Section 1 Program

Overview

Introduction:

Twenty years ago, the rubber industry realized that the basic skills of workers declined as machinery became more high-tech and computerized. Rubber companies had "to hire chemical or mechanical engineers and put them on the manufacturing floor for 18 to 24 months to acquire experiences required in rubber processing technology." Companies were forced to "spend more money on worker training and less on product development." The industry needed "a labor force with significant knowledge in the material science and processing, as well as a background in tooling, mold making and product design to become productive in the plants," according to a study by the Rubber Manufacturers Association (RMA).

It has long been recognized, nationally, that Ferris State University (FSU) offers a blend of traditional liberal arts education with career oriented professional training. In 1989, plastic industry representatives and RMA decided to build the new American Center for Excellence in Plastics and Rubber Technologies (ACEPART) at FSU building on the highly successful plastics programs already on the FSU campus. The goal of the ACEPART project was "to help meet the employment and applied research needs of small and medium sized rubber and plastics manufacturers and processors, who desperately needed skilled workers." The name was later changed to the National Elastomer Center (NEC). Based on the labor demand of the rubber industry, each year, the center would generate twenty-four graduates who would be able to make an immediate contribution in the manufacturing environment.

In 1998, the first class in the rubber programs commenced. The new NEC facility and rubber programs are the realization of a unique industry/government education partnership whose sole purpose is to provide skilled, hands-on technicians and manufacturing engineers trained at the university level for the rubber industry. Ten years later, while the U.S. manufacturing industry is evolving rapidly under the pressure of ever rising energy costs, global competition and regulatory requirements, the rubber program graduates enjoy competitive salaries and 100% placement, demonstrating the value of rubber programs at Ferris.

On the other hand, the programs have been struggling with low enrollment and poor program productivity based on the ratio of Student Credit Hours/Full Time Equated Faculty (SCH/FTEF) since the last review. Although we have seen a positive turning point, indicated by the number of freshmen enrolled in falls of 2007 and 2008, it remains true in the recommendations brought up by the Academic Program Review Council six years ago that "the University must supplement the faculty and administrators in rubber programs through the use of institutional resources for focused marketing that will increase the program visibility and the awareness of prospective students... New ways must be identified to reach not only high school market, but also non-traditional sources such as the military (and those who are currently working in the rubber industry)."

The department has also missed the opportunity to better integrate the Plastics and Rubber Programs after numerous meetings and intensive discussion of curriculum changes during last year. The synergy of incorporating Rubber Program with Plastics Program in the same department has not been fully realized. One Plastics faculty is needed to help teach rubber courses after one rubber faculty retired last semester. This transition could have been smoother with better integration between the two programs.

With the brief history of well-planned and executed rubber programs at Ferris, mentioned above, it has special meaning today to carefully review the programs which were developed through the efforts of so many people from the state of Michigan, academia, and from industry.

A. Program Goals

The first goal of the programs is to generate an adequate number of graduates for the rubber industry. Because of low enrollment, the rubber companies have been asking for more than we can supply.

The second goal is to recruit more students to meet the program capacity. This goal is similar to the first one but is important to the university, in particular with regards to the productivity of rubber programs. After the retirement of one of the two program faculty members, one plastics program faculty has been "recruited" to teach a processing course. We hope the negative image of the "one-person" program will be resolved once enrollment justifies a second full-time faculty member.

The third goal is to keep the lab equipment updated, fully functional, and safe for the students use during class time.

The fourth goal is to update and enrich the program curriculum, emphasizing project management and problem solving skills.

It is the consensus of the program faculty and the Industrial Advisory Board that continual efforts should be put forth to these goals so that we can prepare students for careers to serve the U.S. rubber industry better and keep it fully competitive in the global economy.

B. Program Visibility and Distinctiveness

Through the funding from the state of Michigan, RMA, and the support of the private sector, the rubber programs were provided with state-of-the art equipment and training procedures. The Rubber Division of the American Chemical Society (ACS) has helped the programs to start its first student chapter at Ferris. During the Division's annual technical meeting and Rubber Expo we are given a booth each year, free of charge, where the technical presentations and attendance of the program students are well received. The Division has awarded our students with highly competitive annual undergraduate scholarships for quite a few years. In one year, 2 out of 3 scholarships were awarded to our program students.

The West Michigan Rubber Group (WMRG), the local group of the Rubber Division, has been giving the programs support through material donations, seminars on special topics, field trip requests and scholarships. The great interaction between program students and the rubber industry is partially due to the reimbursement of expenses for the students' trip to the Divisional annual technical meeting.

Several other universities in the U.S. offer polymer science/engineering programs; however, their approach is not as hands-on until the graduate level. Furthermore, instead of allowing their graduates to become productive on the factory floor immediately, their training focuses more on the funded "research and development." On the other hand, students in Ferris' rubber programs are trained in every key aspect of the rubber industry and acquire a broad range of knowledge and experiences in manufacturing and product development. With mandatory summer internships, students are able to expand their learning experience and enhance the program's visibility. Graduates of rubber programs enjoy 100% placement and work all over the country with their average salary the highest among the College of Technology (COT) graduates. Up to this moment, Ferris is still the only university to offer rubber degrees at the undergraduate level.

C. Program Relevance

According to the survey done by RMA, there is a high level of satisfaction with the FSU graduates currently employed in the rubber industry. The labor market demands of program graduates are based on the following indicators:

- Virtually 100% placement with good salary reported by the Institutional Research & Testing of FSU in the graduate follow-up.
- Continuous inquiry of rubber companies requesting for interns and graduates available.
- No trouble for those alumni seeking relocation or career advancement.

The main reasons why high school students choose Ferris rubber programs are the favorable market and prospects for a good salary. Survey of the freshmen in the program also revealed why they chose the rubber major: either recommendation from someone they knew or attending the department's "Career day." All these facts point to an urgent need for good marketing strategies to emphasize the 100% placement and good starting salary after graduating from the programs.

To improve the program enrollment, recruiting plans and techniques have been examined and practiced frequently since the last program review in 2002. The general feeling of the Advisory Board during the annual meeting is not very optimistic. It is probably fair to say that nobody is happy with the enrollment of rubber programs. A draft of the petition letter from the Advisory Board to extend in-state tuition to out-of-state students is included in this review.

In separate meetings while discussing a DVD for recruitment purposes, both the Advisory Board and WMRG felt that the recruiting issue may also be a result of the low visibility of the rubber industry to the general public. They agree that video clips showing good examples of how rubber products are utilized to improve our lives should be included in the recruiting DVD.

Like other manufacturing sectors in the United States, the rubber industry faces very challenging times brought on by global competition, energy costs and regulatory burdens. To meet the ever growing challenges, the industry needs to adopt a modern management system to increase the productivity and improve the profit margin. Necessary items include:

- Having a good knowledge of rubber chemistry, rubber processing, equipment used for all processes, testing techniques, and part design techniques, to enable development and refinement of products to advance the ability to solve processing problems.
- Having knowledge now about quality, design, and manufacture improvement systems such as Six-Sigma and Lean Manufacturing.
- Having knowledge about personnel management techniques that will produce a well trained, motivated work force.
- Having knowledge about "best" manufacturing practices.
- Creating an environment of life-time learning for the employees.

Students in the rubber programs are taught these skills, some with more emphasis than others, and have a chance applying them in the lab classes.

D. Program Value

We have to keep manufacturing and technology of high end products in the United States and the industry is asking for more rubber graduates. Where are we getting the new talents for the industry?

Nationwide, science and traditional engineering education is in trouble. The impact of this problem is that less young people are choosing engineering as their careers. The hands-on training in the Rubber Technology and Rubber Engineering Technology programs at FSU offers a possible solution to train technologists to meet the need of the rubber industry. This is the opinion shared by the instructors of seminars sponsored by the American Society of Mechanical Engineering (ASME) attended by the author two years ago.

As President Bush calls for lifting the ban on drilling oil off the US coast, there has been a serious shortage of ships used for deep-water offshore oil drilling. In fact, "the world's existing drill-ships are booked solid for the next five years... and the biggest shipbuilders are in Asia." That makes it impossible for any rapid turnaround in oil exploration and supply and ease today's energy crisis, even if the Congress goes along with the President concerning increased drilling tomorrow. This type of problem shows a lack of critical industrial capabilities in the United States that are needed to maintain our way of life. In one sense, the rubber programs at Ferris could be used as a barometer to predict the future of manufacturing in the United States. What would happen if we do not resolve to take all the necessary measures to improve the enrollment today? Letting the Rubber Engineering Technology Program wither would be another good example of losing manufacturing capability and thereby increasing the likelihood of decreasing living standards in the United States. If we can make this program a success, the hands-on training in the Rubber Technology and Rubber Engineering Technology programs at FSU could help address the possible loss of technology, loss of competitiveness, drop in living standards, and national security issues in this country.

There is a high level of satisfaction with the FSU graduates by employers according to the summary survey of RMA members. The employers also say that FSU graduates demand high starting salaries. Both of these results are indicators that the program is generating first-rate engineers and technicians. The consensus of the surveys conducted for this review also indicates that this program, the only one of its type in the nation, needs to maintain innovation in the curriculum to remain current with industry practices. With the tradition of working closely with RMA, ACS Rubber Division, and the Industrial Advisory Board, we trust that the Ferris Rubber program will continue to address new innovations and skills as needed, and will therefore be a real value for both students and the rubber industry.

Section 2A

Rubber Program Review - Alumni survey

1. When did you receive your "Rubber" degree(s) from Ferris?
   - A. A.A.S. 1
   - B. B.S. 14

2. Are you currently employed in the Rubber industry?
   A) Yes (14) B) No (1 in plastics)

Check the following which best describes the function you perform

A) Sales and Marketing (1)
B) Process/production engineering (7)
C) Management Title: (4)_
Value stream/MFG/Lab managers
D) Product design and development (6)
E) Technical service (2)
F) Education and training (1)
G) Project management (4)
H) Quality control/ quality assurance (3)
I) Cost estimating (3)
J) Purchasing (1)
K) Mold design (1)
L) Mold making
M) Mold repair and maintenance
N) Partner/owner
O) Contract engineer

Check the title that is closest to yours

4.

A) Engineer (7)
B) Senior engineer (2)
C) Engineering supervisor/manager
D) Engineering consultant
E) Sales and marketing representative(l)
F) Sales and marketing management
G) Production manager (1)
H) Plant manager
I) Vice president
J) President
K) Owner
L) Other: (5)

5. Check all the processes your company has in-house
A) Compounding (11) B) Injection molding (10) C) Compression molding (10)
D) Transfer molding (8) E) Extrusion (11) F) Steam curing (2) I)
G) LCM curing(l) H) Microwave curing(l) Decorating(l)
J) Assembly(7) K) Other 2

6. Check all the processes your company uses externally to satisfy its customers
A) Compounding (6) B) Injection molding(2) C) Compression molding (3)
D) Transfer molding(2) E) Extrusion(3) F) Steam curing
G) LCM curing H) Microwave curing I) Decorating
J) Assembly K) Other 1

7. What is your employment location? City/State? CAfl) /CO(1)/DE(2) / GA(1) / INffl / MA(1) / *MK5) I* NH(1) / NV(1) / RI(1)

8. What industry segment do you work in?
   - A. Automotive (8)
   - B. Furniture (1)
   - C. Medical (2)
   - D. Computers/electronics
   - E. Recreational products (2)
   - F. Household goods (1)
   - G. Packaging
   - H. Other (specify) (7) chemical process / semicon / aerospace / construction equipment / pet product / Industrial / military /energy / oil /gas

9. Would you be interested in a continuing education course offered by FSU plastic or rubber? If yes, what subject(s) would you like covered?
A) Yes (4) B)No (7) Course/seminar title: ________________________
Course/seminar title: ________________________
Course/seminar title: ________________________
Course/seminar title:

10. How would you rate the following? (Circle)
1= Very Good 2= Good 3=OKand improving 4=OK but worsening 5= Poor
3.20 (A). 12 3 4 5 The economy
2.77 (B). 12 3 4 5 Environmental issues affecting your company
3.23 (B). 12 3 4 5 Ability to hire additional technical employees
2.53 (C). 1 2 3 4 5 Salaries
2.60 (D). 12 3 4 5 Benefits
2.00 (E). 12 3 4 5 Career choice
3.17 (F). 12 3 4 5 Health of the rubber industry
2.17 (G). 12 3 4 5 Job change opportunities within the industry
2.17 (H). 12 3 4 5 Career growth opportunities

11. Please address the following issues, which are being discussed as possible changes at FSU and give them a rating.
1= Strongly agree 2= Agree 3= No opinion 4= Oppose 5= Strongly oppose

a) **(1.93)** 12 3 4 5 Increasing the global focus of the curriculum
b) (3.13) 1 2 3 4 5 Increasing the entrance requirement for all incoming Freshmen
c) **(3.60)** 12 3 4 5 Increasing the entrance requirements for all "Rubber" freshmen
d) **(3.47)** 12 3 4 5 Reduce the entrance requirements for all "Rubber" freshmen
e) (3.67) 12 3 4 5 Reduce or eliminate the GPA requirements to advance from the A.A.S. program into the B.S. program

12. Please review the following methods to support the rubber programs and identify those areas which you are willing to help with by rating each area.

Would you like us to contact you? **Yes** (3) **No** (3) (If yes, we need the contact information below.)

1= Willing to help 2= Will help if arm is twisted 3= Not willing

a) **(2.29)** 12 3 Influence employer to make a financial donation
b) (2.50) 12 3 Influence employer to make an equipment donation
c) **(2.31)** 12 3 Assist in developing student scholarships
d) **(2.23)** 12 3 Assist in recruiting local perspective students
e) **(2.62)** 12 3 Improve increased rubber program visibility on campus
f) **(2.07)** 12 3 Improve increased rubber program visibility in your region

13. In reviewing the attached course check sheet, which courses would you add or expand? Which would you delete? (See attached)

14. We have seen declining enrollment for the past 2 years. Most of our students choose rubber because of personal referrals. Are you less likely to recommend the Ferris Rubber Program than you were two years ago? **Yes** (2) **No** (11)

If "Yes", why? __ Lack of employment security
__ Too much stress in this industry
__ Concerns regarding the quality of the Ferris Rubber Program

15. What other recommendations do you have on curriculum, (not just rubber courses), facilities, student recruitment, etc.?

Optional - address (Database for alumni to contact past classmate)

Personal information:

Name: ____________________

Address: ____________________

E-mail: ■_______________

Phone:

Thank you in advance for your assistance!

Matthew Yang, Professor, Rubber Engineering Technology,

Alumni's answers for the survey questions:

9. Would you be interested in a continuing education course offered by FSU plastic or rubber? If yes, what subject(s) would you like covered?

a. Systematic or scientific mold for thermoset material
b. Business courses centered on Injection molding.
c. Rubber to Metal Bonding.

13. In reviewing the attached course check sheet, which courses would you add or expand? Which would you delete?

a. I didn't get one.
b. No attachment, Strongly suggest including in-depth instruction on CSR molding, Add medical molding focus to a course, obtain ABET accreditation.
c. Course sheet was not included in this mailing.
d. I do not have the list of courses with me. However, I do remember taking 2 required classes on SPC (1 was on Excel & more theory, the other more practical & manual). Combine the classes or eliminate 1. Make room for rubber to metal bonding & peel testing, shear testing, cycle testing.
e. Add an extensive, in depth tooling class.
f. Engl 311 not necessary, Mech 340 not necessary.
g. Eliminate EEET 201 and PLTS 320.

14. We have seen declining enrollment for the past 2 years. Most of our students choose rubber because of personal referrals. Are you less likely to recommend the Ferris Rubber Program than you were two years ago?
Yes, No, If Yes, why?

a. Lack of employment security.
b. Too much stress in this industry.
c. Concerns regarding the quality of the Ferris Rubber Program or other.
d. The long term manufacturing outlook is poor and the rubber specialization is hard to transfer to non-rubber engineering positions vs. traditional engineering degrees.
e. Eyes of employer and curriculum.
f. Depends upon the person the Rubber program is more independent study than many other programs.
g. Stress in industry is a very REAL concern. Not enough qualified workers in industry,
h. Concern regarding the quality of the Ferris Rubber Program

15. What other recommendations do you have on curriculum, (not just rubber courses), facilities, student recruitment, etc?

a. Electives offered for more specialized industry segments.
b. Students should walk out knowing how to use Lear and Six Sigma principles to improve productivity, reduce costs and develop new products, DOE competency, understanding statistical significance
c. Understand how to solve problems themselves and understand how to tap the plant floor resources to solve problems. 5-why, C & E etc. Students should also know how to set data (SQL) and how to design databases and IT tools for poke Yoke. Also need a high level of understanding of supply chain and outsourcing principles ...APICS/Oliver Wight, STOP, IBM. In general... I think the program... at least when I was there.. .was too focused on compound development and formulation. If you want to increase enrollment and have higher/more successful students after earning the degree I would change the program focus to process / manufacturing / operations engineering / management. Compound development is a field all in itself and only a "special" Ferris student will be good at it. Leave it for the Polymer Scientists.
d. Plastics & Rubber programs need to work together more, for being in the same building and sharing classrooms they (staff & students) don't have much to do with each other. It might be helpful to students (rubber) to do a senior research (yr long) project. Employers like to hear about that stuff.
e. More school visits.
f. Merge the Plastics & Rubber. Many applications are combining elastomers and plastic. MUST add focus to medical molding industry i.e. ISO 13485, Process Validations, GMPIS, FDA QSR's, Device classifications, ect, Get LSR Arburg IMM up and running!
g. Student Recruitment offer some incentives for alumni spread across the nation to contact local guidance counselors and tell them how lucrative a position in the rubber industry can be.

h. Rubber to Metal Bonding (4 responses)

i. Get to the high schools & explain the hands-on work, not a desk job, & the starting salaries compared to other programs, j. Also, try to get to the kids' parents. The kids won't always bring the info home & discuss with parents. Talk to engineering classes, physics, chemistry, AP chemistry. Too many kids have little or no direction when they start college, k. Need recruitment CD. Thorough DOE 1. Have a detailed tooling course, 300 or 400 level, m. Have a "Rubber in Automotive" course. Focus on applications, recommending guest speakers.

n. Provide some training on FEA. o. Provide a breakdown of different analytical equipment such as DMTA, FTIR...

Section 2A: Summary for Graduate Follow-up Survey

1. Surveys were mailed to alumni, including BS class of 2002, the first class of rubber programs. Total of seventy-four surveys were sent with fifteen responses and twelve "returned to sender." The response rate was 20.3 %.

2. Among fifteen completed surveys, fourteen were BS graduates and one was an AAS graduate.

3. Fourteen respondents are working in the rubber industry and one in plastics.

4. According to the returned survey, program graduates are working in ten states listed below:
   CA(1) CO(1) DE(2) GA(1) IN(1) MA(1) MI(5)NH(1)NV(1) RI(1)
   Six more graduates were re-connected through phone calls and e-mails after the surveys were compiled. As of end of May, 2008, twenty-one program graduates are working in twelve states with nearly half in the Midwest:
   CA(1) CO(1) DE(4) GA(1) IL(1) IN(1) MA(1)MI(7)NH(1)NV(1) OH(1) RI(1)

5. A majority of graduates are working as process/production engineers. Quite a few of them are working on product design and development, project management, and management.

6. Almost half of their jobs are related to the automotive industry.

7. Molding processes used by their companies are about equally divided among injection, compression, and transfer molding. It is interesting to learn, however, that compounding and extrusion are weighted as important as the molding operations.

8. About half of the graduates consider the economy, health of the rubber industry, and chances of hiring additional technologists are not great. They think their salary and benefits are better than OK and they also feel good about their career choice and growth opportunities.

9. Graduates want to see more global focus of the curriculum.

10. They show mild opposition to the following:
    - Increasing the entrance requirements for all rubber freshmen; and
    - Reducing or eliminating the GPA requirements to advance from the AAS program into the BS program.

11. The willingness of supporting the rubber programs is not high in the following areas:
    - Influencing their employers to make a financial and equipment donation.
    - Assisting the development of student scholarships.
    - Assisting the recruitment of local perspective students.

12. They seem more willing to improve the rubber program's visibility in their regions. And the majority of them are likely to recommend the Ferris rubber programs to other people in order to help the enrollment.

13. Some good ideas of recruiting high school students are mentioned, including the production and distribution of recruitment CD/DVDs.

14. Numerous good suggestions and recommendations are raised in regard to the curriculum change and topics that need to be included in program courses. A few of their suggestions have been implemented, however, most of them need to be studied carefully for their relevancy and feasibility to be included into the program curriculum.

January 8, 2008

Dear Rubber Alumni:

Happy New Year to everyone! I hope you are well and enjoying the fruits of the education you received at Ferris.

Every Ferris program goes through a formal Program Review every 5 years. This allows us to assess how well we are meeting our goals and what changes or improvements should be considered. We need you to help us evaluate the Rubber Programs at Ferris as your perspective on the program is crucial to the review. The results of this review will be shared with the top levels of the University, and often result in additional resources.

I have included the survey form for you to fill out and send back in the return envelope. You can also fax the survey back at 231-591-2642.

Please contact Bob Speirs (231-591-2650), Jill Gregory (231-591-2640), or me (231-591-5263) if there is anything we can do to help you in your careers. Especially let us know if you change positions or companies, as a strong Ferris rubber network will help everyone.

I look forward to hearing from you.

Sincerely,

Matthew Yang
Associate Professor
Rubber Programs
Plastics and Rubber Engineering Technology Department

Section 2B Employer

Follow-up Survey

Please rate the following items from 1 as strongly disagree to 5 as strongly agree:

Company 1; 420 employees; Interns: 0; Hires: 2; Classification: Extrusion
Ratings:
Problem solving skills - 4
Technical writing skills - 5
Presentation skills - 4
Interpersonal skills - 4
Technical competency - 5
Time management skills - 4
Accuracy in job performance - 4
Speed in job performance - 5
Understanding of rubber equipment - 5
Contribution towards the operation's goals - 4
Understanding of rubber terminology - 5
Would you hire another Ferris student? Yes
Other comments? None

Company 2; 68 employees; Interns: 1; Hires: 0; Classification: R&D
Ratings:
Problem solving skills - 4
Technical writing skills - 3
Presentation skills - n.a.
Interpersonal skills - 4
Technical competency - 5
Time management skills - 2
Accuracy in job performance - 3
Speed in job performance - 3
Understanding of rubber equipment - 5
Contribution towards the operation's goals - 2
Understanding of rubber terminology - 5
Would you hire another Ferris student? Yes
Other comments? Our experience was great in technical skills but poorer in routine work skill sets.

Company 3; 85 employees; Interns: 2; Hires: 0; Classification: Injection & Compression/Transfer molding

Ratings:
Problem solving skills - 3
Technical writing skills - 2-3
Presentation skills - n.a.
Interpersonal skills - 3
Technical competency - 3
Time management skills - 2-3
Accuracy in job performance - 2-3
Speed in job performance - 2-3
Understanding of rubber equipment - 3-4
Contribution towards the operation's goals - 3
Understanding of rubber terminology - 4-5
Would you hire another Ferris student? Maybe
Other comments? Would perhaps consider but typically can't compete on salary requirements and/or job responsibility.

Company 4; employees: n.a.; Interns: multiple; Hires: multiple; Classification: molding, extrusion, mixing, r&d

Ratings:
Problem solving skills - 4
Technical writing skills - 4
Presentation skills - 4
Interpersonal skills - 4
Technical competency - 4
Time management skills - 4
Accuracy in job performance - 4
Speed in job performance - 4
Understanding of rubber equipment - 4
Contribution towards the operation's goals - 4
Understanding of rubber terminology - 4
Would you hire another Ferris student? Yes
Other comments?

Company 5 - A tire manufacturer replied, commenting that they have hired 8 FSU graduates at retail locations. None of these individuals are graduates of the rubber program.

(E-mail attached to the employer follow-up survey results)

January 8, 2008

TO: Matt Yang, Ferris State

FROM: Dan Mustico

SUBJECT: FSU Employer Follow-up Survey Results

Dear Matt:

I've summarized here the limited feedback I received from our membership, with regard to the survey we circulated last fall. In most cases, respondents had never retained an FSU intern or hire.

Hopefully this provides some level of insight going forward, and you always have my full support.

You can reach me at (202) 682-4866 or dan@rma.org. Happy New Year!

###

cc: Bob Speirs
attachment

Section 2B Summary of Employer Survey

On behalf of the RMA and its membership, I would submit that there is a high level of satisfaction with the FSU graduates currently employed in our industry, and further hopes that industry can assist in sustaining this valuable program.

We are currently faced with very challenging times as manufacturers in a North American market which is pressured by energy costs and ever growing regulatory burdens, which only serve to accentuate the pressures of global competition and the fight to maintain and strengthen the U.S. manufacturing workforce.

Components which are central to the long-term success of the FSU's Rubber program are

1) The global competitiveness of U.S. manufacturing;
2) Realistic mentoring of degree-candidates in what to expect in workplace opportunities both in the U.S. and increasingly overseas;
3) Maintaining innovation in the curriculum to remain current with industry Practices;
4) Monetary and human resources to sell the program to degree candidates, parents, and industry.

Finally, one of the only "critical" points I have heard from industry is that FSU graduates are demanding unrealistic starting salaries. My feeling on that is that as long as they continue to be placed at 100%, as we have come to expect, it is an indication that the program is generating first-rate engineers and technicians.

It is understandably all about resources, and we respect the fight for resources within FSU, just as I hope you also respect the same within industry. I have the full support of our members to do everything I can to assist you in continuing to build this program for the future.

Regards,

Daniel J. Mustico Vice President
Elastomer Products Group Rubber
Manufacturers Association 1400 K
Street, N.W. Suite 900 Washington,
D.C. 20005 (202) 682-4866
dan@rma.org

Section 2C **Graduating Student Exit Survey**

Currently the programs do not have graduating student exit survey. The development of the exit survey will be a goal in the future.

Section 2D

STUDENT PERCEPTIONS OF RUBBER PROGRAMS

Rubber Program Only
Fill out only once.

Check the statement that best describes your objective for attending college: (Check the one most appropriate.)

-Prepare to get a job... 20
-Improve my job skills for present occupation... ____
-Personal interest.
-Other (Describe).

