receive proper attention and credit because the work was reported in a careless manner. You should be aware that written reports carry a message farther than the spoken word and have greater permanence. Therefore, technical workers often are known more widely for their writings that for their talks.

9.2 - Steps in Writing a Report

The planning stage of the report is concerned with assembling the data, analyzing the data, drawing conclusions from the data analysis, and organizing the report into various logical sections. The planning of a report is usually carried out by considering the various facets of the work and providing a logical blend of the material. The initial planning of a report should begin before the work is carried out. In that way the planning of the work and planning of the report are woven together, which facilitates the actual writing operation.

Outlining the report consists of actually formulating a series of heading, subheadings, sub-subheadings, etc., which encompass the various sections of the report. The outline can then be used as a guide to the writing. A complete outline can be detailed to the point at which each line consists of a single thought or point to be made and will then represent one paragraph in the report. The main headings and subheadings of the outline are usually placed in the report to guide the reader.

The writing operation should be carried out in the form of a rough draft using the maximum technical and compositional skill at the command of the writer. However, do not worry about perfection at this stage. Once you get going, don’t break stride to check out fine details of punctuation or sentence structure.

Editing is the process of reading the rough draft and employing self-criticism. It consists of strengthening the rough draft by analyzing paragraph and sentence structure, economizing on words, checking spelling and punctuation, checking the line of logical thought, and, in general, asking oneself the question “Why?” Editing can be the secret of good writing. It is better for the writer to ask himself embarrassing questions that to hear them from his technical readers, his supervisor, or his instructor. In connection with editing, it has often been said that the superior writer makes good use of both ends of the pencil.

It is generally good practice to allow at least a day to elapse after writing the rough draft before editing it. That allows the writer to forget the logical pattern used in writing the report and appear more in the role of an unbiased reader when editing.

Many mistakes or weak lines of thought that would normally escape unnoticed are thereby uncovered. The rewriting operation consists of retyping or rewriting the edited rough draft to put it in a form suitable for the reader. An important tip for preparing a handwritten report draft is to use every other line on the paper. In that way you will be able to make correction in the empty lines and use part of your rough draft without doing a complete rewrite.
Suggested Outline to use in Organizing a Report

Title Page
Abstract
Acknowledgement
Table of Contents
Nomenclature (if applicable)
List of Tables (if applicable)
List of Figures (if applicable)
Executive Summary
Introduction
Methodology
  Analysis/Modeling
  Experimentation
Results and Discussion
Conclusions/Recommended Future Work
References
Appendices

Following may be helpful in providing the writer with additional information and tips in preparing a report.

The Abstract-A Summary of the Entire Report

An Abstract is a complete, concise distillation of the full report. Although first in the report, it is always written last. It provides a brief (one sentence) introduction to the subject, a statement of the problem, highlights of the results (quantitative, if possible), and the major conclusion. It must stand alone without citing figures or tables. A concise, clear approach is essential. Most abstracts are short and rarely exceed 200 words.

The Introduction-Why Did You Do What You Did?

An introduction generally identifies the subject of the report, provides the necessary background information, including appropriate literature review, and provides the reader with a clear rationale for the work described. It states the hypothesis or concept tested. The introduction does not contain results and generally does not contain equations. The use of figures and tables should be limited in the Introduction.

Analysis Modeling-What Does Theory Have to Say?

An Analysis section describes a proposed theory or a descriptive model, if available. It does not contain results, nor should extreme mathematical details be provided. Sufficient detail (mathematical or otherwise) should be provided for the reader to clearly understand the physical assumptions associated with a theory or model.

Experimental Program-What Did You Measure and How?

The Experimental Program section is intended to describe how experimental results were
obtained. Provide an overview of the approach, test facilities, validations, and range of measurements. As a rule of thumb, provide just sufficient detail to allow the experiment to be conducted by someone else. Do not give instructions or commands to the reader; rather report what was done. If a list of equipment is included in the report. It should be a table in body of the report, or it should be placed in an appendix. Uncertainty analysis information can be described either here or in the Results section, or both. In cases in which both an analysis and experiment are described, these two sections of the report should complement and support each other. The relationship of the analysis to the experiment should be clearly stated. If a numerical simulation was performed, it might be described under a separate heading, such as Numerical Model, using guidelines similar to those under the Experimental Program.

Results and Discussion—So What Did You Find?

Here you present and discuss your test results and tie them back to your original objectives or hypothesis. Data must be interpreted to be useful. This transforms raw data into useful results. When presenting your results, remember that even though you are usually writing to an experienced technical audience, what may be clear to you may not be clear to the reader. Assuming too much knowledge can be a big mistake, so explain your results even if it seems unnecessary. If you can’t figure them out, say so: “The mechanism is unclear and we are continuing to examine this phenomenon.” Often the most important vehicles for the clear presentation of results are figures and tables. All of the figures and tables should be numbered and have descriptive titles. Column heads in tables should accurately describe the data that appear in the text of the Results section. Since you have spent significant time in preparing the plots and tables, you are intimately familiar with their trends and implications: the reader needs your insight to understand the results as well as you.

