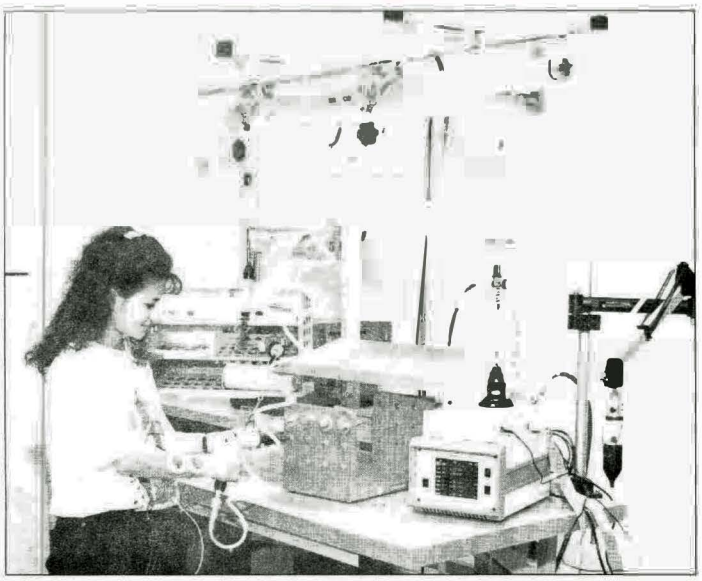
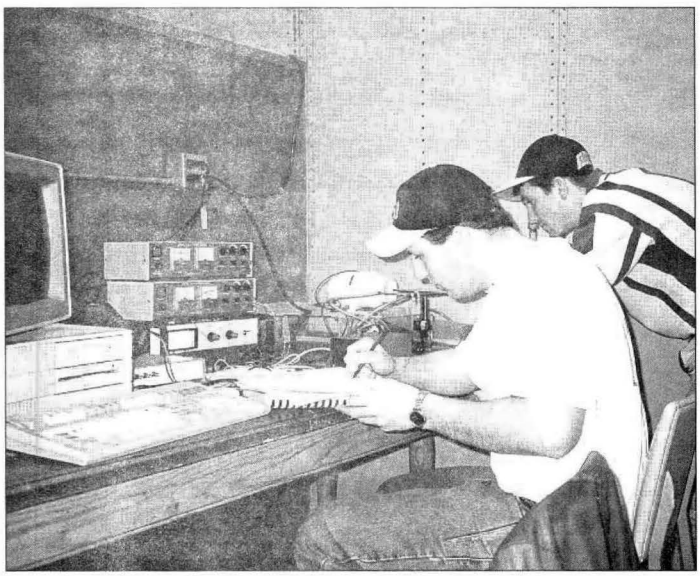
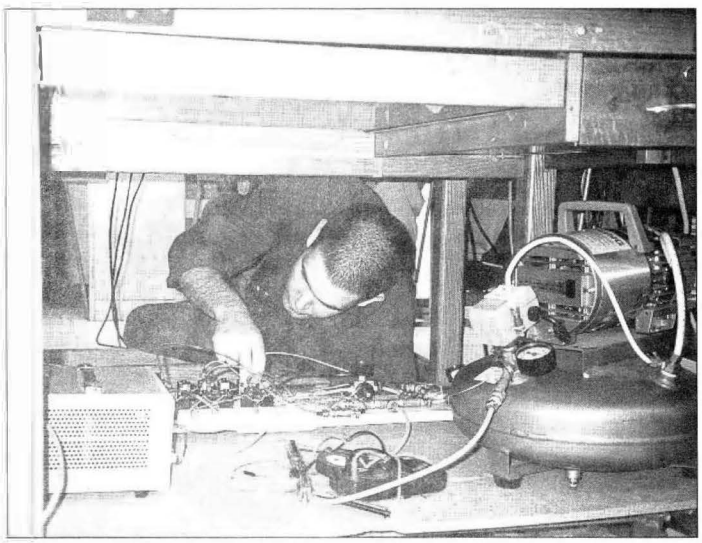
4-1997

20th Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences







20th Conference on Senior Engineering Design Projects

Thursday, April 17, 1997

Bernhard Center

9 a.m. to 4:30 p.m.