Check the statement that best describes why you picked the Ferris Rubber Program for a curriculum:

-Availability of a job upon graduation 9
-I wanted to work in the rubber industry 2
-Published pay rates of the industry/career.......... 4
-Reputation of the program 3
-Other students excited about the program.......... _ 2
-Hands-on education... 4
-Scholarship.. _ 1 _
-Recommendations of others (check all that apply)
  -Other students 2
  -Relative or friend 2
  -High school counselor/teacher....... 1
  -Ferris faculty/administrator............. 6
  -Someone in the industry................ 1
-Other (Describe)., getting a minor in Polymer Technology________________________

Check your current student status in the Rubber Program:

Freshman 11 Sophomore_____ Junior Senior 6
Dual major__5
Completed I^{s} and 2nd internships____________________

Have you completed any internship yet?

None__13________Completed 1st internship 2

PLACE AN "X" IN THE BOX THAT APPLIES A "comments" column is provided if you wish to explain your answer and use the "Don't Know" column for items you are unsure about.	p00R 1	FAIR 2	AVERAGE 3	PRETTY G00D 4	G00D 5	D0NTKN0W	COMMENTS Average
1. Courses in the Rubber Program are: - Based on realistic industry requirements			**1**	5	**11**	1	4.58
- Up-to-date in their content		**1**		5	**12**	2	4.55
- A "value" to me at their current tuition cost		**2**	**2**	5	**8**	3	4.12
2. The courses taught in Rubber Program have a syllabus which will tell me what I will learn	**1**		**3**	5	**11**		4.25
3. The course content taught is: - Up-to-date with the practices of industry			**1**	7	**9**	2	4.47
- In line with my needs and interests			**1**	6	**11**	2	4.56
- Understood by the professors teaching			**1**	4	**13**	2	4.67

PLACE AN "X" IN THE BOX THAT APPLIES A "comments" column is provided if you wish to explain your answer and use the "Don't Know" column for items you are unsure about.	pO0R 1	FAIR 2	AVERAGE 3	pRETTY G00D 4	G00D 5	D0NTKN0W	COMMENTS **Average**
4.The teaching methods used in the course: - Utilize technologies which help me understand			3	6	11		4.40
-Apply knowledge from instructor experience			3	3	13		4.53
5.When laboratory activities accompany lecture: - State-of-the-art equipment is utilized	2		4	8	6		3.90
-Experiences parallel the lecture topics		1	3	7	9		4.20
-Hands-on experiences are "paced" well		2		3	15		4.55 Needs to be faster
6. Aside from the structured class topics/sessions: -I find the instructor's experience meaningful			1	4	14		4.68
-I can gain insight into future positions			3	3	12	2	4.50
-I am given consistent information			2	6	12		4.50
7. Other Rubber Industry information: -Is attainable from extra-curricular activities presented by and supported through the instructors			2	10	8		4.30
-Opportunities are available through the instructors			3	7	10		4.35
8. The program instructors: -Know the subject matter and occupational reqmts.			4	4	11		4.37
-Are available to provide help when I need it			1	3	16		4.75
-Provide interesting & meaningful subject matter			1	5	13	1	4.63
-Are fair and equal with students in general			2	4	14		4.60 Depends on Prof.
9. Instructional lecture and laboratory facilities: - Are up-to-date and kept that way	1	1	3	6	9		4.05
-Provide a positive environment for learning			1	5	14		4.65
-Are safe, functional, and well maintained			3	6	11		4.40
-Include enough work stations for class size	1	1	4	7	6		3.65
10. Instructional equipment such as: -Text books are good, clear, and meet class needs	1	3	4	7	4	1	3.53
-Sufficient lab equipment & materials for class			4	9	6	1	4.11
-Lab equipment is safe, functional, and maintained			1	9	9		4.42
11. The elective/support classes required are: - Meaningful and worth-while	3		3	8	5	1	3.63
-Fitting choices for the overall program and degrees	2		2	8	4	3	3.75
-Taught by instructors who can relate to rubber	3	1	5	4	4	3	3.29
-Are "in-step" with the core classes in the program	1	1	6	6	3	3	3.53

PLACE AN "X" IN THE BOX THAT APPLIES A "comments" column is provided if you wish to explain your answer and use the "Don't Know" column for items you are unsure about.	pO0R 1	FAIR 2	AVERAGE 3	pRETTYG00D 4	G00D 5	DONTKN0W	COMMENTS (AVERAGE)
12. The "internship" requirements of the program: -Internship is accessable				9	7	4	4.43
-Are meaningful and worth-while (1st & 2nd)		1		4	8	6	4.46
-Give insight into the expectations of the industry				6	8	6	4.57
-Are faculty assisted and followed up by them	2		2	4	6	5	3.86
-Are appropriate in quantity, time, or requirements.			2	4	8	6	4.43
13.1 am given adequate individual attention: -By my instructor in the laboratory (student ratio)			1	5	14		4.65
-By my instructor in the classroom (student ratio)			1	5	13		4.63
14. My classroom experiences include: -Adequate "challenges" given by professor		2	4	8	6		4.00
-Adequate availability of computers	1	1	1	8	8		4.11
-Adequate access to the internet	1	1	1	7	9	1	4.16
-Adequate reference materials available			2	7	9	1	4.39
15.1 receive proper advising from program advisor.			4	5	9	1	4.28
16. Overall, I would: -Choose this program again as I first did			2	2	15	1	4.68
-Recommend the program to another			2	2	16		4.70
-Rate the program		1	1	4	13		4.53, Great Program

How did you view your career potential when you came into the program?... ________________________________

How do you view your career potential now? ____________

ADDITIONAL COMMENTS SPACE: (Use back of sheet if necessary.)

Students Answers for Question 1:

How did you view your career potential when you came into the program?

1. Didn't know about rubber.
2. So,so.
3. OK, not spectacular.
4. Good. (5 responses)
5. Very good.(2 responses)
6. Good potential
7. Pretty high
8. Pretty well (2 responses)
9. Exciting
10. High and strong
11. Adding to my knowledge
12. I view the opportunity of getting a job as pretty well.

Students Answers for Question 2:

How do you view your career potential now?

1. Know a lot about rubber (hands on).
2. Good
3. Very good (2 responses)
4. Pretty well (2 responses)
5. Pretty high
6. Going up (2 responses)
7. Good potential
8. Great (3 responses)
9. Extremely well
10. High and strong
11. Exceptional
12. Better and will allow more opportunity.

13.1 believe that I will have no trouble finding a job after graduation.

Additional comments:

Need more challenge, too easy for me.

Section 2D Summary of Rubber Program

Student Survey

1. Overall, the degree of satisfaction is high based on the survey conducted among the student body consisting of 55% freshmen where 65% of them had not completed an internship yet. Ten percent of them are dual majors in the rubber and plastics programs.
2. There are minor concerns with some issues, such as:
    a. Tuition cost
    b. Syllabi of rubber program courses
    c. Equipment in the lab is getting too old.
    d. Textbooks not meeting class needs.
    e. Concerns about the required support / elective courses
        i. Not meaningful
        ii. Does not fit the programs and their degrees iii. Are
        not taught by instructors who can relate to rubber iv. Are
        not "in-step" with the core rubber courses
    f. Not enough assistance and poor follow-up during their internships.
    g. Need a little bit more challenges from the professors.
3. Some of the issues listed above have been improved since the last program review. Although the issues may be raised mostly by the freshmen, all of the concerns need to be watched closely and dealt with when possible.

Section 2E **Faculty**

Perceptions

The Program faculty consists of Assistant Professor Auggie Gatt (retired in May, 2008) and Associate Professor Matthew Yang, a good match for the programs. Because of their education, background, and experiences, a broad range of rubber technology can be covered to train program students to be able to work on the shop floor after they are hired by the rubber companies.

Both feel the curriculum is very appropriate with regards to the program goal of developing "generalist" technologists who can be further developed along more specific lines by employers. The program courses are designed by faculty to train students how to safely operate the basic instrument and equipment commonly used in industry. Students are then taught how to apply theories to their lab work during lectures. In this way, we fulfill FSU's philosophy of hands-on learning. This will reduce students' anxiety levels when reading the "textbooks" written at the graduate level.

The mandatory internship for both AAS and BS provide students with a great opportunity to look at their career in an intimate way at an earlier stage. It is important because students will be learning by working in a different setup from the university's labs, making them more employable after graduation. Poor communication is probably why a few students complained about not having enough support and no follow-ups from the faculty. We should make it absolutely clear that the information sheet must be filled out by the students before they head off for their summer internship. More than one way of communication between students and their internship advisor should be clearly stated in the information sheet so that any questions can be answered in a timely fashion without any confusion.

Students are encouraged to participate in the Special Studies and the results are brought up to the annual national technical meeting of the Rubber Division Students' participation and presentations in front of the people from the rubber industry not only enhance their learning experience, but also strengthen the bond between the programs and the rubber industry.

To show their support of the programs from the Rubber Division, West Michigan Rubber Group (WMRG), one of the local Rubber Groups of the Division, helped to create and mentor the Ferris Student Rubber Group, the first student chapter in the Division. To help increase the program's visibility, WMRG moves one of the technical seminars and the annual banquet to Ferris. Every November, seminar participants have the chance to appreciate the state-of-the-art facility. The program students are encouraged to attend both the seminar and the banquet free of charge.

Most incoming students have the basic math and science skills to be successful in the programs. Communication skills, particularly the written one, are below average and not adequate enough for the faculty. Oral presentations using multi-media is implemented in every course, while writing reports are required for lab courses. All these practices do not seem to improve the technical presentation skills necessary for industry-acceptable levels for those graduating from the BS program.

It is the consensus among the faculty, graduates and the industry that maintaining innovation in the curriculum to remain current with industry practices is essential for the success of the programs. The Industrial Advisory Board and those experts in the industry are consulted frequently to keep the course contents up-to-date with the current practices of the industry. Some changes made to the curriculum are a result of having been proposed by the faculty and concurred with by the Advisory Board. Future curriculum changes should focus more on the basic project and people management as well as technical presentation skills. Another issue is the need of equipment maintenance, which is increasingly adding more stress each year to the only lab manager responsible for both the plastics and rubber programs' labs. New equipment acquired through consignment and procurement will become more urgent, especially if we want to keep the facility up-to-date with the current technology.

There is higher ratio in the student body of dual majors in plastics and rubber in the last few years. This seems to dilute their enthusiasm in the advanced rubber courses and also lowers their willingness to participate in professional events. The members of WMRG have expressed their frustration and have requested program students to improve their participation, especially for reimbursed professional activities.

The retirement of one of the faculty members does not help much in terms of running the programs. One faculty of the plastics programs has been recruited to teach one rubber processing course. However, the rubber program becoming a "one-person" program is somehow spread among the student body. The author concurs that "the students need some variety in teaching style to help maintain their effectiveness in learning." Extra effort needs to be undertaken by the faculty and administration to make the transition as smooth as possible. It is important, therefore, that "the faculty should continue to maintain and expand relationships with the industry to facilitate the acquisition of additional equipment and the recruitment of students," as the APRC recommended six years ago. The program faculty is fully aware that it is imperative for him to seek the advice of the Advisory Board to prioritize the goals and issues before becoming overly stressed.

Section 2F Rubber Advisory Board Survey Results

In the survey questions below an answer of (1) meant the answerer strongly *disagreed* with the question premise. An answer of (5) meant the answerer strongly *agreed* with the question premise. In the question concerning has your company hired rubber interns or graduates, (1) indicated yes and (2) indicated no.

	Avg.	Std. Dev.	# of Don't Know
How Many years have you served on the advisory board?	5	3.67	
Has your company Hired graduates or Interns from Ferris?	1.4	0.55	

0

Instructional Program Content and Quality

1 Is keeping with industry Trend and changes	3.00	0.71	0
2 Satisfies a broad range of industries (auto, furniture, household, etc.)	3.50	0.58	1
3 Education has a good balance of hands-on vs. theory	3.33	0.82	0

Instructional Equipment and Machinery

1 Is updated to reflect latest technology used in industry	2.67	0.52	0
2 Is maintained in good running condition	3.00	1.26	0
Is sufficient for the number of students enrolled (students/machine in lab, 3 number of rooms, etc.)	3.80	0.45	0
4 Meets health and safety standards	3.40	1.26	0
Is appropriately funded by the University (excluding grants and gifts from 5 industry)	2.40	0.89	1
6 Represents sound industry standards (house keeping, procedures, etc.	3.17	0.75	0

The Placement Services for this Program

1 Knows the level of need for professionals in the rubber industry	3.00	1.26	0
Is valuable to the student for finding employment and help students evaluate 2 good vs. bad positions/companies	3.60	0.89	1

		Std. Dev.	# of Don't Know
3 Shows that industry comes to FSU looking for students	3.20	1.10	1

Rubber Advisory Board Survey Results

Staff

	Avg.		
1 Is adequate in student to instructor ratio	3.00	0.63	0
2 Has sufficient opportunity to grow with industry (technology, etc.)	3.33	1.03	0

Is represented by strong leadership practices and has a voice in the University 3 operations	2.25	0.50	1

Advisory Board

1 The meeting time is well spent	3.25	**0.50|**	2

2 The input is considered/utilized	3.50	1.29	2
3 Meeting agendas are appropriate for giving direction	3.20	0.84	1
4 Meets often enough to keep program on track	2.80	1.10	1
5 Is provided adequate and proper direction to function efficiently	3.00	1.22	1

Section 2F **Analysis of Results of Ferris State Rubber Program Advisory Board Survey - 2008**

Six Advisory Board Members completed the Advisory Board Survey. Scoring for any question on the survey could range from (1) which indicated complete disagreement with the question premise to (5) which indicated complete agreement with the question premise. The accompanying summary sheet provides the average score and standard deviation for each question along with the number of no responses for each question.

Below is a listing of answers that received rating both above and below the average score of 3. A score of 3 would normally indicate that the responder was somewhat ambivalent about whether they did or did not support the question premise. However, probably only ratings greater than or equal to 3.5 or less than or equal to 2.5 should note significant support or non-support for the original question premise.

Those Questions with Average Ratings above (3)

Instructional Program Content and Quality	Score
2. Satisfies a broad range of industries (auto, furniture, household, etc.)	3.5
3. Education has a good balance of hands-on vs. theory	3.33
Instructional Equipment and Machinery	
3. Is sufficient for the number of students enrolled (students/machine in lab, number of rooms, etc.)	3.8
4. Meets health and safety standards	3.4
6. Represents sound industry standards (housekeeping, procedures, etc.)	3.17
The Placement Services for this Program	
2. Is valuable to the student for finding employment and helping students Evaluate good vs. bad positions/companies	3.6
3. Shows that industry comes to FSU looking for students	3.2
Staff	
2. Has sufficient opportunity to grow with industry (technology, etc.)	3.33
Advisory Board	
1. The meeting time is will spent	3.25
2. The input is considered/utilized	3.5
3. Meeting agendas are appropriate for giving direction	3.2

Those Questions with Average Ratings below (3)

Instructional Program Content and Quality

None

Instructional Equipment and Machinery

1.	Is updated to reflect latest technology used in industry	2.67
2.	Is appropriately funded by the university (excluding grants and gifts from industry	2.4

The Placement Services for this Program

None

Staff

1.	Is represented by strong leadership practices and has a voice in the University operations	2.25

Advisory Board

4.	Meets often enough to keep program on track	2.8

Those Questions with Average Ratings of (3)

Instructional Program Content and Quality

1. Is keeping with industry trends and changes

Instructional Equipment and Machinery

2. Is maintained in good running condition

The Placement Services for this Program

1. Knows the level of need for professionals in the rubber industry

Staff

1. Is adequate in student to instructor Ratio

Advisory Board

5. Is provide adequate and proper direction to function efficiently

Section 2F

Summary of Ferris State Advisory Board Survey for Rubber Engineering Technology Program

The results of the Advisory Board Survey indicated that the Advisory Board thought there were some good aspects of the program and some areas that they were not quite so happy about. Two of the items which got the lowest ratings were: (1) Lab equipment being fully up-to-date and being fully functional for use at class time, and (2) Adequate support being provided by University staff for recruiting students and supporting the Rubber Engineering Technology Program. In regards to the 1st statement, several students have complained about sometimes having difficulties in starting up equipment when they needed it at class time.

The Advisory Board has been somewhat disappointed that more effort has not been made to recruit students and produce a recruitment video or other training materials that individuals from the rubber industry could use to help to recruit students to the program. There has been quite a bit of interest expressed by this board and the local West Michigan Rubber Group to work with high schools, in their local areas, if such material were available. Recruitment to the program may not only a University problem, but may also be a result of the rubber industry not being highly visible to the general public. A discussion in the April 25,2008 Advisory Board meeting concerned using examples of how rubber products are used in our life to help attract future students. Video clips showing how rubber products are used could be very useful.

The Advisory Board has also discussed the need for their being more than one professor teaching the Rubber Technology classes. The students need some variety in teaching styles to help maintain the student's effectiveness in learning. Students have also provided this type of comment to the Advisory Board.

The Advisory Board has discussed at some length what they want if they hire students from the Rubber Engineering Technology program. A summary of these wants are as follows:

1. Understand how rubber machinery works and know how to resolve machinery problems associated with the production of parts
2. Understand basic rubber compounding and mixing and know how to trouble shoot recipe and mixing problems
3. Have good rubber testing skills and the ability to interpret and apply the results of the testing
4. Have basic project and people management skills
5. Have technical presentation skills
6. Have basic part design skills

A real value of the Rubber Engineering Technology Program to the rubber industry is to provide well trained students that will help keep the USA rubber industry fully competitive in the world economy.

Jim Manore
Advisory Board Member

Section 3A

Profile of Students

As reported through the FSU Productivity Report, Fall 2002 - Winter 2007, the profile of the Rubber Program students is shown as follows:

By Gender —

	AAS Degree		BS Degree	
Year	Male	Female	Male	Female
2003	85%	15%	95%	5%
2004	95%	5%	89%	11%
2005	83%	17%	86%	14%
2006	90%	10%	100%	0
2007	100%	0	100%	0

By Ethnicity —

	AAS Degree				BS Degree			
Year	White	Black	Hispanic	Other	Whit	Black	Hispanic	Other
2003	85%	5%	10%	0	72%	17%	0	11% unknown
2004	78%	12%	5%	5% unknown	78%	11%	11%	0
2005	67%	8%	8%	7% foreign/unk	**180%**	20%	0	0
2006	80%	0	10%	10% unknown	67%	0	12%	12% Indian
2007	92%	0	8%	0	50%	0	25%	25% Indian

By Full/Part Time —

	AAS Degree		BS Degree	
Year	Full	Part	Full	Part
2003	100%	0	84%	0
2004	89%	11%	89%	11%
2005	92%	8%	100%	0
2006	90%	10%	100%	0
2007	100%	0	100%	0

Ferris State University
APR 03-07 Enrollment by Sex and Ethnicity

TE
Pre-Rubber Technology
AAS

		Gender						Ethnicity			Full/Part Time	
Term	Enrolled	Male	Female	Unknown	Black	Hispanic	Indian/Alaskan	Asian/Pac Islander	White	Foreign	Full Time	Part Time
200308	2	2	0	0	0	0	0	0	2	0	2	0
200408	1	1	0	0	0	0	0	0	1	0	1	0
200708	1	1	0	0	0	0	0	0	1	0	1	0

Ferris State University
APR 03-07 Enrollment by Sex and Ethnicity

TE
Rubbe Technology
AAS

		Gender						Ethnicity			Full/Part Time	
Term	Enrolled	Male	Female	Unknown	Black	Hispanic c	Indian/Alaskan	Asian/Pac Islander	White	Foreign n	Full Time	Part Time
200308	18	15	3	0	1	2	0	0	15	0	18	0
200408	18	17	1	1	2	1	0	0	13	1	16	2
200508	12	10	2	1	1	1	0	0	8	1	11	1
200608	10	g	1	1	0	1	0	0	8	0	9	1
200708	12	12	0	0	0	1	0	0	11	0	12	0

Ferris State University
APR 03-07 Enrollment by Sex and Ethnicity

TE
Pre-Rubber Engineering Technology
BS

Gender

Ethnicity

Full/Part Time

Term	Enrolled	Male	Female	Unknown	Black	Hispanic	Indian/Alaskan	Asian/Pac Islander	White	Foreign	Full Time	Part Time
200308			0	2	0	5	0					
200408			0	1	0	3	0					
200508			0	2	0	2	1					
200608			0	1	0	1	"1					

Ferris State University
APR 03-07 Enrollment by Sex and Ethnicity

TE
Rubber Engineering Technology
BS

Gender

Ethnicity

Full/Part Time

							Hispanic		Indian/Alaskan	Asian/Pac Islander	White	Foreign	Full Time	Part Time
Term	Enrolled	Male	Female	Unknown	I			Black	Hispanic					
200308	14	13	1	2	1		0		0	0	11	0	11	3
200408	6	5	1	0	0		0		0	0	6	0	5	1
200508	4	3	1	0	0		0		0	0	4	0	4	0
200608	4	4	0	1	0		0		0	0	3	0	4	0
200708	4	4	0	0	0		1		1	0	2	0	4	0

Ferris Stc^e University
APR Graduated 2002-03 Through 2006-07
Average GPA and ACT

TE
Rubber Technology

AAS

	FSU GPA			ACT		
Year	Average GPA	Min. GPA	Max. GPA	Average ACT	Min. ACT	Max. ACT
2002-2003	3.02	2.101	4.000	21.91	15	27
2003-2004	2.82	2.031	3.397	18.43	15	21
2004-2005	3.12	2.150	3.716	20.40	13	27
2005-2006	2.98	2.675	3.288	22.67	18	26
2006-2007	3.12	2.260	3.779	20.00	16	23

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Ferris State University
APR Graduated 2002-03 Through 2006-07
Average GPA and ACT

TE
Rubber Engineering Technology
BS

	FSU GPA			ACT		
Year	Average GPA	Min. GPA	Max. GPA	Average ACT	Min. ACT	Max. ACT
2002-2003	3.10	2.731	3.317	20.50	16	23
2003-2004	3.22	2.590	4.000	23.63	19	27
2004-2005	3.08	2.828	3.458	19.33	15	22
2005-2006	2.83	2.533	3.248	21.50	15	27
2006-2007	3.77	3.710	3.830	20.50	20	21

Ferris State University
APR Graduated 2002-03 Through 2006-07
Average GPA and ACT

TE
Rubber Technology

AAS

	FSU GPA			ACT		
Year	Average GPA	Min. GPA	Max. GPA	Average ACT	Min. ACT	Max. ACT
2002-2003	3.02	2.101	4.000	21.91	15	27
2003-2004	2.82	2.031	3.397	18.43	15	21
2004-2005	3.12	2.150	3.716	20.40	13	27
2005-2006	2.98	2.675	3.288	22.67	18	26
2006-2007	3.12	2.260	3.779	20.00	16	23

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Ferris State University
APR Graduated 2002-03 Through 2006-07
Average GPA and ACT

TE
Rubber Engineering Technology
BS

	FSU GPA			ACT		
Year	Average GPA	Min. GPA	Max. GPA	Average ACT	Min. ACT	Max. ACT
2002-2003	3.10	2.731	3.317	20.50	16	23
2003-2004	3.22	2.590	4.000	23.63	19	27
2004-2005	3.08	2.828	3.458	19.33	15	22
2005-2006	2.83	2.533	3.248	21.50	15	27
2006-2007	3.77	3.710	3.830	20.50	20	21

DO CD

Ferris State University
APR 03-07 Enrollment by Residency, Age, FSU GPA, and ACT

TE

Pre-Rubber Technology AAS

	Residency				Age	FSU GPA			ACT		
Term	**Blank**	**Resident**	**Midwest Compact**	**Non-Resident**	**Avg. Age**	**Avg. GPA**	**Min. GPA**	**Max. GPA**	**Avg. ACT**	Min. **ACT**	Max. **ACT**
200308	0	1	1	0	25	2.24	2.240	2.240	19.00	18	20
200408	0	1	0	0	23	2.00	2.000 0	2.000	19.00	19	19
200708	0	1	0	0	18	.00		0'	18.00	18	18

Ferris State University
APR 03-07 Enrollment by Residency, Age, FSU GPA, and ACT

co **TE**

Pre-Rubber Engineering Technology BS

	Residency				Age	FSU GPA			ACT		
Term	Blank	Resident	Midwest Compact	Non-Resident	Avg. Age	Avg. **GPA**	Min. GPA	**Max. GPA**	**Avg. ACT**	**Min. ACT**	**Max. ACT**
200308	0	4	1	0	28	2.31	1.979	2.782	17.60	15	21
200408	0	3	0	0	29	2.34	2.150	2.675	15.33	13	18
200508	0	3	0	0	31	2.75	2.172	3.196	16.33	15	18
200608	0	2	0	0	30	2.62	1.950	3.290	16.00	**16**	16

Section 3A **Profile of Students**

— Summary

Program students are mostly in-state, full-time and attend classes during the day. Every year, starting from 2000, we saw one or two non-traditional students (those who are older than the average high school graduates in their classes) enrolled in the programs. They have been employed for a few years before coming back to finish their college educations and earn their BS degree. They achieved a higher GPA probably because they knew what they were goal oriented and were able to prioritize and focus on their tasks better. Typically, they were eager to learn new subjects and did not hesitate to ask questions nor mind working on extra assignments.

They would volunteer for the positions in the Ferris Student Rubber Group and actively participate in the professional events to interact with the people in the industry. As the result of all these factors, 4 out 6 Ferris recipients of ACS Undergraduate Scholarship were non-traditional students. Two other Ferris recipients enrolled in the programs right after high school graduation and shared the same traits as the non-traditional students. From 2002 to 2006, there was at least one winner from Ferris rubber programs. Two scholarships were awarded to Ferris non-traditional students each year in 2002 and 2003.

For years 2007 and 2008, none of the program students appeared on the recipient list of ACS Scholarship, perhaps the result of poor participation in professional events, lack of volunteering, more competition from other universities, or a combination of all the factors mentioned above. Meanwhile, programs saw a higher ratio of dual majors enrolled during the same period of time. "Plastics students that are taking rubber classes often do not have the same level of interest in the more advanced rubber classes and they have a tendency to hinder the teamwork during lab times," as commented by the students during the Interaction Meeting with the Advisory Board in 2008.