Conclusions—What Do I Now Know?

The Conclusions section is where you should concisely restate your answer to the question, “What do I know now?” It must support or refute your hypothesis. It is not a place to offer new facts, nor should it contain another rendition of experimental results or rationale. In a short summary, restate why the work was done and how it was done, and provide a conclusion to the work. An appropriate conclusion might be “The temperature measuring system calibrated in this study was found to indicate the correct temperature over the range 30-250°F with no more than a ±1°F uncertainty at 95% confidence: It would not normally be useful or appropriate to conclude, “The temperature measuring system was tested and worked well.” Conclusions should be clear and concise statements of the important findings of a particular study; most conclusions require some quantitative aspects to be useful.

References

The references cited in a formal list should be available to the reader and described in sufficient detail for the reader to obtain the source with a reasonable effort. References for this document provide a format guide.

Appendices
Appendices are places to place superfluous but possible useful information. They should stand on their own and should not provide information critical to the report that information should be in the main body of the report. Uncertain whether information should be in an Appendix? Ask yourself: If the reader did not read the Appendix, would the report be sufficient? It should be!

Writing Tips

1. Accuracy is important, but so is consistency. Define all nonstandard terms the first time they are used and stick to those terms and definitions throughout all writing on that subject. Err on the side of clarity if you must err, so that if a particular construction is questionable, add the extra words that make it longer but guarantee its clarity.
2. Don’t overdo significant figures. This is one of the surest ways of convincing the astute reader that you are an amateur. How many figures can you reproduce for a given measurement? Use that number.
3. Avoid the use of contractions and possessives and jargon. On occasion, jargon serves a useful function—one of neatly describing or labeling an otherwise troublesome concept or process. Still, use jargon only when your audience will understand it and a simple substitution doesn’t exist.
4. Technical writing is often in the third person to focus attention on the subject matter at hand. The active voice is preferred where possible, but choose the style that suits your writing best. The important thing is to communicate effectively.

9.3 - Amplification on Component of the Report

- Title page
  The title page clearly identifies the following elements:
  - Title of the project
  - Author(s)
  - Entity for which the project was done (e.g., San José State Univ., Department of Mechanical Engineering, ME 195, etc.)
  - Date
- Abstract
  The abstract provides the following information (ASME Manual, MS-4):
  - A clear indication of the objective, scope, and results of the paper so that readers may determine whether the full text will be of particular interest to them.
  - Key words and phrases for indexing, abstracting, and retrieval purposes.
- Acknowledgements
  It is very important to recognize the contribution of others to the success of your work. Design is never done in a vacuum! Be thoughtful of how others helped you achieve success. Common areas are:
- Project sponsorship or financial support
- Donations of equipment, supplies, etc.
- Technical help
- Other help of a significant nature

- Nomenclature
  The nomenclature section lists any symbols, variable names, etc. and shows what they stand for. Lettered symbols come first, in alphabetical order. Greek symbols come next, in alphabetical order.

- Executive Summary
  The executive summary is a brief, concise summary of important information, intended for specific readers who want to know, but don’t have the time, patience, or energy to slog through a rambling, obscure report.

  The executive summary answers the following questions:
  - What is the problem?
  - What is the solution of the problem?
  - What actions are recommended or have been taken? The executive summary must be:
    - **Brief**: The executive summary is generally not longer than a few pages, unless figures make up a significant portion.
    - **Crisp**: Words and sentences must be relevant to the subject. Avoid filler and verbiage that doesn’t add important information.
    - **Readable**: The executive summary should be organized and formatted so that the reader can quickly extract the essential information. Use ample headings and subheadings to form a clear outline of the subject that can be readily understood by the reader. Multiple points or features should be tabulated or bulleted (for example, this list). All statements in a common tabulation must have the same grammatical structure.
    - **Will-illustrated**: Figures must have brief, self-explanatory titles with text that explains the significance of what is shown. Figures should be integrated into the text, not grouped together at the end. If needed, full-page figures should be oriented so that the bottom is adjacent to the outer edge of the report, not adjacent to the binding.

- Introduction
  The introduction presents the following information:
  - **Background of the problem**: The background sets the stage, provides context, explains the need for the solution.
  - **Functional specification**: The functional specification clearly spells
out in quantifiable terms how the solution must perform.

*State-of-the-art review:* The state-of-the-art review summarizes prior and related solutions to the problem. For example, patents, journal papers, reports, etc.

- The Solution
  
  This section clearly presents the solution to the problem. It is critical that this section contains sufficient illustrations, drawings, photographs, etc., to fully communicate the solution to the problem.

- Analysis and Performance Results
  
  This section presents *results* of testing and modeling of the solution. Graphs, charts, tables, etc., should be used and described to clearly show how the solution performs relative to the design specifications.

- Discussion
  
  This section reflects on the performance of the solution and interprets the meaning of the information presented in the previous section. Discussion on failure models is appropriate in this section.

- Conclusions and Recommendations for Future Work
  
  This section summarizes the meaning of your results and outlines what could be done in the future to carry on development of your work. In other words, answer the questions, “So what?”, and “What more could be done on this problem?”