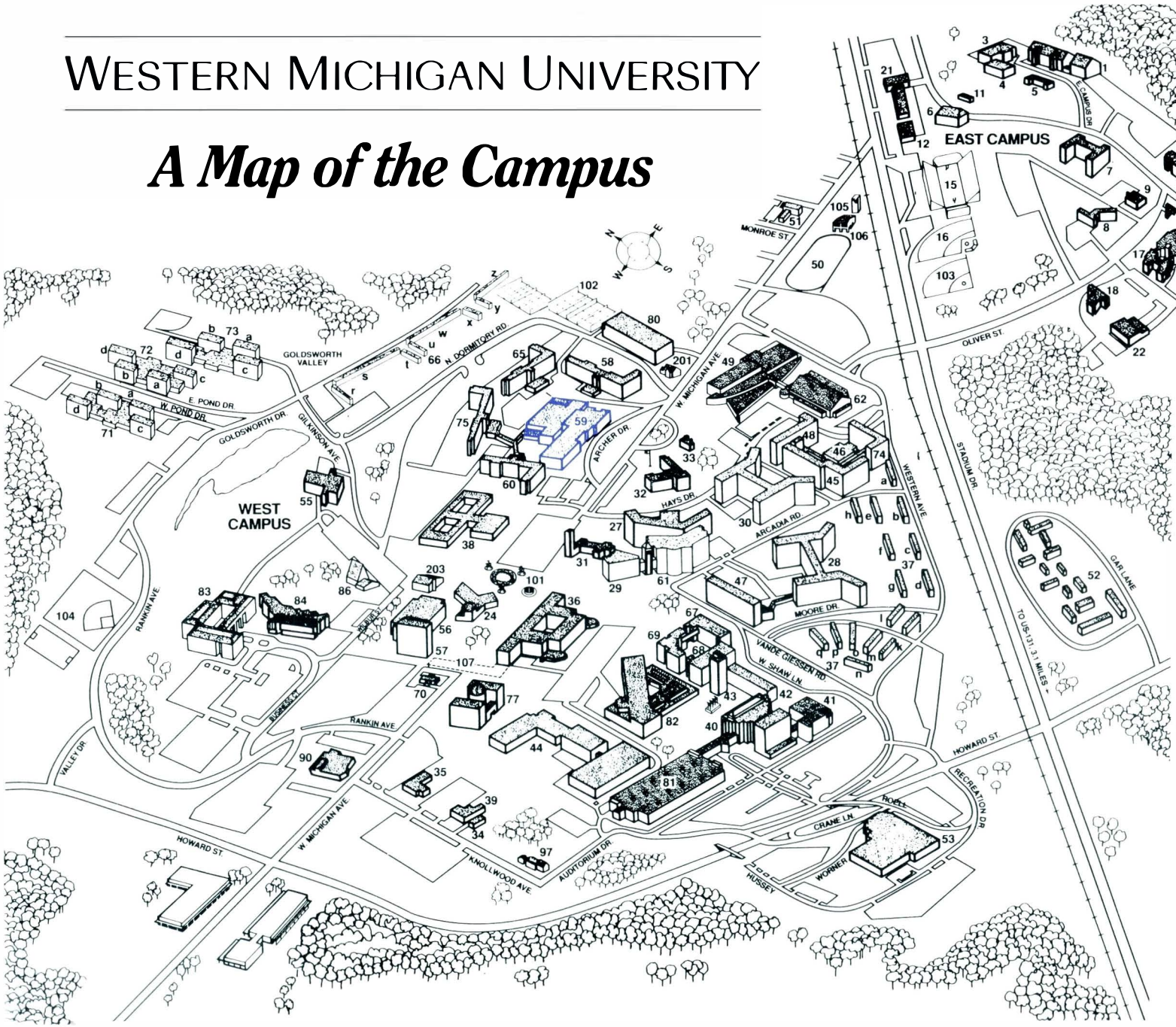
College of Engineering and Applied Sciences