Section 3B

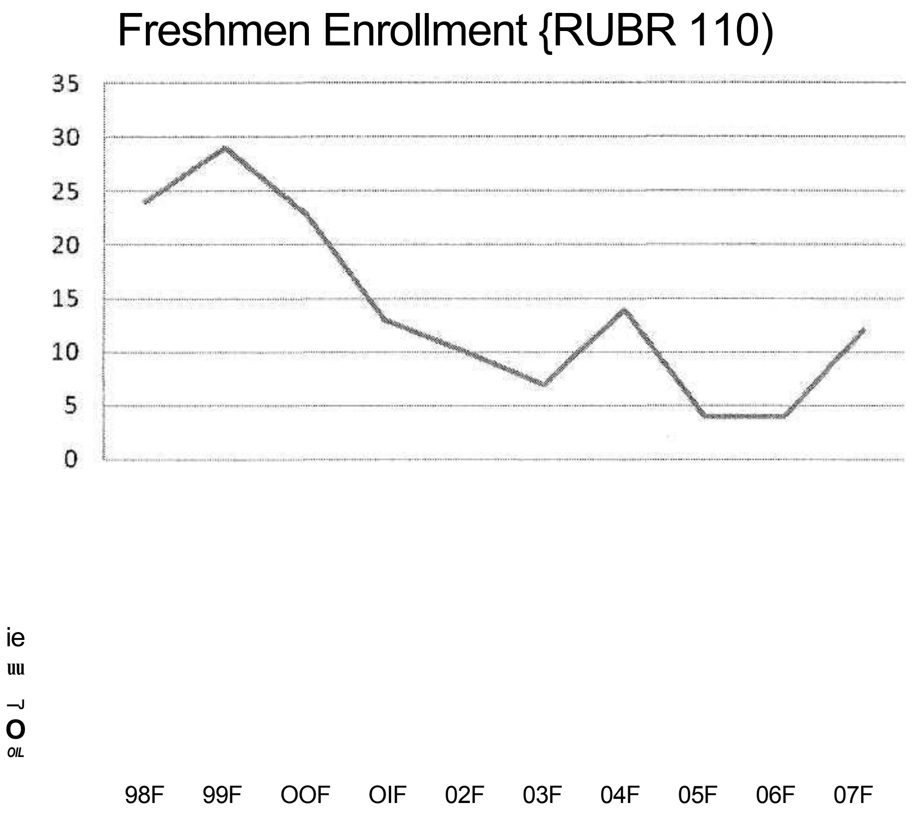
RUBBER TECHNOLOGY, RUBBER ENGINEERING TECHNOLOGY - ENROLLMENT TRENDS

The programs enrollment has increased in 2007/08, 50% increase enrollment of the prior year. Incoming freshmen enrollment has averaged 8 new students per year for the past five years, last year there were 12 new students. See the following graph "Freshmen" enrollment (RUBR 110). Program capacity is currently targeted at 24 new students; any additional number would require an additional FTE to cover. In addition to an increase in freshmen enrollment, the Rubber program has lost a faculty to retirement. This puts a significant burden on the remaining faculty by forcing him to teach all the major courses. This has been alleviated by cross training a plastics faculty to cover a course.

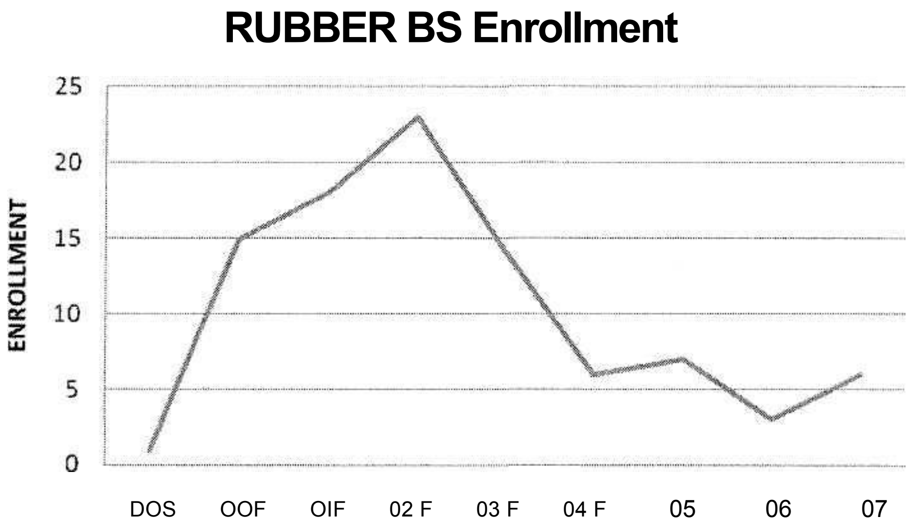
The department believes this reduction in enrollment stems from a poor "manufacturing" image in Michigan. The Automotive economy has been eroding since the late 1990's and many Michiganders perceive that the manufacturing is being exported overseas.

Additionally, nationwide, there is a decrease in enrollment in "manufacturing" oriented programs.

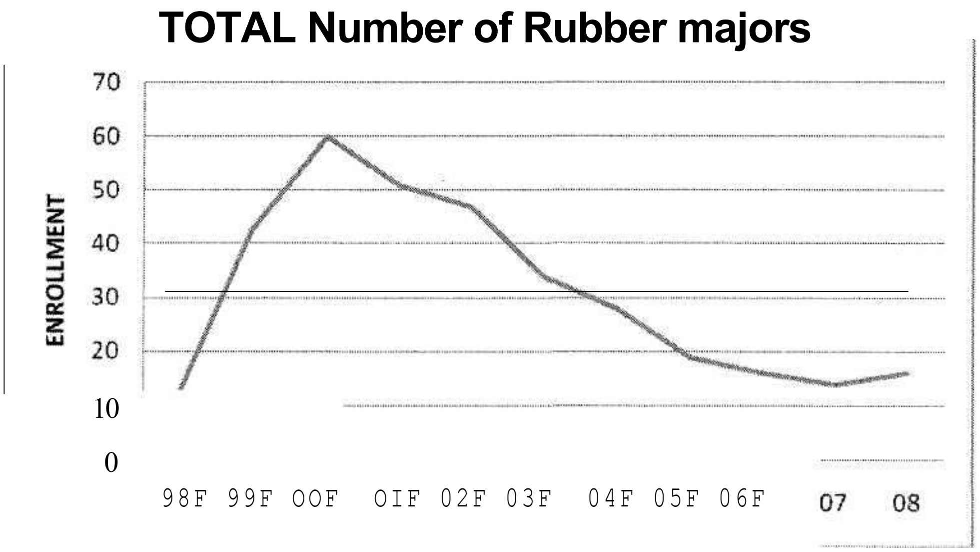
Stability has been achieved by improved recruiting efforts by departmental faculty in conjunction with industry and alumni efforts. The department hosts at least 2 "Plastics and Rubber Career days", where high schools are invited to tour the programs in the department and enjoy a lunch at Westview dining hall. This travel is funded by the department S&E and has started to yield new students. In 2007, 10 freshmen indicated that they attended a Career Day, which swayed their major choice.



~~The Rubber program enrollment in the upper level (BS) is very low. Last year's cl~~ass had 5 seniors in it and this year there is only one true Rubber major and 3 double majors. Most of the current Rubber BS students are double majors (Plastics and Rubber). The reported data is somewhat of a false indicator for the true Rubber enrollment of the 6 students counted, there are only 2 that are Rubber only majors - the remainder are double majors.



The positive is the Rubber program enrollment has stabilized; the negative is there are about 18 majors in the entire curriculum which includes those students who are also pursuing a plastics degree. There is a concerted recruiting effort necessary to increase enrollment and retain those who enroll.



STUDENTS/ENROLLMENT

ENROLLMENT BY PROGRAM
FALL SEMESTER

COLLEGE	**2003/04**	**2004/05**	**2005/06**	**2006/07**	**2007/08**
TECHNOLOGY					
MANUFACTURING Cont.					
OFF-CAMPUS					
Manufacturing Engineering Technology	62	59	56	44	3
Manufacturing Tooling Technology	0	0	0	1	1
Quality Engineering Technology	16	13	11	13	1
Quality Technology BS	0	0	0	1	2
Quality Technology Certificate	1	2	3	1	1
Off-Campus Total	79	74	70	60	5
DEPARTMENT TOTAL	**179**	**163**	**162**	**148**	**140**
MECHANICAL DESIGN					
CAD Drafting & Tool Design Technology Pre-CAD	86	70	72	60	51
Drafting & Tool Design Technology Mechanical	0	2	1	0	0
Engineering Technology - BS Mechanical Engineering	24	37	36	30	28
Technology - AAS Pre-Mechanical Engineering	8	79	62	54	57
Technology - BS Pre-Mechanical Engineering	2	8	7	5	6
Technology - AAS Pre-Product Design Engineering	7	4	5	4	5
Technology , Product Design Engineering Technology	5	7	1	3	6
On-Campus Total	46	32	36	28	25
	251	239	220	184	17 8
OFF-CAMPUS					
Mechanical Engineering Technology Product Design	0	0	0	1	0
Engineering Technology **Off-Campus Total**					
	38	36	25	16	27
DEPARTMENT TOTAL	38	36	25	17	27
	289	275	245	201	20 5
PLASTICS & RUBBER ENGINEERING TECH					
Plastics Engineering Technology Plastics Technology					
Pre-PlastjcsEngineering Technology Pre-Plastics	74	66	42	45	51
Technology Pre-Rubber Technology Pre-Rubber					
Engineering Technology Rubber Engineering	77	63	81	65	56
Technology Rubber Technology **On-Campus Total**	19	12	7	3	5
	4	2	4	4	8
OFF-CAMPUS Plastics Technology **Off-Campus Total**	2	1	0	0	1
	5	3	3	2	0
DEPARTMENT TOTAL	14	6	4	4	4
	18	18	12	10	12
	213	171	153	133	13 7
	0	0	0	1	1
	0	0	0	1	1

STUDENTS/ENROLLMENT

ENROLLMENT BY PROGRAM
FALL SEMESTER

COLLEGE •	2003/04	2004/05	2005/06	2006/07	2007/08
TECHNOLOGY					
MANUFACTURING Cont.					
OFF-CAMPUS					
Manufacturing Engineering Technology	62	59	56	44	3
Manufacturing Tooling Technology	0	0	0	1	1
Quality Engineering Technology	16	13	11	13	1
Quality Technology BS	0	0	0	1	2
Quality Technology Certificate	1	2	3	1	1
Off-Campus Total	79	74	70	60	5
DEPARTMENT TOTAL	179	163	162	148	140
MECHANICAL DESIGN					
CAD Drafting & Tool Design Technology Pre-CAD	86	70	72	60	51
Drafting & Tool Design Technology Mechanical	0	2	1	0	0
Engineering Technology - BS Mechanical Engineering	24	37	36	30	28
Technology - AAS Pre-Mechanical Engineering	8	79	62	54	5
Technology - BS Pre-Mechanical Engineering	2	8	7	5	6
Technology - AAS Pre-Product Design Engineering	7	4	5	4	5
Technology . Product Design Engineering Technology	5	7	1	3	6
On-Campus Total	46	32	36	28	25
	251	239	220	184	178
OFF-CAMPUS					
Mechanical Engineering Technology Product Design	0	0	0	1	0
Engineering Technology **Off-Campus Total**					
	38	36	25	16	27
DEPARTMENT TOTAL	38	36	25	17	27
PLASTICS & RUBBER ENGINEERING TECH	289	275	245	201	205
Plastics Engineering Technology Plastics Technology					
Pre-Plastjcs Engineering Technolpgy Pre-Plastics	74	66	42	45	51
Technology Pre-Rubber Technology Pre-Rubber					
Engineering Technology Rubber Engineering	77	63	81	65	56
Technology Rubber Technology **On-Campus Total**	19	12	7	3	5
	4	2	4	4	8
OFF-CAMPUS Plastics Technology **Off-Campus Total**	2	1	0	0	1
	5	3	3	2	0
DEPARTMENT TOTAL	14	6	4	4	4
	18	18	12	10	12
	213	171	153	133	137
	0	0	0	1	1
	0	0	0	1	1

Ferris State University Administrative Program Review 2007 Enrollment (Headcounts)

TE
Pre-Rubber Engineering Technology
BS

Enrollment (Headcounts) - On, Off, and Total

Term	Fresh On	Fresh Off	Fresh Tot	Soph On	Soph Off	Soph Tot	Junior On	Junior Off	Junior Tot	Senior On	Senior Off	Senior Tot	1st Prof On	1st Prof Off	1st Prof Tot	Mast On	Mast Off	Mast Tot
200308	0	0	0	0	0	0	2	0	2	3	0	3	0	0	0	0	0	0
200408	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0
200508	0	0	0	0	0	0	1	0	1	2	0	2	0	0	0	0	0	0
200608	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0

&, Ferris State University ^{00} Administrative Program Review 2007 Enrollment (Headcounts)

TE
Rubber Engineering Technology
BS

Enrollment (Headcounts) - On, Off, and Total

Term	Fresh On	Fresh Off	Fresh Tot	Soph On	Soph Off	Soph Tot	Junior On	Junior Off	Junior Tot	Senior On	Senior Off	Senior Tot	1st Prof On	1st Prof Off	1st Prof Tot	Mast On	Mast Off	Mast Tot
200308	0	0	0	0	0	0	1	0	1	13	0	13	0	0	0	0	0	0
200408	0	0	0	0	0	0	0	0	0	6	0	6	0	0	0	0	0	0
200508	0	0	0	0	0	0	1	0	1	3	0	3	0	0	0	0	0	0
200608	0	0	0	0	0	0	1	0	1	3	0	3	0	0	0	0	0	0
200708	0	0	0	0	0	0	0	0	0	4	0	4	0	0	0	0	0	0

Ferris State University Administrative Program Review 2007 Enrollment (Headcounts)

TE
Pre-Rubber Technology
AAS

Enrollment (Headcounts) - On, Off, and Total

Term	Fresh On	Fresh Off	Fresh Tot	Soph On	Soph Off	Soph Tot	Junior On	Junior Off	Junior Tot	Senior On	Senior Off	Senior Tot	1st Prof On	1st Prof Off	1st Prof Tot	Mast On	Mast Off	Mast Tot
200308	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200408	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200708	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ferris State University Administrative Program Review 2007 Enrollment (Headcounts)

TE
Rubber Technology
AAS

Enrollment (Headcounts) - On, Off, and Total

Term	Fresh On	Fresh Off	Fresh Tot	Soph On	Soph Off	Soph Tot	Junior On	Junior Off.	Junior Tot	Senior On	Senior Off	Senior Tot	1st Prof On	1st Prof Off	1st Prof Tot	Mast On	Mast Off	Mast Tot
200308	2	0	2	3	0	3	7	0	7	6	0	6	0	0	0	0	0	0
200408	6	0	6	6	0	6	5	0	5	1	0	1	0	0	0	0	0	0
200508	2	0	2	5	0	5	4	0	4	1	0	1	0	0	0	0	0	0
200608	1	0	1	1	0	1	2	0	2	6	0	6	0	0	0	0	0	0
200708	4	0	4	3	0	3	2	0	2	3	0	3	0	0	0	0	0	0

Section 3C

Program Capacity

All the programs' core courses are designed based on the principle of learning-by-doing. Students apply what they have learned during lecture while in the labs. After the lab activities, they are asked to explain their observations. The amount of lab equipment, therefore, becomes the limiting factor to the class size.

In addition, the faculty also has to assess the students' safety depending on the type of equipment and the nature of the process for class. Ferris rubber programs, in one sense, benefit from the regulations of the Occupational Safety and Health Administration (OSHA) that make it impractical for the rubber companies to train their newly hired in house. The unique nature of rubber processing requires a need to touch the moving parts of the machine as well as working in a high temperature environment. In this regard, the lab capacity of rubber programs is limited to 12 students for any processing classes that involve rubber mixing. The number of students in the lecture courses doubles the lab section size.

The initial setup for the rubber programs was to recruit approximately twenty-four freshmen each year with two full time faculty members. In a later labor market analysis completed in September 2002, based on the demands and uses for rubber products and the retiring rate of the experienced employees, the RMA predicted the demand for Ferris graduates would be either good or excellent through 2007. The program capacity, however, should be adjusted to roughly twelve freshmen each year during the transition period with one full time rubber program faculty member and one plastics program faculty member who will start teaching a processing course in fall 2008.

Section 3D

Retention and Graduation of Students

The department has continually exceeded the University average for graduation by almost 50% and College of Technology's graduation average by almost 15%. The department had averaged just under a 60% graduation rate (University averages just over 40%, COT is 51%). This is an indication of the level and quality of teaching the department faculty have demonstrated. This also indicates the relationships developed between the faculty and the department's students, the faculty have been encouraged to work with the student outside of the class room in order to develop a stronger bond as part of our retention efforts.

Within the Rubber degree program the retention is lower than the department average. Although this data is not specifically reported by Ferris, intuition tells us, if 8 freshmen start the program and only 3 earn their BS, this is a 60% loss. The faculty need to work to retain those who have started in the program.

Another significant indication of the work the faculty are doing is the percentage of persisters in the department. The Plastics and Rubber department has over 75% persisters after 4 years and 69% after 7 years. This persistence is significantly higher than the University and the College. The University numbers are 40% lower after 4 years and 37% lower after 7 years. Similarly, the department number is favorable when compared to the College persistence numbers, 31% higher after 4 years and 24% after seven.

Generally, in terms of department performance, the Plastics and Rubber department graduates a higher percent of its students then either the College or the University. Also, when "persister" performance is reviewed the Plastics and Rubber department keeps more of its enrolled students on campus. This is an indication of a committed faculty and students who understand the value of the specific education they are receiving.

PLRU retention 2 & 4 yr degrees				**PLRU Retention 2 yr.**		
2001	% **Graduation (7yrs)**	*Persisters (4yrs)*	*Persisters (7yrs)*	**% Graduation (7yrs)**	*Persisters (4yrs)*	*Persisters (7yrs)*
	75	82	**82**	**75**	**82**	**82**
2002	**64**	76	**64**	**64**	**72**	**64**
2003	**60**	68	**60**	**60**	**68**	**60**
2004	**38**	75		**35**	**74**	
2005	**10**	71		**27**	**73**	
2006	**0**	85		**0**	**83**	
Dept Avg.*		**76.2**				
COT	**59.25**		**68.7 52**	**58.5**	**75.3**	**68.7 52**
Avg.*		**52.25**	**42.75**			**42.75**
University	**50.75**			**50.75**	**52.25**	
*		**45.25**				

Based on entering students from 2001 - 2004

Future of the program

We continually survey our freshmen class to gain a handle on how they arrived in our department. The results indicate that over 80% of them were somehow sent here, by a neighbor, alumni, a person currently in the industry, a person at church, or a teacher. In addition, between 5 and 10 of the incoming freshmen indicated that they attended a "Plastics and Rubber Career day" sponsored by the department.

Challenges

The University needs to "get the word" out to the school districts that the plastics industry is still vital in the region. Contrary to the media's gloom and doom reporting there are still career opportunities for "Rubber" people regionally, nationally and internationally. Virtually 100% placement and reported starting salaries exceeding $55,000/yr.

Additionally, the department and University have to work to gain more local notoriety for the program by getting information items published in local papers, contribute to newspaper articles and increase our presence in the public forums. Also, the University should develop a marketing plan focused specifically on the COT programs in order to attract capable, interested students

DEGREES CONFERRED BY PROGRAM

ACADEMIC YEAR (SUMMER, FALL, WINTER SEMESTERS)

	CERT	AS	BS	MS	CERT	AS	SS	MS	2308^7			
WCHHQLVm									OERT	AS	*m*	*MS*
MANUFACTURING ENGINEERING												
Industrial Practices									1			
Manufacturing Engineering Technology			24				**23**				21	
Manufacturing Tooling Technology		17				**17**				11		
Quality Engineering Technology			2				**3**				1	
Quality Technology	13				**20**				23			
TOTAL	**13**	**17**	**26**	**0**	**20**	**17**	**26**	**0**	**24**	**11**	**22**	**0**
MECHANICAL DESIGN												
CAD Drafting & Tool Design Tecnology		21				21				14		
Mechanical Engineering Technology		17	16			31	**18**			21	25	
Product Design Engineering Technology			23				32				23	
TOTAL	**0**	**38**	**39**	**0**	**0**	**52**	**50**	**0**	**0**	**35**	**48**	**0**
PLASTICS & RUBBER ENG TECHNOLOGY												
Plastics Engineering Technology			**45**				**32**				**22**	
Plastics Technology		**32**				**25**				**29**		
Rubber Engineering Technology			**5**				**8**				**4**	
Rubber Technology		**7**				**3**				**6**		
TOTAL	**0**	**39**	**50**	**0**	**0**	**28**	**40**	**0**	**0**	**35**	**26**	**0**
PRINTING & IMAGING TECHNOLOGY MGMT												
New Media Printing & Publishing			6				6				10	
Printing & Digital Graphic Imaging		17				25				15		
Printing Management			12				12				16	
TOTAL	**0**	**17**	**18**	**0**	**0**	**25**	**18**	**0**	**0**	**15**	**26**	**0**
SURVEYING ENGINEERING												
Geographic Information	**7**				8				**4**			
Surveying Engineering			19				20				**17**	
Surveying Technology		**8**				17				**13**		
TOTAL	**7**	**8**	**19**	**0**	**8**	**17**	**20**	**0**	**4**	**13**	**17**	**0**
WELDING ENGINEERING TECHNOLOGY												
Welding Engineering Technology			**24**				33				28	
Welding Technology		30				24				24		
TOTAL	**0**	**30**	**24**	**0**	**0**	**24**	**33**	**0**	**0**	**24**	**28**	**0**

COLLEGE TOTAL **65 J352J345[0 | j 104 |403J382J *0* ["j 110 J38Q|386I 0**

Source: Office of Institutional Research and Testing

Ferris State University Administrative
Program Review 2007 Graduates

TE
Rubber Technology
AAS

Graduate Headcount

Academic Year	On Campus	Off Campus	Total
2002-2003	21	0	21
2003-2004	11	0	11
2004-2005	7	0	7
2005-2006	3	0	3
2006-2007	6	0	6

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Ferris State University Administrative
Program Review 2007 Graduates

TE
Rubber Engineering Technology

BS

Graduate Headcount Academic Year

	On Campus	Off Campus	Total
2002-2003	9	0	9
2003-2004		0	15
2004-2005	15	0	5
2005-2006	5	0	8
2006-2007	8	0	4
	4		

Ferris State University

Retention and Graduation Rates ofFuli-Time FTIAC Students - By Major

Two-Year Degree Programs

Fall Term

Entering Fall	Major	*N*		Year 2	Year 3	Year 4	Year 5	Year 6	Yea
200608	RFIM	6							
			% Graduated By	0					
			% Still Enrolled In	50					
			% Persisters	50					
			% Non-Persisters	50					

Entering Fall Term	Major	*N*		Year 2	Year 3	Year 4	Year 5	Year 6	Yea
199808	RUBT	8							
			% Graduated By	0	13	13	50	50	50
			% Still Enrolled In	75	37	37	0	0	0
			% Persisters	75	50	50	50	50	50
			% Non-Persisters	25	50	50	50	50	50
199908	RUBT	17							
			% Graduated By	0	6	18	35	65	65
			% Still Enrolled In	76	65	53	30	6	0
			% Persisters	76	71	71	65	71	65
			% Non-Persisters	24	29	29	35	29	35
200008	RUBT	13							
			% Graduated By	0	8	31	38	54	54
			% Still Enrolled In	62	46	23	16	0	0
			% Persisters	62	54	54	54	54	54
			% Non-Persisters	38	46	46	46	46	46
200108	RUBT	3							
			% Graduated By	0	33	67	67	67	67
			% Still Enrolled In	100	67	33	33	33	33
			% Persisters	100	100	100	100	100	100
			% Non-Persisters	0	0	0	0	0	0
200208	RUBT	1							
			% Graduated By	0	100	100	100	100	
			% Still Enrolled In	100	0	0	0	0	
			% Persisters	100	100	100	100	100	
			% Non-Persisters	0	0	0	0	0	
200308	RU6T	1							
			% Graduated By	0	0	100	100		
			% Still Enrolled In	100	100	0	0		
			% Persisters	100	100	too	100		
			% Non-Persisters	0	0	0	0		

Ferris State University

Retention and Graduation Rates ofFuil-Time FTIAC Students - By Major

Two-Year Degree Programs

Entering Fall Term	Major	*N*		Fall Term Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
200408	RUBT		% Graduated By	0	25	25			
			% Still Enrolled In	75	75	50			
			% Persisters	75	100	75			
			% Non-Persisters	25	0	25			
200508	RUBT		% Graduated By	0	0				
			% Still Enrolled In	100	100				
			% Persisters	100	100				
			% Non-Persisters	0	0				

Entering Fall Term	Major	*N 2*		Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
199708	SURT		% Graduated By	0	0	0	0		5
			% Still Enrolled In	50	50	50	50		0
			% Persisters %	50	50	50	50		0
			Non-Persisters	50	50	50	50		50
									50
						-.50 0			
								50	
								50	
199808	SURT		% Graduated By	0	40	40	40	60	60
			% Still Enrolled In	60	20	20	20	0	0
			% Persisters	60	60	60	60	60	60
			% Non-Persisters	40	40	40	40	40	40
199908	SURT		% Graduated By	0	0	0	50	100	100
			% Still Enrolled In	100	100	100	50	0	0
			% Persisters	100	100	100	100	100	100
			% Non-Persisters	0	0	0	0	0	0
200008	SURT		% Graduated By	0	25	25	25	63	75
			% Still Enrolled In	88	63	50	50	12	0
			% Persisters	88	88	75	75	75	75
			% Non-Persisters	12	12	25	25	25	25
200103	SURT		% Graduated By	0	33	33	33	100	100
			% Still Enrolled In	100	67	67	67	0 100	0 100
			% Persisters %	100	.100	100	100	0	0
			Non-Persisters	0	0	0	0		