- References
  
  The references should list all literature, catalogs, interviews, etc. that have been used in the project work. You may either list references in alphabetical order (see References below) and cited as done in the section on the Abstract or Executive sections of this document, or you may number each one and cite the number in your text.

- Appendices
  
  The appendices contain details and other relevant information that are important to the project, but would otherwise bog down the flow of the report if included in the main sections. For example:

  - Alternative design approaches and evaluation
  - Supporting analysis
  - Detail drawings
  - Materials specifications and catalog data
  - Details on testing procedures, apparatus, and raw test data
  - Supporting information, such as catalog data, etc.
Appendices
Document A

Safety Rules

1. Students may not begin scheduled laboratory work prior to the arrival of the instructor.

2. Students may work in the laboratories at times other than regularly scheduled periods only by special arrangement, and must carry identification indicating such approval permission is granted by the instructor with the approval of the department chairman.

3. No student is permitted to work alone in a laboratory with equipment or materials when the procedures are considered to be hazardous by so doing.

4. Students must clean the equipment and areas used during laboratory periods. Equipment issued for laboratory use must be returned at the close of the laboratory period.

5. Students will be held financially responsible for breakage or damage to laboratory equipment due to their own negligence or abuse.

6. Smoking, eating food and drinking beverages, running or acting in a manner that might produce unsafe conditions, are prohibited in all laboratory and classroom areas.

7. Students must observe safety precautions governing laboratory activities as outlined by the instructor. Safety hazards should be reported to the instructor as soon as possible.
Each group in collaboration with the faculty advisor and industry sponsor, if any, is to develop a one-page proposal outlining the specific activities required including deliverable.

Be sure to follow the format provided on the next page, to prepare your project proposal.
Project Proposal Format

Title : 
Industry Sponsor : 
Address : 
Industry Mentor : Name and Address

Faculty Advisor : Name

Student Team Members : 1. (Manager)  
Tel#:  
Email:  

2.  
Tel#:  
Email:  

3.  
Tel#:  
Email:  

Project Scope : 
Project Objectives : 
Deliverables : 
Timetable : 
Required Facilities and Funding :
Monthly Progress Report

Each group is expected to provide monthly reports informing their advisor and industry sponsor of their activities and progress throughout the semester.

See the format on the next page.
Monthly Progress Report Format

Date : 
Course No. : 
Project Title : 

Student Team Member: 1. (Manager) Tel#: 
2. Tel#: 
3. Tel#: 
   etc.

Report Period : 
Accomplishments : 
Problems Encountered :
Solutions Implemented/Proposed: 
Future Activities (next 4 wks):

Student Team Contribution:

<table>
<thead>
<tr>
<th>Student Name</th>
<th>Task Performed</th>
<th>Hours Contributed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (Manager)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Each group is required to prepare a one-page summary of their project. This summary includes:

Title
Project Scope and Objective
Project Results
Sponsor
Faculty Advisor
Student Team Members

Be sure to include a 'clear' photo or drawing of your project to fit in a "3x3" space in the lower right hand side of the page as shown on the following page.

This summary is required and due to your faculty advisor by May 1 of the Spring semester for inclusion in the 'Senior Design Project Summary' booklet available on the 'Engineering Conference Day', the last Friday before the Finals week of the spring semester.
Single-Page Project Summary Format

Title:

Project Scope and Objectives:

Project Results:

Sponsor:

Faculty Advisor:

Student Team Members:

3" x 3" Space
for a photo or
a drawing of the
final project
Senior Design Project Expense Reimbursement

Projects not supported by industry are eligible for some reimbursement of expenses incurred related to their project.

This amount is limited to $50 per student in each group and to be paid for materials purchased only.

The form on the next page may be copied for reimbursement purposes.

Fill out the form completely and submit along with all original receipts. Receipts are to be individually attached on to an 8.5"x11" sheet of paper. Do not staple rather use tape.
Senior Design Project
Expense Reimbursement

Semester: ________________________________

Project Title: ________________________________

Faculty Advisor: ________________________________

Student Members: ________________________________

Please answer questions in one area A, B, or C below:

A-Industry Sponsored: Yes ________________, No ________________
   Industry/Company Name: ________________________________
   Amount Contributed by Company: ________________________________

B-Laboratory Station: Yes ________________, No ________________
   Is this project a laboratory hardware: Yes __________, No __________
   Which laboratory will be located at: ________________________________

C-Professional society design competition: Yes __________, No __________
   Society Name: ________________________________
   Amount of financial support provided: ________________________________

D-Team or individually sponsored: Yes __________, No __________
   Who sponsored this project? ________________________________
   Amount of financial support provided? ________________________________

Amount Spent: ________________________________

Amount Requested: ________________________________

Check Requester’s Name: ________________________________, SID No.: __________
   Address: ________________________________
   _________________________________________

Requester’s Signature (has full consent of the team members): ________________

Faculty Approval: ________________________________

Sr. Project Director Approval: ________________________________

Amount Requested may not exceed no. of students x $50.00

Reimbursement Amount Authorized: ________________________________