Western Michigan University

A World of Difference

WESTERN MICHIGAN UNIVERSITY

A Map of the Campus



Alphabetical guide to buildings

32	Administration Building	D3	
40	Auditorium, Miller	D4	
16	Baseball Field, Hyames	E2	
59	Bernhard Center	C3	
12	Brink Printing Services	E1	
42	Brown Hall	D4	
22	Campus Services Building	F2	
31	Chapel, Kanley	C3	
29	Computing Center	D3	
82	Dalton Center	D4	
68	Dunbar Hall	B4	
01	East Hall	F1	
103	Ebert Softball Field	E2	
58	Ellsworth Hall	C2	
57	Everett Tower	C4	
77	Faunce Student Services Building	C4	
84	Felzer Center	B4	
62	Fieldhouse, Read	E2	
67	Friedmann Hall	D4	
85	Gilmore House	G2	
18	H.O.T. Building	F2	
55	Health Center, Sindecuse	B3	
60	Henry Hall	C3	
24	Honors College, Lee	C3	
16	Hyames Field	E2	
53	Ice Arena and Natatorium	E5	
104	Intramural Fields	A3	
31	Kanley Chapel	C3	
50	Kanley Running Track	D2	
69	Knauss Hall	D4	
39	Knollwood Building	C5	
34	Knollwood Metal Building	C5	
44	Rohrman Hall	C4	
101	Kruglak Sundial and Promenade	C3	
54	Lawson Ice Arena and Gabel Natatorium	E5	
24	Lee Honors College	C3	
61	Library, Waldo	D3	
27	McCracken Hall	D3	
40	Miller Auditorium	D4	
19	Montague House	F2	
47	Moore Hall	D4	
53	Natatorium and Ice Arena	E5	
03	North Hall	F1	
06	Oakland Gymnasium	E1	
09	Oakland Recital Hall	F1	
33	Oaklands, The	D3	
80	Parking Structure I	D2	
81	Parking Structure II	D5	
21	Physical Plant Building	E1	
12	Printing Services, Brink	E1	
101	Promenade and Kruglak Sundial	C3	
51	Public Safety	D1	
70	Public Safety Annex	B4	
62	Read Fieldhouse	E2	
105	Repelling Tower	D2	
56	Rood Hall	B4	
86	St. Adam's Chapel	B3	A4
88	Sangren Hall	C1	
97	Sara Swicknard Preschool	G5	
83	Schneider Hall	A4	
107	Science Addition (Proposed)	C4	
32	Seibert Administration Building	D3	
41	Shaw Theatre	D4	
55	Sindecuse Health Center	B3	
104	Soccer Field	A3	
103	Softball Field	E2	
102	Sorensen Tennis Courts	C2	
05	Speech and Hearing Center	F1	
43	Spaan Tower	D4	
49	Student Recreation Center	D2	
77	Student Services Building, Faunce	C4	
41	Theatres, University	D4	
106	Track Building	D2	
35	Trimpe Building	B4	
11	Upholstery Shop	E1	
17	University Medical and Health Sciences Center	F2	
41	University Theatres	D4	
61	Waldo Library	D3	
15	Waldo Stadium	E1	
10	Walwood Hall	F1	
90	Welborn Hall	B4	
04	West Hall	F1	D1
36	Wood Hall	C4	

Residence Halls and Apartments

75	Bigelow Hall and Annex	C3	
28	Burnham Halls	D3	
45	Davis Hall	E3	
46	Davis Food Commons	D2	
30	Draper Hall	D3	
37	Elmwood Apartments A Q E	3	4
74	French Hall	E3	
66	Goldsworth Valley Apartments	B2	
60	Henry Hall	C3	
65	Hoekje Hall	C2	
30	Siedschlag Hall	D3	
8	Spindler Hall	F2	
52	Stadium Drive Apartments	F3	
7	Vandercook Hall	F1	
48	Zimmerman Hall	D3	

Goldsworth Valley Units 1, 2, 3

73b	Ackley Hall	A2
73c	Britton Hall	B2
72a	Eicher Hall	A2
71b	Eldridge Hall	A2
73d	Fox Hall	A2
72d	Gameau Hall	A2
73a	Hadley Hall	B2
72a	Harrison Hall	A2
72b	Harvey Hall	A2
72c	LeFevre Hall	A2
73d	Shilling Hall	A2
71c	Stinson Hall	A2

Private Property

201	Lutheran Student Center	D2 3
203	Wesley Foundation	B3 4

Conference on Senior Engineering Design Projects

You are invited to attend the twentieth Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 4:30 p.m. **Thursday, April 17**, at the Bernhard Center on the campus of Western Michigan University. The College of Engineering and Applied Sciences sponsors the conference to showcase the work of its graduating seniors, who are required to complete a capstone project that puts into practice what they have learned. Many of the projects are sponsored by business and industry.

The conference is **free** and open to the public. You are welcome to attend all or part of the day's events. Reservations are not necessary.

High school and community college teachers are encouraged to bring students to the conference. Buses can drop off passengers in the circular drive in front of the Bernhard Center and then park in the lot in front of Hoekje Hall. (See map; take North Dormitory Road. Hoekje is #65 on the map.)