2005/2006 Graduate Follow-Up Survey Summary

College: Technology

	Degrees				Placement Information			
TECHNOLOGY	CERT	AS	BS	TOTAL	# Responded	% Response	Placement Rate	Ave Salary
ARCHITECTURAL TECH & FACILITIES MGMT								
Architectural Technology		17		17	11	65%	100%	$ 32,477
Facilities Management	1		12	13	6	46%	100%	$ 32,916
AUTOMOTIVE								
Automotive Body		14		14	10	71%	100%	$ 37,409
Automotive Engineering Technology			28	28	15	54%	100%	$ 36,211
Automotive Service Technology		83		83	56	67%	98%	$ 39.608
Performance Machining	23			23	5	22%	100%	$ 37,930
Performance Motorsports	31			31	6	19%	100%	$ 35,469
CONSTRUCTION TECHNOLOGY & MGMT								
Building Construction Technology		43		43	25	58%	100%	$ 37.334
Civil Engineering Technology		14		14	5	36%	100%	$ 36,678
Construction Administration	18			18	4	22%	100%	$ 42,933
Construction Management			61	61	26	43%	96%	$ 59,601
ELECTRONICS/CNS								
Computer Networks & Systems			10	10	4	40%	100%	$ 39.315
Electrical Power Generation	3			3	1	33%	NA	NA
Electrical/Electronics Engineering			7	7	4	57%	100%	$ 34,516
Industrial Electronics Technology		15		15	7	47%	100%	$ 37,064
HEAVY EQUIPMENT								
Automotive & Heavy Equip Mgmt			31	31	16	52%	100%	$ 36,994
Heavy Equipment Service Engr Tech			11	11	6	55%	100%	$ 54,648
Heavy Equipment Technology		23		23	16	70%	100%	$ 39,007
HVACR								
HVACR Engineering Technology			35	35	27	77%	100%	$ 53,930
HVACR Technology		31		31	25	81%	100%	$ 42,876
MANUFACTURING ENGINEERING								
Manufacturing Engineering Technology			23	23	13	57%	100%	$ 61,802
Manufacturing Tooling Technology		17		17	9	53%	100%	$ 39,071
Quality Engineering Technology			3	3	2	67%	100%	NA
Quality Technology	20			20	4	20%	100%	$ 38,954
MECHANICAL DESIGN								
CAD Drafting & Tool Design Technology		21		21	15	71%	100%	$ 39,244
Mechanical Engineering Technology		31	18	49	27	55%	100%	$ 40.970
Product Design Engineering Technology			32	32	13	41%	100%	$ 61,379
PLASTICS & RUBBER ENG TECHNOLOGY								
Plastics Engineering Technology			32	32	17	53%	100%	$ 56,900
Plastics Technology		25		25	18	72%	100%	$ 51,633
Rubber Engineering Technology			8	8	4	50%	100%	$ 58.759
Rubber Technology		3		3	2	67%	100%	$ 46,908
PRINTING & IMAGING TECHNOLOGY MGMT								
New Media Printing & Publishing			6	6	3	50%	100%	$ 40.880
Printing & Digital Graphic Imaging		25		25	14	56%	100%	$ 39.738
Printing Management			12	12	6	50%	100%	$ 43,227
SURVEYING ENGINEERING								
Geographic Information	8			8	2	25%	100%	NA
Surveying Engineering			20	20	14	70%	100%	$ 44,093
Surveying Technology		17		17	11	65%	91%	$ 39.802
WELDING ENGINEERING TECHNOLOGY								
Welding Engineering Technology			33	33	28	85%	100%	$ 59,630
Welding Technology		24		24	15	63%	100%	$ 53,874
Technology TOTAL	**104**	**403**	**382**	**889**	**492**	**55%**	**99%**	**Not calculated**

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Section 3E

Program Access

There has been a variety of training developed by the RMA and ACS Rubber Division in order to ease the shortage of skilled technologists for the rubber industry: CD based self-study courses, short courses in the lecture room setup, or correspondence courses of different levels. None of these met the demands of the RMA members until hands-on training at Ferris was identified to be the most effective way of learning and the NEC was constructed at FSU's Big Rapids' campus.

The essence of a hands-on education for the Ferris rubber programs is to teach students in a lab setting much like a rubber production plant. This kind of university level education would exclude the possibility to teach core courses at other sites or on-line. In fact, FSU is still the only institution that offers AAS and BS in Rubber Technology / Engineering Technology.

The advancement of graphic design and computer simulation may allow us to modify some of the program courses to be taught on-line with the following additional requirements:

- Attending intensive lab training at the NEC for 90 hours to earn the credits for some of the core rubber courses.
- Fulfilling mandatory 400 hours internship(s) similar to the current AAS and BS requirements

It can be done by a team with the right combination of talents and enough resources. Who would be in charge of marketing???

Section 3F **Rubber Programs**
Curriculum

The Rubber Programs are defined as a 2 + 2 progression. Students apply for entry into Rubber Technology which is a two-year curriculum that terminates with an Associate of Applied Science (A.A.S.) degree. The entry criteria are:

1. 2.0 GPA
2. High School Algebra and MATH ACT=19.
3. Students have to take CHEM 103 during the first semester for those without High School chemistry

Students that receive an A.A.S. degree in Rubber Technology, and meet the entrance requirements for progression, can apply for entrance in Rubber Engineering Technology program which is a two-year curriculum that terminates with a Bachelor of Science (B.S.) degree. The other entry criteria are:

1. 2.70 GPA in Rubber classes
2. 2.5 GPA in Math classes
3. 2.5 GPA overall.

When the Rubber Programs were first created, the curricula were designed parallel to the successful FSU Plastics Programs which emphasize a broad understanding of processes, design principles, engineering systems, and materials. Through several Advisory Board meetings, it was decided that the students with business and leadership training would be more desirable by the rubber industry. A physics course was also recommended to be included in the curricula. The curriculum change also includes Supervision and Leadership (MGMT 305) and Principles of Accounting (ACCT 201). These changes became effective starting from the fall semester, 2001.

Rubber Curriculum Analysis

	A.A.S. Rubber Technology (2 years, 69 credits total)	B.S. Rubber Engineering Technology (4 years, 134 credits total)
1. Rubber	29% (20 credits)	32% (43 credits)
2. English	13% (9 credits)	9% (12 credits)
3. Math	12% (8 credits)	6% (8 credits)
4. Technology	14% (10 credits)	25% (34 credits)
5. Science	19% (13 credits)	10% (13 credits)
6. Business	4% (3 credits)	4% (6 credits)

Total

99%

7. General Education	9% (6 credits)	13% (18 credits)

100%

Section 3F Rubber Program Curriculum Change — 2008

When the retirement of one rubber faculty was approved one year ago, one member of the plastics faculty was asked to help teach a rubber processing course. At about the same time, it was decided that the rubber curriculum had to undergo another change.

The first objective of the change is to facilitate a smooth transition with minimal disturbance of student learning. The second objective is to reduce the teaching load off the remaining rubber faculty.

Meanwhile, with the proposed plastics curriculum change, a degree of synergy between the plastics and rubber programs was anticipated; however, it would require too much work to find the perfect synergy due to the following reasons:

- There are too many topics already in PLTS 110 to allow any further expansion to incorporate topics, such as thermoset rubber.
- Serious mismatch in credit hours of processing courses between the two programs.
- Poor match in credit hours of two tooling and product design courses.
- Pre-requisites make it easier for the plastics majors to take rubber courses and become dual majors, within one extra year at most. It is not reciprocal for the rubber majors. Those rubber students will have to spend at least two extra years in order to become dual majors.

The member of the plastics faculty who would be helping to teach the rubber course seemed to be frustrated about the negative responses for a few suggestions he proposed in the department's curriculum meeting. The author suggested having a one-on-one meeting with him if he still wanted to help the rubber programs. The meeting time was agreed upon and is set for Monday afternoon when both of us were free.

In the end, a draft of rubber programs' check sheet was used for discussion. He agreed the next step would be to finalize the curriculum of rubber programs in August. By that time, there should be a solid plan for the 3 rubber processing courses.

Main features of the check sheet draft are listed as follows:

A. Drop the following rubber courses:
   - RUBR 110, Intro to rubber technology. 3 credit hours.
   - RUBR 212, Rubber tool design and construction, 2 credit hours.

B. Replaced by the following plastics courses:
   - PLTS 110, Intro to plastics, 3 credit hours, to replace RUBR 110.
   - PLTS 212, Plastics products and tool design I, 5 credits, to replace RUBR 212.

C. Add the following courses:
   - RUBR 100, Intro to Rubber, 1 credit hour.

- MECH 390, Solid modeling / Intro to FEA, 2 credit hours.
- RUBR 333, Rubber project #1,3 credit hours.

D. Take out one credit hour and turn them into 3 credit-hour courses for the following rubber courses:

- RUBR 211, Rubber processing 2.
- RUBR 223, Rubber materials and test
- RUBR 312, Rubber product design

Attachments:

1. Current program check sheet.
2. Proposed check sheet for fall, 2008.
3. Sample syllabi of rubber core courses.

(Curriculum proposed for Fall, 2008)

Section 3F

Rubber Technology

Associate in Applied Science

First Year - Fall Semester

		Credits
PLTS 110	Introduction to plastics	3
RUBR 100	Intro to Rubber	1
ETEC 140	Eng. Graphics	3
MATH116	Algebra & Num. Trig	4
ENGL 150	English 1	3
____________	Cultural Enrichment	3
		17

First Year - Summer Semester

Second Year - Fall Semester

RUBR 211	Rubber Processing 2 English 2	3
ENGL 250	Plast prod & tool design I Intro	3
PLTS 212	to Physics Fund. Public	5
PHYS211	Speaking	4
COMM 121		3
	66 credits	18

EEET New 4 credit course

First Year - Winter Semester

RUBR 121	Rubber Processing 1 Algebra &	3
MATH 126	Anal. Tri§ General Chemistry	4
CHEM 121	Social Awareness	5
		3
		15

RUBR 193 Rubber Technology

Internship 4 **Second Year - Winter**

Semester

RUBR 223	Rubber Materials &Test	3
EEET XXX	Electrical Fundamentals	4
CHEM 211	Fund. Org./Polymer Chem.	4
MECH 250	FLUIDPOWER	2
MGMT 305	Supervision & Leadership	3
		16

Rubber Engineering Technology

Bachelor of Science

Third Year - Fall Semester

		Credits
MECH 340	Static & Strength	4
RUBR 321	Rubber Compounding	4
ENGL 311	Adv. Technical Writing	3
MECH 390	Solid modeling /FEA	2
MFGE 3 51	Intro Industrial Ene	3
		15

Third Year - Summer Semester

Fourth Year - Fall Semester

PLTS 320 Plastics & Elastic Material 3
RUBR 411 Adv. Rubber Processing 4
RUBR 333 Rubber project # 1

2

________ Social Awareness 3
___________ Cultural Enrichment (200+) 3
15

60 Credits plus internship **With G. Conti teaches RUBR 211 in fall, 2008**

Third Year - Winter Semester **Credits**

PLTS 300 Eng. Management Sys.
RUBR 312 Rubber Design Principles
ACCT201 of Acct. Cultural Enrichment
PLRUXXX PLRU elective

16

Internship RUBR 393
4

Fourth Year - Winter Semester

Plastics Senior Seminar
PLTS 499 Intro Plant Engineering
MFGE 451 Pits Cost, Pack & Econ Is 3
PLTS 410 Statistical Quality Cont 3 Social
MFGE 353 Awareness (200+) 3
13

Associate in Applied Science in Rubber Technology
\ ; . and" . , • . . . < ' ", , Bachelor of Science in Rubber Engineering Technology
Curriculum Guide Sheet ' - >

Name.

email: | ID

Adv/sor. | Ph: | , -cot

YEAR 1 - FALL SEMESTER

RUBR	110	Introduction to Rubber
ETEC	140	Engineering Graphics
ENGL	150	English 1
MATH	116	Iuterm. Algebra & Num. Trig (ACT19 or MATH 110)

FSUS

____________ Cultural Enrichment

100 Freshman Seminar

Total Semester Credits

YEAR 1 - SPRING SEMESTER

RUBR 121 Rubber Processing 1 MFGT 150 3 2

Manufacturing Processes CHEM 121 General Chemistry 1 5 '4 3

(CHEM 103 or H/S CHEM) MATH 126 Algebra &

Analytical Trig (MATH 116) Social Awareness **11**

iTotal Semester Credits

YEAR 1 - SUMMER SEMESTER

RUBR	193	Rubber Internship	4
		Total Semester Credits , " _- - „	"4

YEAR 2 -FALL SEMESTER

RUBR	211	Rubber Processing 2
RUBR	212	Rubber Tool Design & Construction
ENGL	250	English 2 (ENGL 150)
COMM	121	Fundamentals of Public Speaking
PHYS	211	Introductory Physics 1 (MATH 116 or 120)

Total Semester CJred/ts -< , ^–

□ **Graduation Application Submitted**

YEAR 2 - SPRING SEMESTER

RUBR	223	Rubber Measurement & Testing	4
EEET	201	Electrical Fundamentals	3
MECH	250	Fluid Powers w/Controls	2
MGMT	305	Supervision and Leadership	3
CHEM	211	Fund. Organic/Polymer Chemistry (C-in CHEM 121)	4
		vTotaJ Semester"Credits ' * ' !	16,

'Prerequisites for all PLTS 300/400 classes is admittance into Rubber/Plastics Engineering Technology program.

YEAR 3 - FALL SEMESTER

PLTS	300	Plastics Engineering Mgmt Systems*	4
EEET	301	Controls of Automation (EEET 201)	3
MECH	340	Statics & Strengths of Matis (MATH 126)	4
MFGE	351	Intro Industrial Engineering	3
ENGL	311	Advanced Technical Writing (ENGL 250)	3
		Tptal-SetnpsterlCt^dits '";*"C' '-TV'-	17

YEAR 3 - SPRING SEMESTER

RUBR 312 Rubber Product Design* RUBR 4

321 Rubber Compounds* ACCT 201 4

Principles of Accounting 1 STQM 260

Continuous Improvement Tools Cultural 3

Enrichment

3

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CD Graduation Application Submitted 3

17-

YEAR 3 - SUMMER SEMESTER

RUBR 393 Rubber Internship*

Total Semester Credits

YEAR 4 - FALL SEMESTER

RUBR	411	Advanced Rubber Processing*
PLTS	320	Plastics & Elastic Materials*
		Technical Elective
	___	Cultural Enrichment (200 level or higher)
		Social Awareness

Total Semester Credits -

Q Graduation Application Submitted

YEAR 4 - SPRING SEMESTER

RUBR	499	Rubber Senior Seminar
PLTS	410	Plastics Cost, Pkug & Econ. Issues*
MFGE	353	Statistical Quality Control (MATH 115)
MFGE	451	Intro to Plant Engineering (Technology Student)
___________		Social Awareness (200 level or higher)

Total Semester Credits

Notes:

40 CREDITS OF 300 LEVEL COURSEWORK OR ABOVE ARE REQUIRED FOR GRADUATION

General Education Requirements:

> (3cr): Global Consciousness, One Course (3cr): Race/Bhnici(y/Gender(REG), One Course(3er): Foundation - Mulllple requirements may be satisfied by a single coun Cultural Enrichment - 9 credits (3 credits in course > 200 level); Social Awareness • 9 credits (3 credits in course > 200 level) Reference: http://wwvtf.rerris.edu/ntrals/academics/gened/gen_edspecificl.html

Name,":		
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ENTRY CRITERIA FOR ENTRY INTO THE ASSOCIATE DEGREE:

1. 2.0 GPA (High School or College Transfer GPA).
2. High School Algebra (or MATH 110 or equivalent) and a 19 MATH ACT subscore; MATH 116 placement. .... • - .
3. High School Chemistry [or CHEM 103.

ENTRY CRITERIA FOR ENTRY INTO THE BACHELOR DEGREE:

1. Application by March 1 prior to Fall term requrested.
2. AAS in Rubber Technology.
3. **2.70 GPA in Rubber (RUBR) classes.**
4. 2.5 GPA in MATH classes including MATH 116 and MATH 126.
5. **2.50 GPA overall.**

ASSOCIATE DEGREE REQUIREMENTS

1	- _____J!V?„joVC>uMi'S	`CT	Orade	Pts	Sent	Yesi	School	Notes * % ' - *■ , /I
RUBR	110 Introduction to Rubber	3						
RUBR	121 Rubber Processing 1	3					/	
RUBR	193 Rubber Internship	4						
RUBR	211 Rubber Processing 2	4					< , , *	
RUBR	212 Rubber Tool Design & Construction	2						
RUBR	223 Rubber Measurement & Testing	4						
			\					
EEET	201 Electrical Fundamentals	3					^ > ,	
ETEC	140 Engineering Graphics	3						
MECH	250 Fluid Powers w/Controls	2						
MFGT	150 Manufacturing Processes	2					^ V.	
MGMT	305 Supervision and Leadership	3						
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ENGL	150 English 1	3					*S"„ * a.	
ENGL	250 English 2	3					<» %	
COMM	121 Fundamentals of Public Speaking	3					-»V>'	
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CHEM	121 General Chemistry 1	5						
CHEM	211 Fund Organic/Polymer Chemistry	4						
PHYS	211 Introductory Physics 1	4						
	116							
MATH	Interm. Algebra &Num Trig	4						
MATH	126 Algebra it Analytical Trig	4						, ,4 .... ' „' . ·,
	Cultural Enrichment	3						|U Global U REG }
	Social Awareness	3	----					U Global"""U'REG"1l' U'SF ---------- 1 ....' ■ ■ - . ,

BACHELOR DEGREE REQUIREMENTS

RUBR	312 Rubber Product Design*	4					* 'i „'	
RUBR	321 Rubber Compounds*	4					-- - -	
RUBR	393 Rubber Internship*	4					v it	
RUBR	411 Advanced Rubber Processing*	4						
RUBR	499 Rubber Senior Seminar	1						
PLTS	300 Plastics Engineering Mgmt Systems*	4						
PLTS	320 Plastics &. Elastic Materials*	3						
PLTS	410 Plastics Cost, Pkng & Econ Issues*	3						
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ACCT	201 Principles of Accounting 1	3						
EEET	301 Controls of Automation	3						
MECH	340 Statics & Strengths of Mat'ls	4					·<·. ■>" ■*	
MFGE	351 Intro Industrial Engineering	3						
MFGE	353 Statistical Quality Control	3					" '\ ' < --	
MFGE	451 Intro to Plant Engineering	3					^ " " ^	
STQM	260 Continuous Improvement Tools	3					"■" " / -	
	Technical Elective V-	2						
*S *	>Commurflfatibn}t'?r"Mfa"9V • >						N^ -	
ENGL	311 Advanced Technical Writing buantitatfvgSltjjfc	3					'HO ^"^	
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100	Freshman Seminar						s j	
FSUS	Freshman Seminar	I					v s	

Unofficial Performance Stats

Major: Total Crs / Earned Crs / Honor Points	99
Degree: Total Crs / Earned Crs / Honor Pis	136
GPA Major:	
GPA Degree:	

Section 3G **Quality of Instruction**

Overall, current students feel good about the quality of instruction as indicated in the survey. This is based on the return from a student body consisting of 50% freshmen who were still taking their first rubber course. Most of the alumni made quite a few good recommendations from their perspectives. Some of those recommendations have been implemented in the rubber curriculum. A few of them seem important. We shall consult with the Advisory Board in the future.

The comments of the Advisory Board are based mainly on the "quizzes" given to the students during the Board meeting. Their findings reveal that the students present in the meeting need to better understand a few fundamentals of processing, rubber compounding, testing and part design. Students also need to improve their communication and problem solving skills.

One member of the program faculty has participated in the book club of "learning and teaching" as well as the workshop of "the inquiries into teaching and learning" and has learned some practical teaching techniques on how to turn the classroom into a friendlier learning environment. He feels it is very useful to improve the instruction by inviting Dr. Todd Stanislave to sit in the lecture room in the beginning of the semester and bring back student's feedback. This is more effective than relying upon the S AI which provides us only old information.

Program students are encouraged to conduct special studies and present their results in the Rubber Division's national technical meetings. Guest speakers of expertise in their fields are invited to give seminars regularly. As the result of active participation in the ACS Rubber Division and close interaction with the local WMRG, at least one of the program students was a winner of the prestigious ACS Scholarship every year from 2002 to 2006. Over last two years, this interaction has clearly cooled down a little bit. The author believes this is the main reason why no students from Ferris have been awarded the ACS Scholarship again.

Section 3H

Composition and Quality of Faculty

The Program faculty consisted of Assistant Professor Auggie Gatt and Associate Professor Matthew Yang, a good match for the programs over the past eight years. Because of their educations, backgrounds, and experiences a broad range of rubber technology can be covered to train program students to be able to work on the shop floor after they are hired by the rubber companies. Professor Gatt took the retirement last May.

Professor Robert Speirs has been the Department Chair since 2003.

Assistant Professor Gregory Conti, Plastics Programs since 1987, will be helping to teach the processing class, RUBR 211, next fall.

The Curriculum Vitae of each faculty member is included in this section.

Curriculum Vitae

Gregory J. Conti
320 Tomahawk Lane
Reed City, MI 49677
(231) 832-3813 - Home Phone (231) 591-2963 - Work Phone

Education

1988-
B.S. Applied Mathematics, Ferris State College

1986-
B.S. Plastics Engineering Technology, Ferris State College, Highest Distinction

1985-
AAS Pre-Engineering, Ferris State College, Highest Distinction

1985-
AAS Plastics Technology, Ferris State College, Highest Distinction

Additional Training:
1997 - Mako Controller Training
1997 - C-Mold - Flow Analysis Training
1995 - Vickers Hydraulics Training
1990 - MoldFlow - Flow Analysis Training
1990 - RJG & Associates - Scientific Injection Molding Seminars
1989 - TMC - flow Analysis Training
1989 - Personal designer CAD Training Course
1988 - RJG & Associates - Injection Molding Training Seminars
1986 - SPC and Taguchi (DOE) Training Seminars

Educational Honors and Scholarships

B.S. Applied Mathematics, Highest Distinction - 1988
Ferris State University, Big Rapids, Michigan 49677

B.S. Plastics Engineering Technology, Highest Distinction - 1986
Ferris State University, Big Rapids, Michigan 49677

AAS Pre-Engineering, Highest Distinction - 1985

Wrote-up FMEAs, control plans, production flow charts, etc.

Keeler Brass Company **1984 - 1986**
Grand Rapids, MI
Injection Molding Technician/ Set-up-Set-up injection molding presses for production runs Trouble-shot production problems

Teaching Experience

Ferris State University **November 1987 - Present**
Big Rapids, Michigan 49307 Assistant Professor, Plastics Programs

Courses Taught under Quarters:
PLT 111 - Introduction to Plastics Technology
PLT 121 - Plastics Forming Processing (aka. Processing I)
PLT 131 - Physical Properties of Plastics (aka. Plastics Testing)
PLT 203 - Composites Structures
PLT 204 - Production Processes (aka. Processing II)
PLT 411 - Advanced Plastics Processes
PLT 412 - Plastics Projects I
PLT 431 - Plastics Projects II
PLT 141/341 - Internships in Plastics Technology

Courses Taught under Semesters:
PLTS 110 - Introduction to Plastics Technology
PLTS 211 - Plastics Processing #2
PLTS 223 - Plastics Testing and Properites
PLTS 321 - Plastics Processing #3
PLTS 325 - Plastics Technology for MET
PLTS 342 - Plastics Materials Selection for PDET
PLTS 193/393 - Industrial Internships

*All courses listed above include teaching both lectures and labs for every course with the obvious exceptions of the industrial internships.

Summer 2001
Vitrolite
Conducted material testing and analysis of a proprietary additive for plastics processing

March 2002 ASC
Exteriors
1 session of Process Training taught at the East Tawas facility and attended by all plastics process personnel

Spring/Summer 2002
Lexamar
2 sessions of Process Training taught at the Boyne City facility and attended by most plastics processing personnel and tool room personnel

Summer 2005
Lear Corp
2 sessions of Process Training taught at the Iowa City facility and attended by process technicians, process engineers, managers and supervisors

Summer 2005
Lexamar
2 sessions of Process Training taught at the Boyne City facility and attended by most plastics processing personnel and tool room personnel

Summer 2006
Delphi at Adrian
2 sessions of Process Training taught at the Adrian facility and attended by all process technicians and some key supervisors and process engineers and managers

March 2008
EverReady
1 session of Process Training taught at the St. Albans, VT facility and attended by most plastics processing personnel and tool room personnel

Professional Memberships

The Society of Plastics Engineers
Member from 1982 - 1996

PERSONAL RESUME

AUGGIE R. GATT
165 Elm Boulevard
Cadillac, MI 49601
Phone: (616)775-1967

EDUCATION: B.S. Mechanical Technology,
Bradley University, 1969 M.S.
Industrial Technical Education
Bradley University, 1971

BIRTH DATE: 5-25-47
PERSONAL STATUS: Married, 2 grown children
HOBBIES: Snowmobiling, fishing

CAREER EXPERIENCE:

1989 to Present	Cadillac Rubber 8B Plastics, Cadillac, MI
1989-1991	General Manager, Cadillac Plant
1991 - 1994	Vice President Operations
1994 - 1996	President Cadillac Rubber & Plastics, A Wholly owned Subsidiary of Avon Rubber p.l.c.
1996 - 1997	Managing Director Worldwide Operations - Avon Automotive Division of Avon Rubber p.l.c.
Oct. 97' to Present	President, Avon Automotive, North 8B South America

During my tenure with Avon/Cadillac the company has grown from $71 MM annual sales and 7% PBIT to FY98 sales of $178MM and 14% PBIT with ROCE of 42%. Almost all growth has been organic. Considerable organizational development, training, strategic planning and structured capital spending have accompanied and enabled this growth, largely under my direction. Currently I am responsible for seven factories in North America (including Mexico) with total employees in excess of 2,500.

1984 - 1989	General Manager - Morenci Engineered Rubber Products Division of Champion Spark Plug Co. Morenci, MI

This company had not been profitable since 1979. Through Quality and Process improvements and development and implementation of a strategic business plan, sales were increased from $16MM/yr. to $27MM/yr. in five years and profitability regained in 1987. Acquired new business segment which resulted in opening a new Injection Molding facility in Kendallville, Indiana, in 1986.

1982 - 1984	Engineering Manager, General Tire Industrial Products Division of General Tire, Wabash, IN (now Gencorp)

Responsible for Engineering and maintenance activities of this 700,000 ft^2 factory. Department consisted of over 70 people. Upgraded many processes including mixing and earned President's Award for Energy conservation. Frequently performed special Engineering assignments at other group factories and participated in joint technical exchanges with other companies in Japan and Germany.

1978 - 1982	Engineering Manager - Newbern Rubber Division of Cadillac Rubber & Plastics, Newbern, TN

Oversaw four major plant expansions taking this facility from 28,000 ft^2 to 150,000 ft^2 culminating in installation of a state-of-the art F-270 banbury mixer with microprocessor control. Installed extruders, autoclaves, presses and various specialized equipment.

1975 - 1978	Electrical Maintenance Supervisor - Gates Rubber Company, Galesburg, IL

Responsible for electrical maintenance 2nd shift in this 600,000 ft^2 hose manufacturing facility. Conceived and implemented many cost-saving and production enhancing projects.

1971 - 1975	Instructor, Automotive Technology - Galesburg Area Vocational Center, Galesburg, IL

During my tenure, enrollment in this curriculum grew from 35 students to approximately 100 necessitating addition of another instructor and physical facilities.

REFERENCES: Furnished upon request.

CURRICULUM VITAE

ROBERT G. SPEIRS IE

EDUCATION:

MAY 1980	B.S. Plastics Engineering, University of Lowell, Lowell, MA.
SEPT. 1982	M.S. Plastics Engineering, University of Lowell
Thru 2008	Doctor of Engineering, University of Massachusetts® Lowell (45 credits)

FACULTY POSITIONS:

1981-82	Graduate Assistant, University of Lowell Plastics Engineering Dept.
1981 -82	Adjunct Faculty, University of Lowell, School of Continuing Education
1988-93	Assistant Professor, Ferris State University, Plastics Engineering Technology
1993-2002	Associate Professor, Ferris State University, Plastics Engineering Technology
2002- Present	Professor, Ferris State University, Plastics Engineering Technology
2003 - Present	Department Chair, Plastics and Rubber programs.

COURSES TAUGHT (Ferris State University)

PLTS110	Introduction to Plastics technology
PLTS 121	Plastics Processing 1
PLTS 211	Plastics Processing 2
PLTS 223	Plastics Testing and Properties
PLTS 312	Plastics Product and Tool design 2
PLTS 320	Plastics & Elastomer systems
PLTS 321	Advanced Injection molding
PLTS 342	Plastics Materials Selection
PLTS 499	Plastics Career Skills

COURSES TAUGHT (University of Massachusetts @ Lowell)

26.300	Polymeric Materials I
26.301	Polymeric Materials II
26.25/216	Plastics Processing Laboratory

INDUSTRIAL SEMINARS TAUGHT

Introduction to Injection molding Advanced
Injection molding Trouble-shooting the Injection
molding process Plastics Materials and Testing
Automotive Materials and testing Plastics materials
selection Plastics process selection Automotive
plastics

CONFERENCE PUBLICATIONS:

"Injection Molding CIM Cooperative for Education: Pay-offs for the Plastics Industry"; **P. Engelmann, R. Speirs III, R. Cedarholm. Society of Plastics Engineers-Annual National Technical Conference 1991.**

"Rubber Technician/Technologist: A Skill/Task Assessment"; **R. Speirs and E. Whitmore. American Chemical Society Rubber Division-Annual Conference 1991.**

Development and Manufacture of Visor for Helmet Mounted Display **David Krevor, Gregg McNelly, John Skubon, and Robert Speirs; ; SPIE Vol. 5180; C.E. Rash and C. E. Reese (editors); 2004**

"Manufacturing development of visor for binocular Helmet Mounted Display", **David Krevor, Timothy Edwards, Eric Larkin, Rockwell Collins Display Systems; John Skubon, MXL Industries, Robert Speirs, Ferris State University, Tom Sowden, Contour Metrological & Manufacturing. Proceedings of SPIE Volume: 6671. ISBN: 9780819468192**

MISCELLANEOUS: BOOK REVIEW

"Handbook of Plastics and Composites"; ASM International, 1989. "Handbook of

Plastics Testing Technology"; Shah, V., Wiley Interscience, 1998

Matthew M-S. Yang

Curriculum Vitae

Rubber Program
National Elastomer Center
Ferris State University
919 Campus Drive, NEC 213
Big Rapids, MI 49307-2277

Yangm (a),ferri s. edu

(231)591-5263
(231)591-2642 FAX

Education:

- **May 1982: Master of Science,** Polymer Science, The University of Akron, Akron, Ohio.
- **June 1970: Bachelor of Science,** Chemistry, National Taiwan Normal (Teachers) University, Taipei, Taiwan.

Professional Experience:

- **December 2005 to present: Associate Professor,** Rubber Engineering Technology, Ferris State University
- **December 1998 to 2005: Assistant Professor,** Rubber Engineering Technology, Ferris State University, 919 Campus Drive, Big Rapids, MI 49307-2277.
- **September 1987 to December 1998: Staff Scientist,** Honeywell, Inc. (formerly AlliedSignal, Inc.,) 101 Columbia Road, Morristown, NJ, 07962.
- **April 1984 to September 1987: Senior Research Group Leader,** Alco Chemical Corporation, Chattanooga, TN.
- **February 1981 to April 1984: Research Chemist,** Combustion Engineering Inc. Cast Division, Pittsburgh, PA.
- **May 1973 to August 1978: Manager of Research and Development,** Chan Sieh Chemical Corporation, Taipei, Taiwan.
- **September 1970 to June 1973: Chemistry Teacher,** Yang Ming High School, Taipei, Taiwan.

Thesis:

"Synthesis of poly (vinyl alcohol-g-acrylic acid) and its application as the emulsifier for poly (vinyl acetate), **Master's Thesis,** Polymer Science, Department of Polymer Science, The University of Akron, May 1982.

Professional Training:

- **February 1976:** Showa High Polymer Corp., Osaka, Japan. One month plant and lab training on the manufacturing and applications of acrylic emulsions and their applications for adhesion, coating, and finishing.
- **September, 1997:** ACS short course, Polymeric Adhesives and Composites.
- **June, 2006:** ASME Essential Teaching Seminar.
- **July, 2007:** Introduction to CATIA.
- **2007** : Book Club — Learning and teaching
- **2007 - 2008:** Inquiries into teaching and learning workshop.

Patents and Publications:

- **US Patent 4,659,793 and five related patents from other countries,** "Preparation of aqueous solutions of copolymers of dicarboxylic acids having a low dicarboxylic acid monomer content", April 12, 1987.
- **US Patent 5,453,477,** "Process of polymerizing chlorotrifluoroethylene with alkyl hydroperoxide and metal metabisulfite", September 26, 1995.
- T. F. McCarthy, R. Williams, M. S. Yang, and F. Mares, "Surfactant-free emulsion polymerization of chlorotrifluorethylene with vinyl acetate or vinylidene fluoride", **J. of Applied Polymer Science,70,** 2211-2225, (1998).
- "Polymerization", by Matthew Yang, Ryan Schook, and Tony Kotlarczyk for the West Michigan Rubber Group Technical Seminar at Ferris State University, November 7, 2001
- "Thermoplastic vulcanizates based on Nordel MG (EPDM)", by Steve Collins for RUBR-497 and sponsored by DuPont-Dow Elastomers, Fall, 2002.
- "Curing Behaviors of Nordel MG (EPDM)", by Dustin Greiner for RUBR-497 and sponsored by DuPont-Dow Elastomers, Fall, 2002.
- "Thermoplastic vulcanizates - EPDM and polypropylene blends", by Matthew Yang, T. Kotlarczyk, K. Frank, and T. Kamyszek for the West Michigan Rubber Group Technical Seminar at Ferris State University, November 6, 2003.
- "Properties and aging behavior of EPDM compounds based on low nitrosamine cure system", by K. Frank for RUBR-497 and sponsored by DuPont-Dow Elastomers, July 2004.
- "Nitrosamine-free compounding using dithiophosphate technology", by M. Tuthill and D. Murphy for RUBR-497 and sponsored by Rhein Chemie. Presented in Rubber Divisioin national meeting, Grand Rapids, May, 2004.
- "Nordel MG EPDM sponge rubber study", by A. Levy and J. Cline for RUBR-497 and sponsored by DuPont-Dow Elastomers. Presented in Rubber Divisioin national meeting, Winner of the Best Poster, Grand Rapids, May, 2004.
- "Wood fiber plastic composite study", by A. Sics for PLTS-290 and sponsored by Rhein Chemie, May, 2004.
- "Frequency response of thermoplastic vulcaniates", by M. Tabbert for PLTS-290, presented in the West Michigan Rubber Group Technical Seminar, November 3, 2004
- "Decoration of Santoprene TPV", sponsored by the Advanced Elastomer System, Inc., presented to the sponsored company and in the West Michigan Rubber Group Technical Seminar at Ferris State University, November 9, 2005.
- Electrically Conductive Silicone Rubber, M. Yang and Jay Cline, Best Undergraduate Poster Award, ACS Rubber Division Annual Technical Meeting, Pittsburgh, PA, November, 2005
- Preparation of TPV by Dynamic Vulcanization of Virgin and Recycled SBR Blends, M. Yang and Andrew Hicks, ACS Rubber Division Annual Technical Meeting, Cincinnati, OH, October, 2006
- Urethane Reinforced with NanoTubes, M. Yang and J. Nienaber, ACS Rubber Division Annual Technical Meeting, Cincinnati, OH, October, 2006
- Exploration of Recycled EPDM in a TPV Formulation, M. Yang and T. King, ACS Rubber Division Annual Technical Meeting, Cincinnati, OH, October, 2006

- Nitrosamine Free Cure Systems in EPDM, M. Yang and Jon Nienaber, Best Undergraduate Poster Award, ACS Rubber Division Annual Technical Meeting, Cleveland, OH, October, 2007

Committee Work:
- University Student Life Committee
- University Faculty Research Committee
- College Curriculum Committee
- Rubber Academic Program Review Chair
- Rubber Program Curriculum Chair

Memberships:
- American Chemical Society
- Rubber Division and Student Affair Committee
- West Michigan Rubber Group
- American Society for Engineering Education

Industrial Consulting:
- Glycon Technologies
- Lanxess Corporation (Formerly Rubber Business Group, Bayer Chemicals, Inc.)
- Rubberman, LLC
- Preferred Rubber, Inc.
- Rauwendaal Extrusion Engineering, Inc.

Section 31 Service to Non-Majors

Curricula developed for those who are interested in pursuing a certificate or a minor degree have been discussed. At the request of the College of Business, a minor degree has been created within the department with one rubber course contributed by the rubber programs. The check sheet is attached below.

COLLEGE OF TECHNOLOGY PLASTICS AND RUBBER DEPARTMENT
Polymer Materials Technology
MINOR CHECKSHEET (18 Credits)

Prerequisite: **Chemistry 121 Science elective (S credits) or equivalent University Scientific understanding**

Required Courses:	Credits
PLTS 100 Plastics *A* Elastomers for non-majors	**2 _**
RUBR110 Intro to Rubber Technology	**3 _**
PLTS 110 Intro to Plastics Technology	**3 ~**
PLTS 223 Plastics Testing & Properties <* u«i *uy ami* m */PITS tw***	**5 _**
PLTS 342 Material Selection for non-majors	**3 _**
PLTS 361 Plastics Composites	**2 _**

Meeting the requirement* for this minor U the responsibility of the student. The student ti alio responsible for meeting all FSU General Education requirements as outlined in the university catalog. Your advisor is available *to* assist yon.

Section 3J DEGREE PROGRAM

COST AND PRODUCTIVITY DATA

A breakdown of the student credit hour cost and the full time equated faculty information (SCH/FTEF) will be used to assess the cost and productivity information discussed here. The university data relative to this synopsis is included within the appendix, see Appendix X.

Using the university generated data relative to the 2006-2007 year as a basis, the university wide SCH/FTEF 443.06. In comparison, the SCH/FTEF for the College of Technology shows the aggregate for the college at 335.50. When looking at the Rubber Program for comparison, it was at 97.36 as compared to the plastics program which was 272.95.

There are several reasons for the lower SCH/FTEF value within the rubber program. These include the following points:

- Laboratory sections are small (10-15) in size and long (3-6) in hours.
- The nature of the equipment (number of pieces due to size and expense) is a contributor.
- The nature of the subject matter (highly technical with hundreds of dollars of equipment that students could destroy) is a contributor.
- The safety of the student (using equipment with potentially fatal outcomes if an accident were to occur) is another contributor.
- The necessity for many different technical classes that cover all aspects of the Rubber Industry in general is also a reason for lower productivity numbers. The student is able to be a positive contributor (productive for the company he/she goes to work for right from day one. That is a very positive attribute for them and for the program in the future.
- Lower than desired enrollment, but on the increase the past few years

The Rubber Industry is also getting more diverse and expansive every year. At this point, the student gets a good and solid foundational education. However, the foundation is broadening and more areas of the industry will need to be covered in the future.

Ferris State University Administrative Program Review 2007 SCH's

TE
Pre-Rubber Technology
AAS

Student Credit Hours - On, Off, and Total

Term	Fresh On	Fresh Off	Fresh Tot	Soph On	Soph Off	Soph Tot	Junior On	Junior Off	Junior Tot	Senior On	Senior Off	Senior Tot	1st Prof On	1st Profl Off	1st Prof Total	Mast On	Mast Off	Mast Tot
200308	33	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200408	12	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200708	15	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ferris State University Administrative Program Review 2007 SCH's

TE
Rubber Technology
AAS

Student Credit Hours - On, Off, and Total

Term	Fresh On	Fresh Off	Fresh Tot	Soph On	Soph Off	Soph Tot	Junior On	Junior Off	Junior Tot	Senior On	Senior Off	Senior Tot	1st Prof On	1st Profl Off	1st Prof Total	Mast On	Mast Off	Mast Tot
200308	29	0	29	51	0	51	103	0	103	100	0	100	0	0	0	0	0	0
200408	93	0	93	73	0	73	74	0	74	16	0	16	0	0	0	0	0,	0
200508	31	0	31	80	0	80	50	0	50	15	0	15	0	0	0	0	0	0
200608	16	0	16	17	0	17	33	0	33	92	0	92	0	0	0	0	0	0
200708	63	0	63	47	0	47	31	0	31	50	0	50	0	0	0	0	0	0

Ferris Staie University Administrative Program Review 2007 SCH's

TE
Pre-Rubber Engineering Technology
BS

Student Credit Hours - On, Off, and Total

Term	Fresh On	Fresh Off	Fresh Tot	Soph On	Soph Off	Soph Tot	Junior On	Junior Off	Junior Tot	Senior On	Senior Off	Senior Tot	1st Prof On	1st Profl Off	1st Prof Total	Mast On	Mast Off	Mast Tot
200308	0	0	0	0	0	6	26	0	26	44	0	44	0	0	0	0	0	0
200408	0	0	0	0	0	0	0	0	0	44	0	44	0	0	0	0	0	0
200508	0	0	0	0	0	0	17	0	17	28	0	28	0	0	0	0	0	0
200608 ■•	0	0	0	0	0	0	0	0	0	27	0	27	0	0	0	0	0	0

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Ferris State University Administrative Program Review 2007 SCH^{f}s

TE
Rubber Engineering Technology
BS

Student Credit Hours - On, Off, and Total

Term	Fresh On	Fresh Off	Fresh Tot	Soph On	Soph Off	Soph Tot	Junior On	Junior Off	Junior Tot	Senior On	Senior Off	Senior Tot	1st Prof On	1st Profl Off	1st Prof Total	Mast On	Mast Off	Mast Tot
200308	0	0	0	0	0	0	16	0	16	168	0	168	0	0	0	0	0	0
200408	0	0	0	0	0	0	0	0	0	92	0	92	0	0	0	0	0	0
200508	0	0	0	0	0	0	17	0	17	47	0	47	0	0	0	0	0	0
200608	0	0	0	0	0	0	17	0	17	44	0	44	0	0	0	0	0	0
200708	0	0	0	0	0	0	0	0	0	61	0	61	0	0	0	0	0	0

FERRIS STATE UNIVERSITY

Ranked Listing of Student Credit Hours (SCH) / Full Time Equated Faculty (FTEF) Aggregated by Department Fall + Winter Semesters 2006-2007

en

Department	Student Credit Hours/ Full Time Equated Faculty (SCH/FTEF)
Heavy Equipment	330.37
EET-CNS	323.38
Automotive	319.60
Mechanical Design	290.25
HVARC	279.96
Television Production	273.83
MI College of Optometry	265.42
Printing-Imaging Tech Mgmt	257.44
Plastics-Rubber	239.68
Fine Arts-Foundation	217.60
Design Studies	213.31

FERRIS STATE UNIVERSITY

Ranked Listing of Student Credit Hours (SCH) / Full Time Equated Faculty (FTEF) Aggregated by Course Prefix Fall + Winter Semesters 2006-2007

Course Description	**Course Prefix**	**Student Credit Hours/ Full Time Equated Faculty** (SCH/FTEF)
Integrated Physical Sciences	INPS	160.00
Kendall Sculpture/Functional Art	KCSF	143.04
Pharmacognosy	PHCG	138.82
Kendall Education	KCED	137.71
Horticulture	HORT	131.66
Kendall Metals/Jewelry Design	KCMJ	113.10
Kendall College Historic Preservation	KCHP	109.09
Kendall College Historic Preservation	KCHP	108.27
Education-Get Promoted	EDGP	100.55
Rubber Technology	RUBR	97.36

Ferris State University

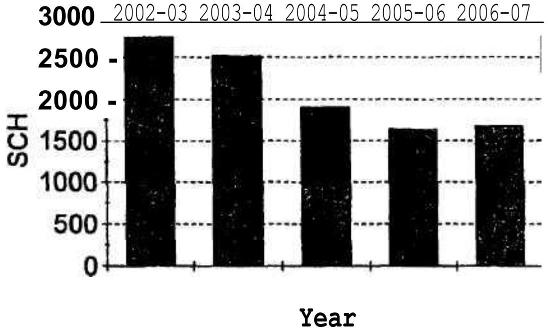
Student Credit Hours (SCH), Full Time Equated Faculty (FTEF) and SCH/FTEF
Aggregated by Department

Fall and Winter Terms Combined

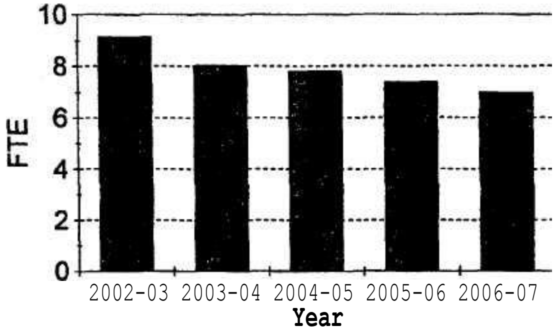
Plastics and Rubber
(College of Technology)

co

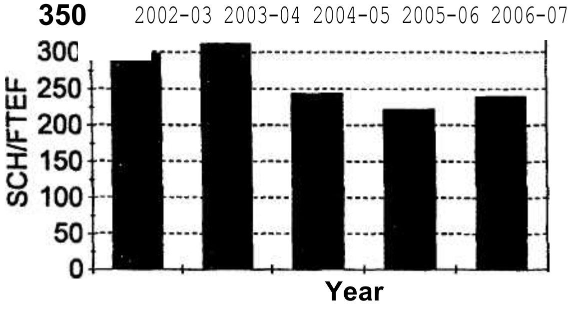
Plastics and Rubber
SCH's



Plastics and Rubber
FTEF



Plastics and Rubber
SCH/FTEF



Year	SCH	FTEF	SCH/FTEF
2002-03	2,727.00	9.15	298.11
2003-04	2,504.00	8.03	31164
2004-05	1,902.00	7.81	243.59
2005-06	1,637.00	7.39	221.42
2006-07	1,676.00	6.99	239.68

Caution: When viewing graphs, please note the differences in scales

Source: Office of Institutional Research, g:\...\facload\0607\prdte9g.rsl

FERRIS STATE UNIVERSITY

Student Credit Hours (SCH), Full Time Equated Faculty (FTEF) and SCH/FTEF
Aggregated by University by Department within College

			Student Credit Hours			Full Time Equated Faculty				SCH/FTEF			
Department	Year	Summer	Fall	Winter	F + W (a)	Summer	Fall	Winter	AvgF + W (b)	Summer	**Fall**	**Winter**	F + W (a/b)
College of Technology													
Mechanical Design	2002-03	196.00	2,109.00	1,928.00	4,037.00	1.67	8.35	10.29	9.32	117.37	252.50	187.37	433.10
Mechanical Design	2003-04	40.00	2,168.00	1,986.00	4,154.00	0.27	9.54	9.06	9.30	148.15	227.19	219.21	446.60
Mechanical Design	2004-05	131.00	2,007.00	1,875.00	3,882.00	0.44	9.78	10.42	10.10	297.73	205.14	179.94	384.29
Mechanical Design	2005-06	110.00	1,859.00	1,764.00	3,623.00	0.56	9.71	10.91	10.31	196.43	191.40	161.69	351.36
Mechanical Design	2006-07	80.00	1,801.00	1,467.00	3,268.00	0.67	11.12	11.40	11.26	119.40	162.00	128.67	290.25
astics and Rubber	2002-03	421.00	1,179.00	1,548.00	2,727.00	4.02	8.88	9.42	9.15	104.73	132.85	164.33	298.11
Plastics and Rubber	2003-04	384.00	1,236.00	1,268.00	2,504.00	2.49	7.90	8.17	8.03	154.22	156.46	155.20	311.64
Plastics and Rubber	2004-05	372.00	833.00	1,069.00	1,902.00	2.28	7.89	7.73	7.81	163.16	105.59	138.34	243.59
Plastics and Rubber	2005-06	259.00	795.00	842.00	1,637.00	1.54	6.89	7.90	7.39	168.18	115.40	106.62	221.42
Plastics and Rubber	2006-07	238.00	0.00	0.00	0.00	2.68	0.00	0.00	0.00	88.67			
Plastics-Rubber	2006-07	0.00	732.00	944.00	1,676.00	0.00	7.24	6.75	6.99		101.12	139.92	239.68
Printing & Imaging Technology Mgmt	2002-03	163.00	958.00	1,015.00	1,973.00	1.17	8.25	9.08	8.67	139.32	116.12	111.78	227.70
Printing & Imaging Technology Mgmt	2003-04	191.00	953.00	953.00	1,906.00	1.17	7.89	8.00	7.94	163.25	120.80	119.13	239.92
Printing & Imaging Technology Mgmt	2004-05	214.00	1,018.00	983.00	2,001.00	1.17	7.88	6.34	7.11	182.91	129.27	155.05	281.53
Printing & Imaging Technology Mgmt	2005-06	187.00	1,005.00	956.00	1,961.00	1.17	6.28	6.14	6.21	159.83	160.03	155.70	315.78
Printing & Imaging Technology Mgmt	2006-07	177.00	0.00	0.00	0.00	1.17	0.00	0.00	0.00	151.28			
Printing-Imaging Tech Mgmt	2006-07	0.00	812.00	909.00	1,721.00	0.00	5.96	7.41	6.68		136.24	122.67	257.44
Surveying	2002-03	114.00	764.00	994.00	1,758.00	1.00	5.50	6.36	5.93	114.00	138.91	156.29	296.46
Surveying	2003-04	3.00	673.00	966.00	1,639.00	0.00	5.33	6.15	5.74		126.19	157.11	285.49

FERRIS STATE UNIVERSITY

Student Credit Hours (SCH), Full Time Equated Faculty (FTEF) and SCH/FTEF Aggregated by Course Prefix within College and Department

		Student Credit Hours				Full Time Equated Faculty				SCH/FTEF			
Prefix	Year	Summer	Fall	Winter	F + W 00	Summer	Fall	Winter	Avg F + W (b)	Summer	Fall	Winter	F + W (a/b)
College of Technology													
Mechanical Design		0.00	264.00	108.00	372.00								
ETEC	**2006-07**	**76.00**	**910.00**	**759.00**	**1,669.00**	**0.00**	**1.44**	**0.79**	**1.12**		183.33	**135.87**	**332.91**
		40.00	**864.00**	**795.00**	**1,659.00**	**1.00**	**2.61**	**3.04**	**2.82**	**75.75**	348.76	**249.92**	**591.20**
MECH	**2002-03**												
		44.00	**745.00**	**865.00**	**1,610.00**	**0.27**	**3.67**	**3.24**	**3.45**	**148.15**	235.64	**245.18**	**480.23**
MECH	**2003-04**												
		68.00	**716.00**	**686.00**	**1,402.00**	**0.19**	**3.49**	**3.24**	**3.36**	**231.58**	213.73	**267.07**	**478.84**
MECH	**2004-05**												
		80.00	**747.00**	**657.00**	**1,404.00**	**0.39**	**2.87**	**3.15**	3.01	**174.36**	249.77	**217.78**	**466.04**
MECH	**2005-06**												
		120.00	**225.00**	**516.00**	**741.00**	**0.67**	**3.52**	**3.52**	3.52	**119.40**	212.39	**186.83**	**399.22**
MECH	**2006-07**												
ED													
		0.00	**306.00**	**468.00**	**774.00**	**0.67**	**0.97**	**2.59**	**1.78**	**180.00**	**232.76**	**198.99**	**416.33**
PDET	**2002-03**												
		87.00	**365.00**	**425.00**	**790.00**	**0.00**	**1.00**	**1.43**	**1.21**		**306.00**	**327.85**	**637.70**
PDET	**2003-04**												
		42.00	**310.00**	**441.00**	**751.00**	**0.25**	**1.38**	**2.51**	**1.95**	**348.00**	**264.31**	**169.25**	**405.95**
PDET	**2004-05**												
		0.00	**315.00**	**281.00**	**596.00**	**0.17**	**2.00**	**3.03**	**2.52**	**247.06**	**155.00**	**145.54**	**298.61**
PDET	**2005-06**												
PDET	**2006-07**					**0.00**	**2.52**	**2.75**	**2.63**		**125.00**	**102.18**	**226.19**
		349.00	**1,019.00**	**1,343.00**	**2,362.00**								
Plastics and Rubber						**2.68**	**6.88**	**7.50**	**7.19**	**130.22**	**148.22**	**178.99**	**328.55**
		308.00	**1,086.00**	**1,150.00**	**2,236.00**								
PLTS	**2002-03**												
		316.00	**739.00**	**969.00**	**1,708.00**	**2.00**	**6.54**	**6.67**	**6.61**	**154.00**	**165.94**	**172.47**	**338.47**
PLTS	**2003-04**												
		227.00	**700.00**	**757.00**	**1,457.00**	**1.91**	**6.67**	**6.09**	**6.38**	**165.45**	**110.85**	**159.09**	**267.76**
PLTS	2004-05												
		214.00	**0.00**	**0.00**	**0.00**	**1.32**	**5.28**	**6.53**	**5.91**	**171.97**	**132.63**	115.86	**246.71**
PLTS	2005-06												
		72.00	**160.00**	**205.00**	**365.00**	**1.34**	**0.00**	**0.00**	**0.00**	**159.23**			
PLTS	2006-07												
		76.00	**150.00**	**118.00**	**268.00**	**1.34**	**2.00**	**1.92**	**1.96**	**53.73**	**80.00**	106.96	**186.38**
RUBR	2002-03												
		56.00	**94.00**	**100.00**	**194.00**	**0.49**	**1.36**	**1.50**	**1.43**	155.10	110.66	78.56	**187.56**
RUBR	2003-04												
		32.00	**95.00**	**85.00**	**180.00**	**0.37**	**1.22**	**1.64**	**1.43**	151.35	**76.91**	**61.11**	135.73
RUBR	2004-05												
		24.00	**0.00**	**0.00**	**0.00**	**0.22**	**1.61**	**1.36**	**1.49**	145.45	**58.97**	**62.33**	121.02
RUBR	2005-06												
RUBR	2006-07					**1.34**	**0.00**	**0.00**	**0.00**	17.91			