Teachers who cannot accompany their students to the conference may ask their students to sign in and out at the information table in the lobby on the second floor of the Bernhard Center. Sign-in sheets will be mailed to teachers the day after the conference.

Parking is available in the ramp near the Bernhard Center.

Presentations begin on the hour and half hour. Please do not enter a room after a presentation has begun.

Session locations, starting times, and page number for project descriptions:

Construction Engineering, Materials Engineering, and Industrial Design - A-I	205	9 to 2:30	p. 6
Construction Engineering, Materials Engineering, and Industrial Design - B-I	205	3 to 3:30	p. 10
Electrical and Computer Engineering	210	9 to 4	p. 11
Industrial and Manufacturing Engineering - A-I	204	9: 30to 1:30	p. 16
Industrial and Manufacturing Engineering - B-I	209	9 to 3	p. 19
Mechanical and Aeronautical Engineering - A-I	208	9 to 3:30	p. 23
Mechanical and Aeronautical Engineering - B-I	213	9 to 3:30	p. 27
Mechanical and Aeronautical Engineering - C-I	242	9 to 3	p. 31
Paper and Printing Science and Engineering - A-I	211	9 to 2	p. 35
Paper and Printing Science and Engineering - B-I	212	9 to 2	p. 39
Paper and Printing Science and Engineering - C-I	215	9 to 2	p. 43

A **lunch** break is scheduled from noon to 1 p.m. **For more information about the conference**, call Yvonne Steffler at (616) 387-4017.

CMD = Construction Engineering, Materials Engineering, and Industrial Design
ECE = Electrical and Computer Engineering
IME = Industrial and Manufacturing Engineering
MAE = Mechanical and Aeronautical Engineering
PPSE = Paper and Printing Science and Engineering

Time	Room	Dept.	Topic
9	205	CMD-A-I	Chameleon: Concept Interior for a Passenger Vehicle
	210	ECE	Safety Lock for Industrial Chipper
	209	IME-B-I	Isolating the Effects of Non-Return Valves in Injection Molding Machines
	208	MAE-A-I	Omega Clip Redesign
	213	MAE-B-I	Differential Pressure Leak Testing of a Pneumatic Filter
	242	MAE-C-I	Transmission Case Lifting Eye Tensile Test Block
	211	PPSE-A-I	Effects of Chloride and Alum on Corrosivity of White Water with Closure
	212	PPSE-B-I	The Study of Headbox Streaks and Micro Fiber Flocculation
	215	PPSE-C-I	Closing the White Water Loop Using an Aerobic Trickling Filter
9:30	205	CMD-A-I	"Metacar" Concept Seating
	210	ECE	Psychological Test Data Collection Device
	204	IME-A-I	Redesign of the Variable Pump Sub-Assembly Process
	209	IME-B-I	Detachable Cup Holder with Heating Device for Automobiles
	208	MAE-A-I	Pressure Assembly for Accumulation Conveyor
	213	MAE-B-I	A Device for Measuring the Ford F Series Exterior Door Handle Spring
	242	MAE-C-I	Wind Tunnel Calibration Model
	211	PPSE-A-I	A Study of Semi-Chemical Pulping with Borax
	212	PPSE-B-I	Beating Effects on Mechanical Recycle
	215	PPSE-C-I	The Effect of Aerobic Biological Treatment on Odorous Hydrogen Sulfide Emissions
10	205	CMD-A-I	"Conqueror" - Versatile Automotive Passenger Space
	210	ECE	ATD Instrumentation Confirmation Controller
	204	IME-A-I	Injury Reduction in the Pump Marking Process
	209	IME-B-I	The Tee-It-Up!
	208	MAE-A-I	Improved Coupling System for Torsional Testing
	213	MAE-B-I	Wire Bending Module for Use in Slip Ring Production
	242	MAE-C-I	Computer Code of Aerodynamic Forces and Moments Matrix
	211	PPSE-A-I	The Effects of Silica Surface Area on Microparticle Retention Aid Systems
	212	PPSE-B-I	The Efficiency of Surfactants on Xerographic Ink