FERRIS STATE UNIVERSITY

Student Credit Hours (SCH), Full Time Equated Faculty (FTEF) and SCH/FTEF Aggregated by Course Prefix within College and Department

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		Student Credit Hours				Full Time Equated Faculty				SCH/FTEF			
Prefix	Year	Summer	Fall	Winter	F + W (a)	Summer	Fall	Winter	AvgF + W (b)	Summer	Fall	Winter	F + W (a/b)
College of Technology													
Plastics-Rubber	2006-07	0.00	655.00	892.00	1,547.00	0.00	5.59	5.75	5.67		117.20	155.22	272.95
PLTS RUBR	2006-07	0.00	77.00	52.00	129.00	0.00	1.65	1.00	1.33		46.67	52.00	97.36
Printing & Imaging Technology Mgmt		0.00	30.00	84.00	114.00	0.00	0.67	1.10	0.88		45.00	76.56	129.26
NMPP NMPP NMPP	2002-03												
NMPP	2003-04	0.00	63.00	101.00	164.00	0.00	0.67	1.08	0.87		94.50	93.23	187.43
	2004-05	0.00	69.00	81.00	150.00	0.00	0.77	1.09	0.93		89.35	74.54	161.39
PHOT PHOT PHOT	2005-06	0.00	85.00	90.00	175.00	0.00	0.62	1.04	0.83		137.84	86.54	211.27
PHOT PHOT	2002-03	105.00	123.00	150.00	273.00	0.50	0.50	0.50	0.50	210.00	246.00	300.00	546.00
PMGT PMGT PMGT	2003-04	129.00	150.00	222.00	372.00	0.50	0.50	0.75	0.63	258.00	300.00	296.00	595.20
PMGT PMGT	2004-05	84.00	216.00	225.00	441.00	0.25	0.80	0.75	0.78	336.00	270.00	300.00	569.03
PTEC PTEC PTEC	2005-06	111.00	144.00	75.00	219.00	0.50	0.45	0.17	0.31	222.00	320.00	441.18	706.45
PTEC	2006-07	75.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	150.00			
	2002-03	58.00	154.00	165.00	319.00	0.67	2.00	2.08	2.04	86.57	77.00	79.33	156.37
	2003-04	62.00	204.00	189.00	393.00	0.67	2.33	2.43	2.38	92.54	87.43	77.82	165.06
	2004-05	130.00	186.00	173.00	359.00	0.92	2.23	1.00	1.61	141.30	83.46	173.00	222.39
	2005-06	76.00	186.00	310.00	496.00	0.67	1.67	1.51	1.59	113.43	111.27	205.95	312.26
	2006-07	102.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	152.24			
	2002-03	0.00	651.00	616.00	1,267.00	0.00	5.08	5.40	5.24		128.07	114.02	241.65
	2003-04	0.00	536.00	441.00	977.00	0.00	4.39	3.74	4.06		122.13	117.97	240.43
	2004-05	0.00	547.00	504.00	1,051.00	0.00	4.07	3.50	3.79		134.26	143.86	277.40
	2005-06	0.00	590.00	481.00	1,071.00	0.00	3.54	3.42	3.48		166.59	140.45	307.47

Section 3K

Assessment and Evaluation

There is no outcome assessment test developed yet currently in the programs.

Section 3L **ADMINISTRATION EFFECTIVENESS**

Throughout the review process, just a couple of issues arose that need to be addressed in relationship to the effectiveness of how the rubber program is run. First of all, there is only 1 faculty member in the Rubber program and Plastics faculty are assisting by teaching rubber courses currently. The department and faculty have not produced a workable plan as to how to handle the relationship between the Plastics and Rubber curriculums/programs.

Secondly, enrollment needs to be increased, the industry and clambering for "Rubber" graduates, the open position to graduate is near 6 to 1 meaning we could place 30 students with relative ease. The College and University need to determine how to attract student into this program.

Section 3L

ADMINISTRATION EFFECTIVENESS

Throughout the review process, a couple of issues arose that need to be addressed in relationship to the effectiveness of how the rubber program is run. First of all, there is currently only one faculty member in the Rubber program teaching rubber courses. A smooth transition with regards to the retirement of one Rubber faculty was evidently not properly communicated with the students and the Industrial Advisory Board.

To help teach the rubber course, one faculty member from the Plastics program has been recruited after sitting in the class taught by the retired Rubber faculty for one semester. One of the few concerns being raised by this Plastics faculty is the need of the department to produce a workable to handle the relationship between the Plastics and Rubber curriculums/programs. This particular issue was planned to be resolved during numerous departmental meetings on the curriculum changes for both Plastics and Rubber programs. In the end, the member of the Plastics faculty who will help to teach the rubber course was clearly uncomfortable with the proposed curriculum change for the Plastics program. We have missed the opportunity for the department to integrate the two programs and improve the overall productivity.

Secondly, enrollment needs to be increased. The industry is requesting for more "Rubber" graduates and the number of open positions to graduates is nearly 6 to 1, meaning we could place 30 students with relative ease. On top of the recruiting efforts made by the departmental faculty, the College and University need to determine how to attract students into this program. As documented in the Section 2F, the Advisory Committee Perceptions, the Board members and people in the rubber industry have expressed their disappointment about the poor support being provided by the College and University. A few actions have been suggested by the Board and hopefully will be carried out soon.

Rubber and Plastics programs share one Administrative Assistant who has been effectively providing good clerical support. On the other hand, there is only one Lab Manager who is in charge of regular maintenance of all the processing equipment and testing instruments of both programs. In addition, there is a need of trouble-shooting when the classes are in session; however, Lab Manager's workload can be quite overwhelming from time to time. Unfortunately, there is only one part-time assistant assigned to him during the semester. Adequate funding to hire one more assistant is needed for the Lab Manager to do a better job on housekeeping and maintenance of the aging equipment.

Section 4A Facilities and Equipment

A. Instructional Environment

The 27,000 square-foot National Elastomer Center (NEC) was an expansion from the original Plastics Engineering Technology (PET) Center with state-of-the art lecture rooms, computer and reference rooms, and open-area labs loaded with state-of-the art manufacturing equipment and testing instruments. It houses both the Plastics Engineering Technology and Rubber Engineering Technology Programs after the renovation was completed in 1997.

There are four main lecture rooms in the NEC. The largest one is a tiered room, perfect for use as a conference room, with the capacity to accommodate up to ninety people. There are also five main lab prep rooms that can be used both as staging areas and small lecture rooms. All the rooms inside NEC are comprised with a full range of multimedia delivery systems.

B. Computer Access and Availability

There are plenty of computers in the labs, reference room, hallways, and a computer lab in one room with 15 work stations used for the design, tooling, and project management classes. The tiered room is equipped with LAN outlets at each seat. Computers that control the instruments are all internet ready. All the computers are loaded with software and available to any students when classes are not in session until nine in the evening when the building is locked. In addition, the NEC has wireless network access for those who bring their own laptops.

C. Library Resources

FLITE (library) provides the latest references and online resources. Librarians are very helpful for any searching requests from the faculty and students. Plenty of computers in the FLITE are also loaded with software such as Microsoft Office and CAD which are easy access to our students.

Section 4B

Equipment

Equipment and Other Instructional Technology

The hands-on education of the rubber programs requires a variety of processing equipments, such as mixers, mills, presses, extruders and injection molding machines for teaching. Most of the equipment are used ones and are donated by rubber companies. Acquisition of new equipment or up-dating the existing machines is not easy because of the economic conditions or the value of Ferris rubber programs may not be fully appreciated by the equipment manufacturers, who are serving the rubber industry in limited numbers. On the other hand, plenty supplies of different rubbers, processing oils and chemicals are all donated by the industry who have a good relationship with the programs through the friends, Advisory Board members, alumni of the programs, and special studies conducted at Ferris for the industry. Continuous donations of rubber chemicals with limited shelf life are obtained through the requests made by the faculty.

Despite the problems caused by the aged machines, the rubber lab is quite adequate to cover a wide range of processing commonly used on the rubber production floor. Outside companies would come to the rubber labs and run a few trial runs during the breaks or when the equipment is not being utilized by classes. We would in turn charge the service in the form of endowment for the programs. The biggest challenges faced by the programs are the maintenance and acquisition of new or additional equipment and instrument:

Currently, there is only one lab manager who covers all the work of both the Plastics and Rubber programs. He is very capable of doing the necessary maintenance work of all the machines installed on the lab floors of both Programs. His responsibilities include the requests of trouble shooting and fixing machine breakdowns, which often occur when classes are in session.

Because of the aging equipment, more frequent urgent and emergency requests from the instructors along with class interruptions will occur. There has to be a budget available for the lab manager to hire an assistant to schedule all the necessary maintenance and calibrations of every piece of machinery in the labs.

The rubber programs will need to expand relationships with the industry to facilitate the acquisition of new and up-graded equipment. We can follow the similar practice done in the plastics programs to encourage the willingness of equipment companies to set up their unique equipment here at Ferris and use them for their customer training during class breaks. The annual WMRG seminar held every November at NEC would serve this purpose very well if it is better planned. The faculty should continue to work with and seek the advice of the Advisory Board and the administration.

Summary List of Main Equipment in the Rubber Labs:

Mixing	Origin	Condition
Banbury (Size 1,301b) 2	used	rebuilt
Banbury (Size BR, 3 lb)	used	rebuilt
Brabender Plasticorder (1/2 lb)	used	good
2 Lab mills 10 inch mill 20	used	rebuilt
inch mill	used	rebuilt
	used	rebuilt
Molding		
Dieffenbacher Injeciton Molder		
Rep Injection Molder 2	new	Good after thorough check up and calibration
DESMA Injection Molder	used	Need more molds and help to start up the machine
Wabash vaccum press Wabash	used	rebuilt
compression press	new	good
	used	good
Extrusion / Curing		
Lab Autoclave	new	excellent
1.5 inch hot extruder	used	rebuilt
2.5 inch vented extruder (L/D=20)	used	rebuilt
20 foot hot melt salt bath	used	good
Instruments for Testing		
2 hot presses	new	good
MDPT Rheometers	new	good
2 ODR Rheometers	used	good
2 Mooney Visco meters	used	good
2 Tensometers	new/used	good
Capillary Rheometer	used	good
Cold Retraction (TR10) Tester	new	good
Cold Box (-70° F)	new	good
2 Lab Ovens	used	good
DSC	new	excellent
TGA	new	excellent
DMA	demo unit	good

Section 5

Conclusions

The unique Rubber Technology (AAS) and Rubber Engineering Technology (BS) programs at the College of Technology (COT) have partially met the goals initially set up for the programs. However, the programs are in crisis, to say the least, because of the following formidable challenges:

- Ever changing global economy.
- Surge in the energy and raw material costs.
- Low enrollment and poor productivity.
- Transition inside the programs.

Not every one listed above is negative. For example, shifting labor-intense and low level manufacturing jobs overseas actually creates the needs of technologists of "high-tech" as well as with good management and problem-solving skills. Concerted efforts and well-coordinated actions from the program faculty, administrators, university, rubber industry, and the nation as whole are needed in order to resolve all the challenges that the rubber programs are facing. We need a Master Plan.

This review has provided some facts to point out that the programs are in the position to be part of the links to fulfill Ferris Mission. It is evident that a brain-storm should be held in the immediate future to outline a master plan. The brain-storming should be attended by a team consists of representatives from the University Advancement and Marketing, rubber industry, in particular RMA and the Industrial Advisory Board, program administrators and faculty after the program goals have been re-examined.

The immediate need for the programs to do is the cross-training of the existing faculty members to replace the retired member from the rubber programs. This transition has not been executed smoothly as it is reflected by

- Great stress encountered by the remaining rubber program faculty.
- Serious concerns expressed by the student body and alumni, and the Advisory Board.

Furthermore, the plastics faculty recruited for cross-training only expressed his willingness to help but has reserved his own concerns on the curriculum changes in both the plastics and rubber programs and the amount of support he can acquire once he comes onboard next fall.

It would be an understatement that Ferris rubber programs have come to a crossroad and the progress of programs can be used to forecast the status of the manufacturing industry as well as the science, technology, engineering, and mathematic (STEM) educations in the United States of America.

In this section, survey results collected in the process of this review and from the Advisory Board meeting held on April 25, 2008 will be summarized by following specific categories outlined in this self-study. The relevancy of current program goals to the Mission of the Ferris State University will be discussed in the following sections.

Mission Statement of Ferris State University:

Mission

Ferris State University prepares students for successful careers, responsible citizenship, and lifelong learning. Through its many partnerships and its career-oriented, broad-based education, Ferris serves our rapidly changing global economy and society.

Core Values

- **Collaboration:** Ferris contributes to the advancement of society by building partnerships with students, alumni, business and industry, government bodies, accrediting agencies, and the communities the University serves.

- **Diversity:** By providing a campus which is supportive, safe, and welcoming, Ferris embraces a diversity of ideas, beliefs, and cultures.

- **Ethical Community:** Ferris recognizes the inherent dignity of each member of the University community and treats everyone with respect. Our actions are guided by fairness, honesty, and integrity.

- **Excellence:** Committed to innovation and creativity, Ferris strives to produce the highest quality outcomes in all its endeavors.

- **Learning:** Ferris State University values education that is career-oriented, balances theory and practice, develops critical thinking, emphasizes active learning, and fosters responsibility and the desire for the lifelong pursuit of knowledge.

- **Opportunity:** Ferris, with a focus on developing career skills and knowledge, provides opportunities for civic engagement, leadership development, advancement, and success.

Section 5A Relationship to

FSU Mission

The program goals can be spelled out as follows:

- Adopt an effective recruiting plan to increase the program enrollment and generate enough qualified graduates to meet the demand of the rubber industry.
- Raise the program productivity.
- Keep the equipment updated, fully functional, and safe for the students to use.
- Update and enrich the program curriculum

The creation of rubber programs at FSU has been the result of collaborated efforts of many partnerships. The initial goal, and still the top priority of the programs, is to educate the citizens from the nation to provide the rubber industry with well-trained technologists that "will help keep the USA .. .folly competitive in the world economy."

Although the cross-training of faculty members to replace a retired colleague may have caused some uneasiness among students and Advisory Board members, the effort shown by the program faculty would actually serve perfect examples of believing in life-long learning, always looking for the opportunities to pursue the excellence, and successfully accomplishing the program goals.

Section 5B

Conclusions Relative to Program Visibility and Distinctiveness

The rubber programs at FSU are still the only ones in the nation. When rubber companies ask for their future employees, they specifically request for "Ferris trained" technologist instead of traditionally trained chemists, mechanical, or chemical engineers.

We are the first student chapter affiliated to the Rubber Division of the American Chemical Society. We are also the most active ones in the participation of professional events such as annual RubberExpo® and technical presentations in the national meeting. Any presentation brought to the national meeting by the program students is always guaranteed to win the scholarships awarded by the Division. In the coming national meeting in October, none other than Ferris State University promises to present at least two papers/posters at undergraduate level. Students of Ferris rubber programs have been the winners of the highly competitive and distinguished $5,000 undergraduate scholarships offered to only three students nationwide except last two years. For twice in a row, two Ferris students were the winners of the annual scholarships. These are just a few examples to prove the program visibility and distinctiveness.

Poor participation of program students in the professional activities over the past two years, however frustrated by both the faculty and the Division, seems to reflect a general feeling that if we don't do it. Who else would? It is fair to say that program visibility and distinctiveness have been well established inside the rubber industry. However, it is also quite obvious that majority of the prospective students are still unaware of the tremendous opportunities in this industry and the rubber programs at Ferris.

Members of the Advisory Board, WMRG, and the programs have come up with a plan to run another full campaign for the coming technical seminar held at the NEC. The invitation will extend to the industry worldwide in hope to let the "secrete of the rubber programs at Ferris" out. The long overdue DVD for recruiting could have been a perfect take-away for the participants. The production of recruiting DVD has been an arguing point between the University and members of Advisory Board over the university support of the programs. The author can only hope that the DVD production is still on the top of many action items at the university level.

The other method of getting the messages across to the general public is to keep all the program information on the website. Unfortunately, the program faculty is not trained to be the expert in designing and maintaining an informative website. It is imperative that the program faculty has to work closer with the administrator and personnel from the University Advancement and Marketing.

Current recruiting techniques practiced by the department and program faculty should be re-examined by the marketing expert, too. Current practices do not seem to be effective enough to improve the program visibility to the desired level.

Section 5C

Conclusions Relative to the Program Value

The program value can be reflected by the following facts:

- Virtually 100% placement for the program graduates and high degree of satisfaction of the rubber industry.
- Average salaries of program graduates rank among the highest of the programs within COT.
- High expectation from the members of the Rubber Division and their desire of keeping good relationship with the rubber programs.
- Job shifting due to the global economy and increasing burden of regulation requirements have created demand of technologists with more specific skills similar to those trained at Ferris rubber programs.

Recommendations to fulfill the program value are:

- The faculty of the programs should continue to work with alumni and the Advisory Board and seek advices from them.
- The faculty should continue to review and revise the curriculum to meet the needs of the rubber industry. Besides teaching the basic rubber technology, programs should also focus on the training of technical presentation, basic part design, project and people management skills.

Section 5D

Conclusions Relative to Enrollment

The program capacity is set at 24 incoming freshmen each year. With both the downturn in the economy and retirement of one program faculty, it is more realistic to accept 12 to 15 freshmen and generate about 10 to 12 BS graduates to meet the labor force demand for the rubber industry. With 12 freshmen last fall and 10 more in the upcoming fall semester enrolled in the Rubber program, we have seen an upward trend in freshmen enrollment. The improved enrollment is partially contributed by the recruiting efforts by departmental faculty, according to the freshmen survey. We have to do better, though, because there are nearly 30 positions that need to be filled by the "Rubber" graduates. The recommendations to achieve a sustainable freshmen enrollment are as follows:

- Produce the "recruiting DVD" with the help from the Advisory Board and WMRG and set up a target release date.
- Review and improve the recruiting presentations used for the "Career Day" because the faculty members are not trained recruiting experts.
- Updated program information on the website is needed regularly.
- Recruit students from community colleges and vocational type schools. Many of them do not have the financial means to go to more expensive four-year colleges, and are looking for careers with better pay.
- Extend in-state tuition to out-of-state students.
- Have a brain-storming session assisted by recruiting experts to identify any new ways to reach prospective students from high schools or the so-called non-traditional sources.
- Review and improve the recruiting presentations used for the "Career Day" because the faculty members are not trained recruiting experts.

Section 5E

Characteristics, Quality and Employabiliy of Students

There is high degree of satisfaction with Ferris graduates hired by the rubber industry.. The demanding salaries of our alumni may be considered "unrealistic" by the industry, with virtually 100% placement and feeling good about their salaries, the program graduates seem to do very well in their careers. Continuous job solicitations from the industry guarantees an optimistic job market for the rubber graduates.

The alumni and Advisory Board surveys indicate that they want to keep the entrance requirements for both AAS and BS degrees at the current standards. Other characteristics and quality of students are summarized as follows:

- The minimum ACT composite scores for incoming AAS have been as low as from 13 to 15. This may tell part of the stories why the retention rate of rubber programs is not as high as we wish to see if ACT score can be used as an indicator of preparedness for the college education.
- For students in the BS program, we see minimum GPA's follows the same trends as minimum ACT composite scores. The academic achievement seems to be on the lower side for the school years of 2004-2005 and 2005-2006 based on the combined trends of GPA and ACT.
- In the latest annual Advisory Board meeting, the Board members have identified a few learning/teaching issues during the interacting meeting with a few students, most of them are seniors.
- Some dual majors show low level of interests in the advanced rubber courses. Participation in the Student Rubber Group and the functions of the Rubber Division is significantly lower in the past two years.

Recommendations relative to Students:

- Re-focus on the training of basic rubber technology.
- Administrate proper assessments to better evaluate students' knowledge and skills. Seek advices from Terry Doyle and Todd Stanislav in the Center for Teaching and Learning if necessary.

Section 5F

Conclusions Relative to Quality of Curriculum and Instruction

The quality of curriculum and instruction is pretty much follows the same trend of quality and employability of students outlined in the Section 5E. It is the consensus of the faculty, alumni, and the Advisory Board that the curriculum satisfies a broad range of rubber industry and the education has a good balance of hands-on vs. theory. To keep up to the needs of rubber industry, the program faculty should continue to review and revise the curriculum with the inputs from the Advisory Board and alumni.

There is an immediate need to keep all the equipment fully functional for the classes to use. It has been identified that the scheduled maintenance and calibration of each piece of equipment are the only effective ways to prevent the equipment from breaking down unexpectedly.

Current students also brought up the issues of textbooks and the teaching and relevancy of the elective/support classes. We have not found good textbooks in the market that suit the program's specific needs. The only way is that the program faculty starts to write them. The author has his lecture notes stored in the electronic files and tested them in the classes the following year. It is not going to be an easy job but worthwhile trying to publish a few textbooks to meet the specific needs of the rubber programs.

Other recommendations to improve the quality of curriculum are:

- Focusing more on certain basic skills such as part design, project and people management, and technical presentation.
- Implementing more practice of quality management in different lab classes.

Section 5G Conclusions Relative to the Composition and Quality of the Faculty

There is a strong need to balance the processing and material courses in the rubber programs. Furthermore, the rubber processing courses need to be aligned in a more logic sequence. To replace the retired rubber faculty, it is a great idea of recruiting one member of the plastic programs who is an expert in the plastic processing.

Rubber processing is much broader than the plastics because of the additional need of teaching rubber mixing. To gain the full commitment of this plastic faculty of helping rubber programs, it is important to give him all the needed support when he start teaching his first rubber processing course.

The additional recommendations are:

- Updating lab equipment.
- Continuing faculty development through workshops offered by the Center for Teaching and Learning as well as other coursework and seminars.

CATERPILLAR

Caterpillar Inc.
03 H3500
P.O. Box 4000
MossvillelL 61552-4000

Dean Oldfield,

As a Ferris State alumni and Rubber Program advisor board member I would like to request that Ferris State consider extending in-state tuition to out-of -state students applying for enrollment in the Ferris State Rubber program. I will offer my background as an example of why you should consider this petition.

I am originally from California and prior to attending Ferris State University I had been working in the rubber industry for 14 years. I became interested in returning to school and was looking for a school that had something to do with rubber product manufacturing and found Ferris State using a web search. The program was exactly what I was looking for, being very hands on. The fit to my needs was truly remarkable. I shared the curriculum with some of my colleagues and they were also very impressed and wished they could go to Ferris. I began to discuss the prospect with my wife and we agreed to find out more about the program.

The benefits that I have received from my degree and education are truly outstanding. I have a wonderful job and future working for Caterpillar Inc. I work with three other Ferris State Rubber and Plastic alumni. I have made a name for myself in the rubber industry and my story has been told and written about in a few rubber industry publications. The impact that Ferris State has had on my life is without question outstanding. I would like to think that the university has received something from my attendance as well. The word is getting out that Ferris is the only place to go for rubber education. I can't tell you how many times that I have told my story.

One of the most important criteria of the program at Ferris was the opportunity for in-state tuition. I am almost positive that if I would have had to pay full out-of-state tuition that it would have prevented me from taking the leap of faith that was required to move from California to Michigan. Students that want to sign up for the rubber program from out-of-state are going to have some involvement in the rubber industry already. They, like me, are going to be the kind of students that are really going to benefit from this truly special program. The rubber program is not likely to become the money maker that some of the more popular programs are, but it does give Ferris a reputation for very specialized hands on education that you can't get anywhere in the world, Therefore I request that you give others the opportunity that I have had and extend in-state tuition to out-of-state students it really does make a difference one student at a time.

Thank you for the education,

Sincerely,

Jay H. Cline

Jay H. Cline
Senior Associate Engineer
Material Technology
Caterpillar Inc.

Rubber Division Scholarship Winners

- **2008 Winners:**
  - Sgt. Matthew Carper, University of Nebraska-Lincoln
  - Cory Simon, The University of Akron
  - Ryan Kupchella, The University of Akron
- **2007 Winners:**
  - Sgt. Matthew Carper, University of Nebraska-Lincoln
  - Tyler Hershberger, The University of Akron
  - Michael Frank, The University of Akron
- **2006 Winners:**
  - Jay Cline, Ferris State University
  - Thomas Ralston, University of Nebraska-Lincoln
  - Patrick Vielhaber, The University of Akron
- **2005 Winners:**
  - Kevin Flowers, The University of Akron
  - Thomas Ralston, University of Nebraska-Lincoln
  - Margi Pawlowski, Ferris State University
- **2004 Winners:**
  - Kinsey Leah Hastings, University of Nebraska-Lincoln
  - Molly Beery, The University of Akron
- **2003 Winners:**
  - Kinsey Leah Hastings, University of Nebraska-Lincoln
  - Abraham Levy, Ferris State University
  - Kathleen Franks, Ferris State University

- **2002 Winners:**
  - Abraham Levy, Ferris State University
  - Steve Collins, Ferris State University
  - Adam M. Feist, University of Nebraska-Lincoln
- **2001 Winners:**
  - Matthew Stefanick, The University of Akron
  - Jim Prentis, Ohio University

Rubber Technology Training Award

- **2008 Winner:**
  - John Terry, Johnsonite Inc.
- **2007 Winners:**
  - Dean Hoy, Rohm & Haas Company
  - Kelly Combs, Cooper Tire & Rubber Company
- **2005 Winner:**
  - Del Blue, Sid Richardson Carbon Co., Ohio Rubber & Plastics Group
- **2004 Winners:**
  - Antonio Casiano, Lloyd Manufacturing, Rhode Island Rubber Group
  - Brandon Madaus, L&L Products Inc., Detroit Rubber Group
- **2003 Winners:**
  - Jeremy Bergman, Laur Silicone, West Michigan Rubber Group
- **2002 Winners:**
  - Ron Boersma, Michigan Rubber Products, West Michigan Rubber Group
- **2001 Winners:**
  - Rod Bowman, Flexfab Horizons International, West Michigan Rubber Group
  - Timothy Johnson, JM Clipper Corp., Energy Rubber Group
  - Scott Nelson, Bardon Rubber Products, Wisconsin Rubber Group
  - Randy West, Cooper-Standard Automotive, Fort Wayne Rubber Group

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Rubber
Division
American Chemical Society

RUBBER DIVISION, ACS UNDERGRADUATE SCHOLARSHIP WINNERS ANNOUNCED

May 27,2003

The Rubber Division of the American Chemical Society is pleased to announce the three winners of its undergraduate scholarships for the 2003-2004 academic year;

Kathleen Irene Frank — A senior in rubber technology at Ferris State University, Big Rapids Michigan. Kathleen has been designated as the first Emmanuel M. Kontos Memorial Scholar of the Rubber Division, in memory of the late Dr. Kontos, a highly respected rubber chemist and technologist.

Kinsey Leigh Hastings — a senior in chemical engineering at the University of Nebraska, Lincoln, Nebraska.

Abraham Zachary Levy - A senior in rubber technology at Ferris State University, Big Rapids, Michigan. Abraham is a second-time winner, having received one of these prestigious scholarships for his junior year

With a stipend of $5000, each of these scholarships shall cover tuition, fees and other expenses billed by the respective academic institution. Each winner will be presented with a plaque designating her/him a "Rubber Division, ACS Scholar".

RUBBER DIVISION, INC., AMERICAN CHEMICAL SOCIETY P.O.
Box 499, AKRON OH 44309-0499 USA PHONE: 330-972-7814 FAX: 330-972-5269

FERRIS STATE UNIVERSITY 8/21/2004
COLLEGE OF TECHNOLOGY Plastics and Rubber Engineering Technology Course Syllabus

Course Title: RUBR-110 Introduction to Rubber Technology

Course Description: This course assumes that the student has no prior knowledge of rubber, chemistry, or manufacturing. The course will provide an awareness of the following: rubber industry terminology, the nature of rubber industry, end-use applications of rubber products, the basic processing techniques utilized and safety procedures applicable to the rubber industry. Similarities and differences between rubber and plastics industries will be explored. This course is intended to be the technical foundation on which the remainder of the curriculum is built.

Credit Hours: 3 Semester Hours

Contact Hours:

Lecture: Two Hours/Week
Lab: Three Hours/Week
Field Trip: Two one-day field trips to Michigan rubber processing companies.

Prerequisites: An interest in exploring the field of rubber processing technology.

Textbook Required: "The Vanderbilt Rubber Handbook", 13th Edition

Units of instruction and student learning goals for each unit:

I. Course Introduction

A. Know and understand the course objectives
  - Grading
  - Testing
  - Labs
  - Field trips

B. Safety rules and emergency procedures

II. Introduction to the rubber industry

A. Discovery
B. Name the major end-use markets
C. Name the types of rubber associated with each market
D. Name the major suppliers and their global locations

III. Chemistry and Physics of Elastomers

- A. Chemistry
    1. Organic chemistry
    2. Chemical bonding and chemical structure.
    3. Monomers, polymers, and polymerization.
    4. Vulcanization and crosslinking.
- B. Physics
    1. Force and torque
    2. Pressure, tension, and modulus.
    3. Stress, strain, and elongation.
    4. Visco-elasticity — Creep and stress-relaxtion

IV. Introduction to Rubber Materials

- A. The types of rubber
    1. General purpose rubbers
    2. Solvent resistant rubbers
    3. Temperature resistant rubbers
- B. Differences between rubber and plastics
    1. Thermoplastics
    2. Thermosets
    3. Thermoplastic elastomers (TPE)
    4. Glass transition, melting, and crystallization temperature.
    5. Vulcanization of rubber.

V. Rubber Handling and Processing Methods

- A. Rubber compound mixing
    1. Recipes and cost calculation
    2. Weighing ingredients
    3. Internal mixers
    4. Roll mill mixing
- B. Rubber compound batch testing
    1. Mooney Viscosity and Mooney Scorch
    2. ODRandMDR
    3. Hardness
    4. Specific Gravity
- C. Vulcanization Techniques
- D. Rubber preforming
    1. Barwell Preformer
    2. Extruder
- E. Rubber molding methods
    1. Compression
    2. Transfer
    3. Injection
- F. Other forming methods
    1. Extrusion of shapes
    2. Calendaring and Mandrel molding

VI. Rubber properties and testing

A. Some important properties of rubber
   1. Elasticity
   2. Rebound
   3. Strength
   4. Stiffness
   5. Resistance to temperature extremes
   6. Resistance to chemicals and fluids

B. Rubber property measurement
   1. Tensile
   2. Modulus
   3. Stress relaxation
   4. Compression set
   5. Low temperature stiffness
   6. Aging tests.

VII. Manufacture of Rubber Product

A. Major rubber product categories and the processes used to produce them
B. Describe the product design for each category
C. Describe the types of tooling

VIII. Basic Rubber Product Cost Elements

A. Rubber material (compound)
B. Tooling
C. Processing steps and time
D. Packaging

IX. Field Trip Activities

Two one-day field trips will be utilized to expose the students to a broad range of processes used and products produced in the rubber industry. Details of these field trips will be communicated to the students as they are finalized.

Each student will prepare <u>a field trip report for each trip</u>. This will be due one week after each trip. The following information is to be included in each report:

A. Companies visited
B. Rubber processes employed at each location visited
C. Rubber products or materials produced at each location
D. Polymers/Elastomers used by each location
E. Process flow charts for each product line
F. Housekeeping at each location

RUBR-110 GRADING:

Quiz Score	20%
Homework	6%
Mid-Term	15%
Final (Written)	25%
Lab Reports	25%
Lab Final (Oral Demo)	5%
Field Trip Reports	5%
	101%

Overall %	Grade
96-100	A
92 - 95	A-
89-91	B+
86-88	B
83-85	B-
80 - 82	C+
76-79	C
72 - 75	C-
68-71	D+
63-67	D
59-63	*Dz*
<58	F

RUBR 110 Policies

I. Need a **"Blue Book"** (for Quizzes) and a **Floppy disk.**

II. Attendance

1. There will be weekly quizzes. The lowest 2 will be dropped during the final grading.
2. No make-up on any quizzes.
3. No make-up on mid-term and final exams for unexcused absence.
4. **Leave lab early** will result in lab report deductions.
5. **Absence in lab** will result in "0" in lab report.
6. Any missed lab days must be made up.
7. Arrange or call-in prior to missed class then bring proof.

III. Lab

1. You **must wear** a white **lab coat.** (Ferris Bookstore #3140 & 3155.)
2. You **must wear safety glassed with side shields.**
3. **Shoes** should be of a thick leather, rubber, or plastic-type materials to protect your toes.
4. **Poor housekeeping or no clean-up** will result in lab report deductions.
5. You need a dial caliper in the rubber lab work.
6. There will be six (6) laboratory reports during the semester.
7. The reports must follow the format outlined below:
8. The report is due one week after lab work is done.
9. All work due at beginning of day's class.
10. Late report grades will be **reduced 10%** for each school day.

11. A lab report must be turned in **for each student.** Even if you share the same results in any experiment with your partner, I expect the statements in the sections of Introduction and Discussion will not be the same as your partner.

12. Feel free to discuss your lab reports with me before turning them in. I will be happy to help improve them before grading.

13. The report format is:
    A. **Cover page:** Title of the experiment, the course number and your section number. Your name and the date the experiment is run.
    B. **Introduction: Objectives** of why this experiment is run.
    C. **Apparatus:** All the equipment and instruments used in this experiment.
    D. **Materials and Chemicals:** Include all the materials and chemicals that have been used in performing the experiment.
    E. **Tabulated Table and Results:** Include your data in tables and summarize your experiment.
    F. **Discussion and Answer Questions:** How do you ***feel*** about this experiment? What could have been done better?

IV. Homework

1. There will be five (5) written homework assignments during the semester.
2. Feel free to discuss your homework with me before turning them in.
3. Discussion among classmates is encouraged.
4. You get full credit for the homework you turn in. **Late** homework will be accepted with a reduction of 10% in your homework grade for each school day. There will be penalty for partially finished, or homework with poor quality.

M. Yang

8/21/04

1/4/06

FERRIS STATE UNIVERSITY
COLLEGE OF TECHNOLOGY
Course Syllabus

Course Title: RUBR-121 Rubber Processing 1

Course Description: This first course of rubber processing will cover mixing, shaping and vulcanization of rubber. Students will gain the understanding and knowledge in the material handling, mixing equipment, mixing process and takeoff systems commonly used in the industry. Students will practice with evaluating ingredients, operating different mixers commonly used by the industry, comparing various mixing techniques and putting the rubber compounds into different forms that can be vulcanized into desired products. Mixed rubber compounds will be tested and evaluated to optimize compounding, mixing, and vulcanization processes.

Credit Hours: 3 Semester Hours

Contact Hours: Lecture: Two hours per week
Lab: Three hours per week

Prerequisite: RUBR110

Textbooks Required:

1. "Basic Elastomer Technology" Edited by Baranwal and Stephens
2. "The Vanderbilt Rubber Handbook" Edited by Ohm, 13th Edition.

Units of Instruction:

A. Lecture: (Total 30 units)

1. **Introduction to Course (2 units)**
    - Introduction to the instructor and how to contact the instructor
    - Textbooks and course objectives
    - Review the syllabus, policy and grading

2. **Introduction to Rubber Industry (2 units)**
    - Major products, market and industry trends
    - Key suppliers
    - Manufacturing processes
    - Role of compounders
    - Mixing is central to rubber processing

3. **Vulcanization Techniques (4 units)**
    - Major ingredients, construction of recipes and cost calculation
    - Rheometry—ODR, MDR, Mooney and Capillary rheometers
    - Nomenclature and classification of elastomers

- Curing systems
- Thermoplastic vs. thermoset polymers
- Optimize rubber properties by Design of Experiments (DOE)

4. Overview of Rubber Mixing (4 units)

- Six main classes of raw materials (from the point of view of mixing)
- Four physical changes of ingredients during the mixing cycle
- Carbon black and other reinforcing fillers
- Visco-elasticity of rubber
- Conditioning of mixed rubber compounds
- QC of mixing efficiency
    1. Tensile test
    2. Microscope
    3. Conductivity

5. Internal Mixers (2 units)

- Types and components of internal mixer
- Intermeshing vs. tangential mixing
- Fill factor, Batch size and Batch factor
- Ram
- Power input
- Temperature sensors and control

6. Internal Mixing (4 units)

- Three basic methods / procedures
- Typical mixing procedures
- Masterbatch
- Mastication of NR
- Two-pass mixing
- Dump criteria
- Process variables
- Optimize compound properties by DOE

7. Mill Mixing (2 units)

- Mill safety
- Mill size (D/L)and temperature control
- Front and back rolls vs. Friction ratio
- Typical mixing procedure
- Basic milling techniques

8. Trouble Shooting of Mixing Problems (2 units)

- Poor dispersion
- Scorchiness in rubber compounds
- Contamination

- Poor processability
- Batch - to - batch variation

9. Extrusion (4 units)

- Major components of screw extruder
- Cold feed, hot feed, vented cold feed and pin extruders
- Temperature control
- Effect of extrusion process
- Output rate
- Dimensional stability
- Heat generation
- Rough extrudate

10. Molding (4 units)

- Compression molding
- Transfer molding and mold components
- Injection molding
- Components of injection molding machine
- Molding problems and corrective action
    1. Dimension, appearance and flash
    2. Porosity due to moisture and air
    3. Release
    4. Rubber-to-rubber and rubber-to-metal bonding
    5. shrinkage

B. Lab (Total 15 units)

1. Introduction and Orientation (1 unit)

- Lab safety and chemical handling —MSDS
- Housekeeping
- Mill safety
- Lab notebook must be signed by me at the end of each session
- Writing report
- Determine the dimensions (D/L) and proper batch size of each mills in the rubber lab.

2. Lab #1: Batch Size and Mixing Efficiency of Internal Mixers (2 units)

- EPDM and SBR with 80 parts of carbon black N 550 masterbatches
- Using fill factor of 75%
- Batch factors at 80, 100, and 120%
- Record the following parameters and results:
    i. Movement of Ram
    ii. Temperature
    iii. Power input
    iv. Batch yield
    v. Conductivity of compounds

3. **Lab #2: Rotor Speed and Dispersion of Carbon Black N 550 (2 units)**
    - EPDM with 80 parts CB with sulfur cure system added during the 2nd pass.
    - Using the best Batch Factor determined from Lab #1
    - Three different speeds will be used during the 1st pass
    - Upside-down and modified conventional mixing
    - Record the mixing conditions
    - Run the curing profiles by ODR and Mooney scorch
    - Prepare ASTM standard slabs by compression molding
    - Compare mixing efficiency by the conductivity and tensile properties

4. **Lab #3: Ram Pressure on the Carbon Black Dispersion (2 units)**
    - Similar to Lab #2, except the variation in the ram pressure from 40, 60, to 80 psi.
    - Rotor speed will be determined from Lab # 2.
    - Tensile properties of slabs will be used to judge the mixing efficiency

5. **Lab #4: Oil and Carbon Black Loading on the EPDM Compounds (2 units)**
    - Oil and CB will be used at 3 different levels
    - Mixed EPDM compounds will be evaluated by their tensile properties and Hardness by Shore A Durometer

6. **Lab #5: Neoprene with Metal Oxides (2 units**)
    - Practice internal mixing of Neoprenes G and W with single for W type and double pass for G type
    - Record the mixing conditions
    - Report the following results:
        i. Curing profiles by ODR and Mooney scorch ii.
        Tensile properties iii. Hardness

7. **Lab #6: Hypalon with Different Loading of CB and Accelerators (2 units)**

8. **Lab #7: Injection Molding with Spider Mold (2 units)**
    - Set up DOE with different injection speed and cure time
    - Compare the quality of products by their appearance and weight.

9. **Lab clean up**

POLICIES

ATTENDANCE:

- Arrange / call-in prior to missed class THEN bring proof.
- Any missed lab days must be made up.
- Attendance will be taken during term paper and project presentations and counted as part of your grade.

ASSIGNMENTS:

- All work *{lecture, homework and lab reports)* due at beginning of day's class. There will be 10% deduction per calendar day for late work.
- Excused late work due by next class meeting.

TESTS and Quizzes:

- Notebook for Lab and Lecture
- Signed lab notebook is part of lab grade
- "Blue book" is required for un-announced quizzes.
- "0" for cheating.
- Responsible for information on screen, lecture, and handouts.
- No make-up on any quizzes.
- Two of the lowest quizzes will be dropped during the grading.
- No make-up for tests with unexcused absence.

LAB REPORT DEDUCTIONS:

- **Poor / no clean-up.**
  - Leaving lab early and/or without having my signature on the lab notebook.
  - Improper use of time, tools, and equipment.
  - Come in the lab without preparation.
  - Improper report format.
  - Copied work from "diskette files".

GRADING

QUIZ Scores	25%
Homework	5%
Mid-Term	15%
Final (Written)	25%
Lab Reports	30%
Total	100%

GRADING SCALE

96 - 100	A	76-79	C
92 -95	A-	72-75	C-
89-91	B+	68-71	D+
86-88	B	63-67	D
83 - 85	B-	59-63	D-
80 - 82	C+	<59	F

Laboratory Report Format

- The reports must follow the format outlined below.
- The reports are due the week following completion.
- A lab report must be turned in for each student.
- If your lab partner is not doing his/her share of the lab work or the report writing, do not share your report with them.
- The required lab report format is shown below:
  - o (5 points)Cover Page : Title of the experiment, the course number, section number, and the date when the experiment is finished. o (10 points)Summary: A brief statement of the experiment, the equipment used and the results obtained. o (10 points)Introduction; A statement of why this experiment is run and what is expected.
  - o (10 points) Experimental: Briefly describe the process of the experiment. o (20 points)Data and Results: Tabulate all your data.
    - ■ Describe what actually happened— just facts, no interpretation.
    - ■ Explain your graphs and tables.
    - ■ Include your statistical analysis here: Mean and Standard deviation, deviation of your results from standard/reference values.
  - o (20 points)Discussion:
    - ■ Research into the process.
    - ■ No lab report will get an "A" unless there is some research into the theoretical background and applications of the experiment included in the report.
  - o (Various) Discuss Questions
  - o (10 points)Conclusion: Why do you think you got the results? Make your interpretations here.
  - o (5 points)Bibliography: List your references. o (20 points) Lab notebook with my signature at the end of each lab session. Attach all the raw data, calculation, copies of ODR, Mooney and tensile tests results
- Feel free to discuss your reports with me before you finish them or hand them in. I will be happy to help improve them before grading.

Email: yangm(ffiferris.edu
Phone: (231)591-5263
Fax: (231) 591-2642

Office hours as posted on bulletin board.

FERRIS STATE UNIVERSITY 8/23/02
COLLEGE OF TECHNOLOGY Department of
Plastics and Rubber Engineering Technology

COURSE Syllabus

COURSE TITLE: **RUBR-212** Rubber Tooling Design and Construction

COURSE DESCRIPTION: This course will provide the student with knowledge of rubber processing tooling design and fabrication. Designs for extrusion dies, compression, transfer and injection molds plus trim and deflash tooling will be reviewed. Tooling for rubber products will be designed. They will become familiar with material selection for best machining time, optimum tool life and accuracy. Instruction on the correct and safe operation of machine tools used in the fabrication of rubber process tooling will be given.

CREDIT HOURS: Two semester hours

CONTACT HOURS: Lecture - One hour per week

Lab - Three hours per week

PREREQUISITES: ETEC 140 and RUBR 121

TEXTBOOK: Moldmaking & Die Cast Dies for Metalworking Trainees,
by John Kluz,

UNITS OF INSTRUCTION:

I. Introduction, Orientation, Conduct and Safety.

II. Review of Processing Methods used in the Rubber Industry.
   A. Vulcanization and curing techniques
   B. Manufacturing of tennis and golf balls
   C. Hose and cable technology

III. Compression molds
   A Process of compression molding
      - Heat history of rubber compounds
      - Curing time and thickness of rubber products
   B. Definition of mold components and process of compression molding.
   C. Types of molds
   D. Determination of shrinkage for rubber compounds

IV. Molded Rubber products specifications
   A. Product drawing designation by RMA
   B. Reading drawing by design engineer

V. Transfer mold design and materials
   A. Important features of transfer molds
   B. Definition of transfer mold components.
   C. Types of molds

D. Construction details

VI. Standard transfer and compression molds requirements — A case study
A. Definition of components
B. Dimension, materials, and tolerance.

VII. Injection mold design and materials
A. The components of injection molds and their functions.
B. Molds basics and design objectives
C. Projected area and clamp pressure
D. Parting line and number of cavity
E. Runners and gates
F. Hot vs. cold runner molds
G. Types of gates used for injection molds
H. Pockets and mounting inserts
I. Vents

VIII. Trim and deflash tools and materials
A. Flash extension and thickness
B. Common methods of flash removal
C. RMA designation of flash

IX. Machine tool operation and safety

X. Tool Steels and their hardening
A. Alloying elements
B. AISI Categories
C. Hardening methods
D. Pre-hardened and hardening

XI. Tooling and Bill of Material
A. Identify and understand hardware used in the construction of molds and tooling used in Rubber B. Reading Bill of Materials

XII. Clean up

RUBR-212 GRADING:

Quiz Scores	20%
Homework	10%
Mid-Term	10%
Final (Comprehensive)	25%
Lab work	20%
Mold Drawing Project	10%
Rubber Shrinkage Project	5%
	100%

Overall %	Grade
96-100	A
92 - 95	A-
89-91	B+
86-88	B
83 - 85	B-
80 - 82	C+
76-79	C
72 - 75	C-
68-71	D+
63-67	D
59-63	Dz
<58	F

Attendance, Lab and Homework Policies

I. Attendance

1. There will be weekly quizzes at the beginning of lecture.
2. Two of them with the lowest grade will be dropped.
3. No make-up on any quizzes.

II. Lab

1. You must wear a white lab coat. (Ferris Bookstore #3140 & 3155.)
2. You must wear safety glassed with side shields.
3. Shoes should be of a thick leather, rubber, or plastic-type materials to protect your toes.
4. You need a dial caliper in the rubber lab work.

III. Homework

1. There will be five (5) written homework assignments during the semester.
2. You will have about 2 weeks to finish your homework and turn them in according to the due date printed on the assignments.
3. All work due at beginning of day's class.
4. Feel free to discuss your homework with me before turning them in.
5. Discussion among classmates is encouraged.
6. You get full credit for each homework you turn in. Late homework will be accepted with a reduction of 20% in your homework grade for each school day.

8/23/02
M. Yang

COURSE TITLE: **FERRIS STATE UNIVERSITY** **COURSE: RUBR 223**
COLLEGE OF TECHNOLOGY **DATE: 01-09-2005**

PLASTICS AND RUBBER

DEPARTMENT COURSE

Syllabus

Rubber Measurement and Testing

COURSE DESCRIPTION: This course will allow the students to explore the methods of measuring various rubber and rubber product parameters. Students will become familiar with ASTM test methods for rubber compounds and with the ASTM/SAE material classification system. They will use standard rubber test methods and prepare proper test reports. The concepts and practice of SPC will be covered in the course.

CREDIT HOURS: Four semester hours

CONTACT HOURS: Lecture - Two hours per week Lab
- Six hours per week

PREREQUISITES: MATH 116, RUBR 110

TEXTBOOK:
1. Elastomer Technology-Special Topics
2. The Vanderbilt Rubber Handbook, 13th edition.

UNITS OF INSTRUCTION:

	Lecture	Lab
I.	1. Introduction and orientation 2. Course goals and Textbook 3. Project and grading *Weekl*	Orientation: 1 .House-keeping 2. SAFETY and MSDS. 3. Writing reports 4. Textbooks *Weekl*
II.	A. Review Terminology B. Application of basic statistics 1. Accuracy, bias, and precision. 2. Frequency table, histogram, and distribution 3. Averages — mode, median, and mean 4. Quantitative measures of variability 4.1. Range 4.2. Variance 4.3. Basic analysis of variance 4.4. Standard Deviation 5. Standard. Deviation, Standard Score(z), and their applications for data with normal distribution C. Statistical Process Control (SPC) and Process Capability Indices *Weeks 1 to 2*	**EXP. 1 Statistical analysis** *1.* Money Viscosity of EPDM with different ethylene content *2.* MDR for Ts 1, Tc90, ML and MH *3.* Tensile strength, 100% modulus, and elongation *4.* Statistical analysis by ASTM 5. Control Charts and Process capability *Weeks 1 to 2*

III.

Lecture

1. ASTM Standards D 1349, 1418, 3182, and 3767
2. ASTM D 2000 and Line Call-outs

Week 3-5

IV. Rheometers
1. Mooney Viscometer, D 1646
   Viscosity
   Visco-elasticity
   Mooney viscosity Stress relaxation
   Pre-vulcanization characteristics

2. ODR, ASTM D 2084

3. Rotorless Shear Rheometers (MDR)
   ASTM D 6204 - 99

Week 6

V. Tensile Tester
1. Mechanical properties of elastomers
2. Tension tests (ASTM D 412)
   - 1.1. Modulus
   - 1.2. Tensile strength and stress induced crystallization
   - 1.3. Elongation
   - 1.4. Tension set & stress relaxation
3. Tear strength (ASTM D 624)
4. Adhesion

Week 7

VI. Hardness, Compression Set, Resilience, and Heat Buildup
1. Hardness
   - 1.1. Durometer Hardness, D 2240
   - 1.2. International Hardness, D 1415

2. Compression Set
   - 2.1. Under constant deflection in air at an elevated temperature. D 395B.
   - 2.2. Low temperature compression set. D 1229

3. Resilience, Heat Buildup, and Rebound
Resilience using a rebound pendulum, D 1054
Resilience by vertical rebound, D 2632 Heat generation and flexing fatigue in compression, D623

Week 8

Lab

EXP.2
1. Preparation of rubber compounds by
   ASTMD 3182 and
   NR —ASTM D3184
   SBR —ASTMD 3185
   EPDM — ASTM D 3568
   NBR (2) — ASTM D 3187
   IIR and BUR — ASTM D 3188 and 3958
   CR —ASTM D3190
2. Density
   Density measurement
   Density of vulcanizates
   Calculating sample size
   Determining batch size and batch factor

Weeks 3 to 4

EXP.3

1. Tension tests
2. Tension set
3. Tear resistance
4. Techniques of using measurement equipments. ASTM D 3767; Standard practice for measurement of dimensions.
4. Durometer hardness — before and after fluid immersion.
5. Compression set. D 395
6. Vertical rebound.

Weeks 5-6

VII. Fluid Immersion
1. Hydrocarbon vs. specialty rubbers
2. Solvent resistance, D 471
3. Degree of crosslinking.

Weeks 8&10

VIII. Thermal Stability of Rubber
1. Heat aging (D 573 and D 865)
2. Environmental properties of rubber
    2-1. Oxidative aging
    1.5. Ozone aging
    1.6. Weather resistance and Outdoor testing

Week 11

IX. Cold Tests
1. Glass-transition temperature, T_g, of polymers.
2. DSC
3. Cold box tests (Compression set at low temperature).
4. Retraction at lower temperature (TR test, D 1329)
5. Gehman torsional stiffening resistance (D 1053)

Weeks 12 & 13

X. Abrasion Resistance and Adhesion of Rubber
1. Abrasion resistance
    1.1. Footwear Abrader (D 1630)
    1.2. Pico Abrader(D 2228)

2. Adhesion of rubber to rigid substrates (D429)

Week 13

XL Dynamic Properties of Rubber
1. Rubber deterioration due to dynamic fatigue (D 430)
2. Standard guide for dynamic testing (D 5992)

Week 14

XII. Identification of Rubber and Chemical Analysis
1. Infrared Analysis and FTIR
    1.1. Types of rubber
    1.2. Composition of comonomers in EPM/EPDM and SBR(D3900)
    1.3. Type of diene in EPDM(D 6047)
2. HPLC for accelerators (D 5297)

Week 15

XIII Measurement of Processing Properties Using Capillary Rheometry (D 5099)

Week 16

Exp. 4 Fluids Resistance

After fluid immersion, run
1. Tension tests
2. Tear resistance test
3. Density

Weeks 7-10

EXP. 5 Rubber properties at extreme temperatures

1. Tension tests after heat aging
2. Tear resistance test after heat aging
3. Cold box and hardness tests.
4. TRtest.

Weeks 11 & 12

EXP. 6 Thermal Analysis
1. TGA
2. DSC

Week 13-15

Lab Clean up

Week 16

POLICIES

ATTENDANCE:

Arrange / call-in prior to missed class THEN bring proof.
Any missed lab days must be made up.
Attendance will be taken during term paper and project presentations and counted as part of your grade.

ASSIGNMENTS:

All work *{lecture, homework and lab reports)* due at beginning of day's class.
There will be 10% deduction per calendar day for late work. Excused late work due by next class meeting.

TESTS and Quizzes:

"Blue book" is required for un-announced quizzes.
"0" for cheating.
Responsible for information on screen, lecture, and handouts.
No make-up on any quizzes.
Two of the lowest quizzes will be dropped during the grading.
No make-up for tests with unexcused absence.

LAB REPORT DEDUCTIONS:

Poor / no clean-up. Leaving lab early. **Improper use of time, tools, and equipment.**
Come in the lab **without preparation.**
Improper report format.
Copied work from "diskette files".

Projects:

1. **Project 1, Line Call-out**
2. **Tensile properties and Adhesion of Co-vulcanized Rubbers**

GRADING

QUIZ Scores	**25%**
Homework	**5%**
Mid-Term	**10%**
Final (Written)	**25%**
Lab Reports	**20%**
Projects (8% for each project- including 2 % oral presentation)	**16%**
Total	**101%**

GRADIN SCALE

96 **-100**	**A**	**76- -79**	**C**
92 **-95**	**A-**	**72- -75**	**C-**
89 **-91**	**B+**	**68 -71**	**D+**
86 **-88**	**B**	**63- -67**	**D**
83 **-85**	**B-**	**59- -63**	**D-**
80 **-82**	C+	**<59**	**F**

Laboratory Report Format

- The reports must follow the format outlined below.
- The reports are due at the next regular lab session or meeting.
- A lab report must be turned in for each student.
- If your lab partner is not doing his/her share of the lab work or the report writing, do not share your report with them.
- The required lab report format is shown below:
  - o **Cover Page** : Title of the experiment, the course number, section number, and the date when the experiment is finished. o **Summary:** A brief statement of the experiment, the equipment used and the results obtained. o **Introduction:** A statement of why this experiment is run and what is expected. Also briefly describe the process of the experiment. o **Appparatus:** Instruments and equipment. o **Materials:** Rubber and chemicals used. o **Data and Results:** Tabulate all your data. Also attach your original graphs generated by the instruments.
    - ■ Describe what actually happened— just facts, no interpretation.
    - ■ Explain your graphs and tables. Highlight the main findings from your data.
    - ■ Include your statistical analysis here: Mean and Standard deviation, deviation of your results from standard/reference values.
  - o **Discussion:**
    - ■ Research into the process.
    - ■ No lab report will get an "A" unless there is some research into the theoretical background and applications of the experiment included in the report.
  - o **Conclusion:** Why do you think you got the results? Make your interpretations here. o **Bibliography:** List your references.
- Feel free to discuss your reports with me before you finish them or hand them in. I will be happy to help improve them before grading.

Email:

Phone:(231)591-5263
Fax: (231)591-2642

Office hours as posted on bulletin board.

FERRIS STATE UNIVERSITY **COURSE:** RUBR 321
COLLEGE OF TECHNOLOGY **DATE:** 01-07-05
PLASTICS AND RUBBER ENGINEERING TECHNOLOGY DEPARTMENT

COURSE Syllabus

COURSE TITLE: Rubber Compounds / Compounding

COURSE DESCRIPTION: This course will provide the student with knowledge of basic polymer science applied in rubber technology. The physical and rheological properties of these materials will be examined. The composition of rubber compounds will be explored. This will include the effect of each type of ingredient on the processing and performance of the material. The basics of compound modification to improve processing of the material and /or performance of the product will be taught.

CREDIT HOURS: Four semester hours

CONTACT HOURS: Lecture - Two hours per week
Lab - Six hours per week

PREREQUISITES: Rubber Processing I and II (RUBR 121 and 211)

TEXTBOOK: 1 .Rubber Technology: Compounding and Testing for Performance, Edited by John Dick 2.
Vanderbilt Rubber Handbook

UNITS OF INSTRUCTION:

Lecture

1-1. Introduction, orientation and grading 1-
2. Course goals and textbook 1-3. Polymer
chemistry

Unit 1

II. Rubber compounding
  2-1. Classification of compounding ingredients
  2-2. General industrial product compound
  2-3. Monomers and Polymers (Olefins, vinyls, and acrylics)
  2-4. Dienes and diene polymers

Units 2 and 3

III. Rubber compound economics
  3-1. Batch size, fill factor and batch factor
  3-2. Density (Specific Gravity, sp.gr.) 3-3.
  Cost calculation
  3-4. Compound design and compound cost reduction. 3-5.
  Thermal analysis and reverse engineering—DSC and TGA

Unit 4

Lab

Orientation: 1. Safety
2. MSDS
3. **House keeping** and lab policy
4. Lab notebook
4. Writing reports
5. Project

Weekl

Experiment 1: EVand sulfur vulcanization for NR

1. Prepare carbon black master batches
2. Using Brabender to mix curing system into rubber compounds
3. Run MDR (Including TD)
4. Report property differences after heat aging and compression set.

Weeks 1 &2

Lab Demo on DSC and TGA
(for Term Paper)

Weeks 2 -

Lecture	*LAB*
IV. Elastomer selection 4- 1. R class 4-2. M class 4-3. Low volume specialty elastomers 4-4. Thermoplastic elastomers (TPE) 4-5. ASTM D-2000 o Fluid resistance o Heat resistance and weather aging *Units 5 &6*	**Experiment** 2: Organic accelerators for Sulfur Cure System for NBR and EPDM *Weeks 3&4*
General purpose elastomers and blends 5-1. Diene rubbers 5-2. Polymer effect on mixing 5-3. Polymer effect on curing 5-4. Visco-elasticity 5-5. Stress-strain and hysteresis 5-6. Fatigue and dynamic properties *Units 7&8*	Exp.3: Processability of RubberFillers • Mooney scorch • Capillary Rheometer • Injection molding with spider mold *Weeks 5-7*
VI. Specialty elastomers 6-1.HNBR 6-2. IIR, CIIR, and BUR 6-3. ACM, CR, CM, and CSM 6-4. CO, ECO, MQ, and PU 6-5. FKM 6-6. Cure systems of Specialty Elastomers *Units 9, 10, & 11*	Exp. 4: Metal Oxides and Peroxide Cure Systems *Week8-10*
VII. Carbon black and Non-black fillers 7-1. Reinforcing and non-reinforcing fillers, Surface treatment of fillers 7-2. Carbon Black(CB) 7-2-1. Structure and surface area of CB 7-2-2. Compounding and Mixing CB	Exp. 5: Phenolic Resin and Bisphenol AF Cure Systems *Weeks 11- 12*
7 o g.,. 7-4. Clay and other fillers 7-5. Compound applications *Units 12 & 13*	**EXP.6:** Sponge Rubbers *Weeks 13& 15*
VIII Compounding with oil, ester plasticizers, adhesion promoters, and processing additives 8-1. Compatibility issues 8-2. Application trends 8-3. Processability 8-4. Compounding for brass wire adhesion *Unit 14*	**Presentation and Clean-up** *Week 16*
IX. Tackifying, curing, and reinforcing resins *Unit 15*	

POLICIES

ATTENDANCE:

- Arrange / call-in prior to missed class THEN bring proof.
- Any missed lab days must be made up.
- Attendance will be taken during term paper and project presentations and counted as part of your grade.

ASSIGNMENTS:

- All work *{lecture, homework and lab reports)* due at beginning of day's class. There will be 10% deduction per calendar day for late work.
- Excused late work due by next class meeting.

TESTS and Quizzes:

- **Notebook for Lab and Lecture**
- "Blue book" is required for un-announced quizzes.
- "0" for cheating.
- Responsible for information on screen, lecture, and handouts.
- No make-up on any quizzes.
- Two of the lowest quizzes will be dropped during the grading.
- No make-up for tests with unexcused absence.

LAB REPORT DEDUCTIONS:

- **Poor / no clean-up.**
- **Leaving lab early and /or without my signature on the lab notebook.**
- **Improper use of time, tools, and equipment.**
- Come in the lab **without preparation.**
- Improper report format.
- Copied work from "diskette files".

Term Paper:

- **Polyolefins for Rubber and Plastic Applications**
    1. The draft (20%) is due on **1/27.** Final is due on **2/10.**
    2. Polyolefins should be included in your report/research are: PE, PP, EPM/EPDM, X-PE, CPE, CSM, and polyisobutylene.
    3. **Include DSC findings on polyolefins in your report.**

- Paper should cover at least following 3 areas:
    - Structures and properties relationship
    - Their manufacture and major trade names
    - Their compounding/processing and applications

PROJECT:

- **Each student will be required to design a dynamic vulcanization system**
- **Develop a product/sample.**
- **Document and conduct tests.**
- **Turn in the project report and present your project and your results/finding to the class.**

GRADING

QUIZ Scores	22%
Homework	4%
Mid-Term	12%
Final (Written)	25%
Lab Reports	25%
Project (including 30% oral presentation)	8%
Term paper	5%
Total	101%

GRADING SCALE

96 -100	**A**	**76 -79**	**C**
92-95	**A-**	**72 -75**	**C-**
89-91	**B+**	**68 -71**	**D+**
86-88	**B**	**63 -67**	**D**
83-85	**B-**	**59 -63**	**D-**
80-82	**C+**	**<59**	**F**

Laboratory Report Format

- The reports must follow the format outlined below.
- The reports are due at the next regular lab session following completion.
- A lab report must be turned in for each student.
- If your lab partner is not doing his/her share of the lab work or the report writing, do not share your report with them.
- The required lab report format is shown below:
    - o <u>(5 points)Cover Page</u> : Title of the experiment, the course number, section number, and the date when the experiment is finished. o <u>(10 pomts)Summary:</u> A brief statement of the experiment, the equipment used and the results obtained. o <u>(10 pomts)Introduction:</u> A statement of why this experiment is run and what is expected.
    - o <u>(10 points) Experimental:</u> Briefly describe the process of the experiment.

- (20 points)Data and Results: Tabulate all your data.
  - Describe what actually happened— just facts, no interpretation.
  - Explain your graphs and tables.
  - Include your statistical analysis here: Mean and Standard deviation, deviation of your results from standard/reference values.
- (20 points)Discussion:
  - Research into the process.
  - No lab report will get an "A" unless there is some research into the theoretical background and applications of the experiment included in the report.
- (Various) Discuss Questions
- (10 points)Conclusion: Why do you think you got the results? Make your interpretations here.
- (5 points)Bibliography: List your references.
- (20 points) Lab notebook with my signature at the end of each lab session. Attach all the raw data, calculation, copies of ODR, Mooney and tensile tests results

Feel free to discuss your reports with me before you finish them or hand them in. I will be happy to help improve them before grading.

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Office hours as posted on bulletin board.

FERRIS STATE UNIVERSITY **COURSE: RUBR 312**
COLLEGE OF TECHNOLOGY **DATE: 1-08-08**
Plastics & Rubber Engineering Technology Department

COURSE Syllabus

COURSE TITLE: Rubber Product Design

COURSE DESCRIPTION: In this course, the student will study the concepts of part design beginning with the definition of the "Customer/ End-Use Requirements", through the "Design Cycle" guidelines and product application. Special emphasis will be given to understanding the role of the following elements in Rubber Product Design:

- Material Selection
  Prototyping and Modeling part designs
- The Part Drawing
  Rubber Part Design Basics
  Form, Fit and Function in the application
- Part Quality - what is acceptable
  Relationship of Tool Design to Part Design
- APQP and FMEA
  Relationship of Process Factors to Part Performance
- Part Costing and Design to Cost
- End-use factors that impact rubber part performance

CREDIT HOURS: Four semester hours

CONTACT HOURS: Lecture - Three hours per week Lab
- Three hours per week

PREREQUISITES:
Rubber Processing II (RUBR 211)
Engineering Graphics Comprehensive (ETEC 140)
Rubber Testing (RUBR 223 / 290)

TEXTBOOK:
"Rubber as an Engineering Material: Guideline for users", Khairi Nagdi
"Rubber Products Manufacturing Technology", Bhomick, Hall & Benarey

UNITS OF INSTRUCTION:

I. Introduction, Orientation, Course Goals and Grading

II. Rubber as an Engineering Material
   a. Introduction to Rubber Product Design
   b. Tires and Hoses Manufacturing
      i. Components and their functions ii.
      Construction of tires and hoses

III. Elastomer fundamental
   a. Rubber, Steel, and Plastics
   b. Stress, strain and modulus
   c. Rubber deformations

    - d. Shape Factor
    - e. Tension set and hysteresis
    - f. Viscoelasticity — Spring and dashpot models
    - g. Cyclic deformation
    - h. Dynamic properties and Tan 5
    - i. Glass transition and crystallinity

IV. Rubber Product Design Concepts
    - a. Definition of Product Requirements
    - b. Developments in tire technology
    - c. Rubber for noise and vibration isolators
        - i. Engine and body mouns
        - ii. Rubber bridge bearings
    - d. Hose technology
    - e. V-belt and fan belt
    - f. Sealing technology
    - g. Rubber-covered Rollers
    - h. Life time prediction

V. Selecting a Rubber Material
    - a. General / Solvent resistant / Heat resistant
    - b. Line call-outs

VI. Computer-Aided Design for Mold and Product
    - a. CATIA for 3-D modeling
    - b. Finite Element Analysis (FEA) / Finite Element Modeling (FEM)
        - i. Models for rubber — linear or non-linear?
        - ii. Terminology iii. Types of FEA models iv. Some practical examples

VII. Part Costing / Value Analysis

VIII. Examinations

Case Studies, Lab and Project

Case studies

1. Research on design and manufacturing of tires
    - Tire components and how do they work
2. O-rings in check valves for fluids and rocket engines

Lab work

1. Effects of temperature on tension modulus at constant stress and strain
    - a. Pattern of stress-strain curve for different polymers
    - b. Effect of temperature on rubber band at constant stress
    - c. Change in tension modulus due to heating at a constant strain
2. Shape factor and modulus and hardness
3. Three-D modeling by CATIA software
4. Oil filter gaskets

5. Piston seal for disk brake
6. CV joint boots
7. Timing and V- belts

Project

Construction of sling shots

- Feel free to discuss your reports and other assignments with me before you hand them in. I will be happy to help you to improve them before grading.

Grading

Activity	%
Quizzes	25
Homework	10
Lab and Reports	20
Mid Term Exam	15
Final Exam	20
Project and Presentation	10
Total	100

Grading Scale

95 -100	**A**	**76-78**	**C**
91-94	**A-**	***12-IS***	**C-**
88-90	**B+**	**68-71**	**D+**
85-87	**B**	**63-67**	**D**
82-84	**B-**	**59-63**	**D-**
79-81	**C+**	**<59**	**F**

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FERRIS STATE UNIVERSITY **COURSE: RUBR 411**

8/23/2007

COLLEGE OF TECHNOLOGY Plastics & Rubber Engineering Technology Department

COURSE SYLLABUS

COURSE TITLE: Advanced Rubber Processing

COURSE DESCRIPTION: This course will provide students with exposure to advanced concepts and technologies of rubber molding and extrusion. Students will be required to document control parameters, analyze each of them, and optimize the assignments. Statistical quality controls and process improvement techniques, such as DOE, SPC, FMEA, and APQP will be practiced. In addition, MS Project® and MiniTab® will be used to enhance students' problem solving and trouble shooting skills in molding and extruding different rubbers. Process capability indices will be applied to the selected assignments/projects.

CREDIT HOURS: Four semester hours
CONTACT HOURS: Lecture - Two hours per week
Lab - Six hours per week
PREREQUISITES: Rubber processing I (RUBR 121)
Rubber processing II (RUBR 211)
Rubber Testing (RUBR 223)
TEXTBOOK: Elastomer Molding Technology by John G. Sommer
Vanderbilt's Rubber Handbook

COURSE OBJECTIVES: Upon completion of the course students will be able to

1. Start up and shut down major processing and mixing equipment safely.
2. Demonstrate their understanding of elastomer molding fundamentals.
3. Compare and contrast differences and similarity among extrusion and various molding processes.
4. Identify and evaluate major processing parameters and how they affect the process and product.
5. Apply basic quality control tools and engineering management skills.
6. Collaborate with other team members to develop problem solving methodology.
7. Present their results in coherent, well-written professional reports individually.

COURSE OUTLINE:

Weekl

Lecture 1: Syllubus and policy

1. Course objectives, textbook, policies, and grading system.
2. Course and instructor expectations

Lecture 2: Overview of rubber compounding, heat history, and scale-up of mixing

LAB:

1. **Lab safety and house keeping policy**
2. Organize, shelve and refill rubber and chemicals
3. Project teams
4. Lab reports—format and policy
5. Review and organize Standard Operation Procedures (SOPs) for key equipment.
6. Molding SBR balls for Lanxess project
    i. SOP and spread sheets
    ii. Key features and control issues with Dieffenbacher and DESMA

Week 2

Labor Day, no lecture. **Lecture 3:**

Overview of elastomer molding

1. Molding methods for TSE and TPE
2. Elastomer and system approach for molding systems
3. Performance vs. degree of crosslinking

Reading: Chapter 1, Introduction to Elastomer Molding

LAB:

Lab #1: SBR compounds for ball mold and flow index mold

1. Start up and shut down key processing equipment
2. Construct spread sheets and document all the processing parameters
3. Obtain 2 SBR compounds, fast cure and slow cure, from the instructor with curing data.
4. Evaluate (from 1-5) welding line, mass, and hardness **for flow index molding**
5. For rubber ball molding, using parameters suggested by the instructor and evaluate
    i. Productivity (# of balls that meet the specs/hour) ii. State of curing by hardness test to be performed the following Monday, iii. % of rebound.
6. Repeat at least 3 shots for each set of molding conditions. Report the averaged data collected.
7. Collect all the data and propose a few sets of molding conditions to be used for the DOE study in Lab #3 during Week 3. Turn in Lab Report #1 on Monday, Week 4.

Week 3 (Whenever Monday session is used for lab work, Leture will be moved to the first hour of lab on Friday.)

Lectures 4 and 5: Molding temperature and temperature controls

1. Flow and preform of rubber compounds
2. Curing and shrinkage
3. Temperature controls and thermal conductivity of rubber compounds
4. DOE overview

Reading: Chapter 2, Compression molding of TSE

LAB: (This lab work will take 2 weeks to finish.)

Lab #2: Applying DOE to optimize quality and productivity of SBR (fast cure) balls

1. DOE proj ect team
2. Set up 2 sets of DOE with 3 factors and 2 levels for each factors
3. Use MS Project to construct task sequence and mile stones.
4. Co-relate Platen, "True" molding, and compound temperatures.
5. Develop an optimized process to produce SBR balls with good quality and productivity.

Week 4

Lectures 6 and 7: Reports with DOE, MiniTab and MS Project

1. Design of Experiments (DOE or DOX) i. Factors and levels ii. Full Factorial and Taguchi designs

iii. Design and analysis of simple DOE
iv. Two-level fractional factorial and Taguchi designs 2. Softwares for DOE study: practicing MiniTab and MS Project **Reading: Chapter 2.**
LAB: Finish Lab #2. Report due Friday, Week 5.

Week 5
Lectures 8 & 9:

1. Rubber compounds
   i. Deflashing ii. Use of CTP and retarders for high temperature molding
2. Transfer pot and plunger
3. Pressure and temperature control

Reading: Chapter 3, Transfer molding of TSE
LAB
Lab #3: Process development for molding polybutadiene (PBR) balls by DOE
(Follow the methodology of LAB 2. Finish collecting all the data the following Monday, in Week 6.)

Week 6 Lectures 10 & 11

1. Mold for transfer molding
2. Defects and trouble shooting
   a. Trapped air, blisters, poor knitting, rough surface, and backrinding
   b. surface contamination, Nozzle and runner flash

Reading: Chapter 3, Transfer molding of TSE
LAB
Lab #4: (3 weeks) Injection molding of IIR balls

1. Setup 3 sets of 3 x 2 DOEs
   i. Curing profile and Mooney ML of IIR compounds
   ii. Back pressure
   iii. Temperatures of screw, injection cylinder, platens, compound temperature iv. Injection time, injection velocity and profile
   v. Plastication vi. Extruded (hot feeder) vs. cut strips
2. Focus on Welding line and others to study state of cure and scorchness with flow index mold
3. Hardness
4. # of defects/heat
5. Productivity

Week 7
Lecture 12 and MidTerm

1. Sprue, runners, and gates
2. Cavity design
3. Vent and vacuum

Reading: Chapter 4. Injection molding of TSE
LAB
Continued on Lab #4

Week 8

Rubber Expo in Cleveland, no lectures.

LAB—Finish Lab #4. Report due next Friday.

Week 9

Lectures 13 and 14

1. Defects and trouble shooting for injection molding
2. Mold fouling and cleaning

Reading: Chapter 4. Injection molding of TSE

LAB

Lab #5: Injection molding of BUR (2 weeks)

1. Curing profile and MgO
2. Weight loss by TGA (from 200 to 400 deg. C)
3. Preparation of feeding strips—Extrusion vs. cutting

Week 10

Lectures 15 &16: Extrusion Process

1. Equipment
2. Die change
3. Capillary rheometry

Reading: Chapter 4. Injection molding of TSE

LAB

Finish Lab #5. Report due next Friday

Week 11

Lectures 17 & **18:** Extrusion

1. Capillary rheometry
2. Uniformity of flow and extrudate quality
3. Output rate and productivity

Reading: Chapter 4. Injection molding of TSE

LAB (2 weeks)

Lab #6: Extrusion by DOE (I)

Week 12

Lectures 19 & **20:** Dynamic properties of rubber

1. Mooney stress-relaxation
2. Visco-elasticity of polymers
   1. Rheology of polymers
      a. Newtonian vs. Non-Newtonian
      b. Viscosity, shear stress, and shear rate
      c. Shear rate ranges of various processes for rubber
3. Phase angle (Tan 8) and RPA

LAB

Finish Lab #6. Report due next Friday

Weeks 13 & 14

Lectures 21 & **22:** Continuous mixing and twin screw extruders

Reading: Chapter 5, Mold fouling and cleaning

LAB (3 weeks, weeks 13, 14 and 15)

Lab #7: Extrusion by DOE (II)

Week 15 Ledtures
23 & 24:

1. Injection molding of liquid silicone rubber
2. SPC—control charts and process capability indices for molding and extrusion processes

Reading: Injection molding of liquid silicone rubber
LAB: Finish Lab #7 and lab clean up. Report due next Friday.

POLICIES

ATTENDANCE:

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- Leaving lab early.
- Improper use of time, tools, and equipment.
- Come in the lab without preparation.
- Improper report format.
- Copied work from "diskette files".

GRADING

QUIZ Scores	25%
Homework	5%
Mid-Term	15%
Final (Written)	25%
Lab Reports	30%
Total	100%

GRADING

94 -100	**A**	**7 -75**	**C**
90 -93	**A-**	**6 -71**	**C-**
86 -99	**B+**	**6 -67**	**D+**
83 -85	**B**	**5 -63**	**D**
80 -82	**B-**	**5 -58**	**D-**
76 -79	**C+**	**<56**	**F**

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- The reports are due at the next regular lab session or meeting.
- A lab report must be turned in for **each student.**
- If your lab partner is not doing his/her share of the lab work or the report writing, do not share your report with them.
  - **Lab Report:** The grade of each lab report will consist of the following scores:
    1. **Cover page** and **Summary:** no longer than 2 paragraphs—**10** %
    2. **Introduction:** background, theory, and objectives of the experiment, at least one page—**20%**
    3. **Experimental and Data— 20%**
       - ■ Main equipment and instruments used and methodology
       - ■ Tabulated data (raw data) such as recipes, ODR /MDR, Tensile test and all other tests.
       - ■ These section should contain any results of your experiment that you will use for your discussion and conclusion.
    4. **Results and Discussion: Processed data** with charts, diagrams, figures, etc. — **30** %
    5. **Conclusion — 15 %**
    6. **Bibliography — 5%**

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