	215	PPSE-C-I	Use of an Aerobic Wood Based Bioreactor to Oxidize Hydrogen Sulfide
10:30	205	CMD-A-I	"Freelink" Interactive Furniture for the Office
	210	ECE	Grinding Table Speed Sensor
	204	IME-A-I	Layout and Workcenter Design of New Department
	209	IME-B-I	Tutorials for Finite Element Analysis (FEA)
	208	MAE-A-I	Demonstration of Acoustic Characteristics of a Passenger Vehicle
	213	MAE-B-I	Variable Speed Control to Improve Power Plant Efficiency
	242	MAE-C-I	Universal Joint Assembly Tooling Design
	211	PPSE-A-I	The Effect of Deinking Variables on Flotation Deinking of Electrographic Toners
	212	PPSE-B-I	The Evaluation of Surfactant Parameters on Fiber Yield and Fiber Length Distribution
	215	PPSE-C-I	Viability of Wood Pallets as a Significant Fiber Source
11	205	CMD-A-I	Junction: Mobile, Adjustable Workstation
	210	ECE	Telemetric Torque Measurement System
	204	IME-A-I	Increasing the Efficiency of Material Handling for Assembly Lines
	209	IME-B-I	Interactive Manufacturing Computer Game
	208	MAE-A-I	A New Transition Conveyor System
	213	MAE-B-I	Smart Chuck Design for Automated Welder
	242	MAE-C-I	Adjustable Suspension of a Supermodified Race Car
	211	PPSE-A-I	Feasibility of Sodium Carbonate Pulping of Kenaf for Corrugating Medium
	212	PPSE-B-I	Optimization of Recycled TMP Paper Using Fractionation
	215	PPSE-C-I	The Effects of Base Sheet Properties on Blade Forces in Beveled Blade Coating
11:30	205	CMD-A-I	Sol'o - Solar Powered Office Furniture
	210	ECE	Data Acquisition (DAQ) System on an Automotive Automatic Transmission (ATX) Test Stand
	204	IME-A-I	Optimal Parameter Setting in Corn Flake Dryer
	209	IME-B-I	Data Acquisition and Control System for Engine Testing
	208	MAE-A-I	Dishwasher Pump Test Rig for Sound Measurement
	213	MAE-B-I	Mass Flow Meter Test Stand Redesign
	242	MAE-C-I	V-6 Engine Block Rollover Station
	211	PPSE-A-I	Deinking Recycled Pulp by Cross-Flow Filtration
	212	PPSE-B-I	Effect of Temperature on Recyclability of Mechanical Pulp
	215	PPSE-C-I	The Effect of Pigment and Liquid on Coating Rheology and Dewatering

12 -1 LUNCH BREAK

1	205	CMD-A-I	Vectura: User Interface for Hospital Transfer Stretcher
	210	ECE	Insulin Measurement System for Disposable Syringes
	204	IME-A-I	Implementing a Load Point Consolidation Program
	209	IME-B-I	Remote Identification of Metal Castings
	208	MAE-A-I	Veneered Wooden Shifter Knob
	213	MAE-B-I	Nanodesign of Composite Lubrication Films for Microelectromechanical Vibromotors
	242	MAE-C-I	High Lift Wing for a Supermodified Race Car
	211	PPSE-A-I	The Detection of Stickies Using Infrared Thermography
	212	PPSE-B-I	The Effect of Increased Beating on the Recycling Potential of Mechanical Pulps
	215	PPSE-C-I	The Effects of Directional Drying on Binder Migration
1:30	205	CMD-A-I	"Serene" Crash Cart Design
	210	ECE	Electronic Magneto-Resistive Compass with Voice Output
	204	IME-A-I	Redesigning of A Workcenter to Meet Fluctuating Demand
	209	IME-B-I	Design, Casting, and Testing of A Zero Iron Golf Club Made From Low Cost Alloys
	208	MAE-A-I	Program for Analysis of Heavy Truck Axle Housings
	213	MAE-B-I	Heated Ball Bearing Grease Tester
	242	MAE-C-I	Airborne Thrust Cell Design and Evaluation
	211	PPSE-A-I	The Effect of Repeated Recycling on Paper Strength
	212	PPSE-B-I	The Effects of Recycling on the Hygroexpansivity of Mechanical Pulp
	215	PPSE-C-I	Image Analysis and Rating of Ink Jet Printing
2	205	CMD-A-I	Siberian Enclosure: Concept Kitchen Design
	210	ECE	Liquid Flow Meter
	209	IME-B-I	Driver Seat Ventilation System
	208	MAE-A-I	Jack Apparatus to Relocate Affixed Wheel Assemblage
	213	MAE-B-I	Durability Tester for Glove Compartment Damper
	242	MAE-C-I	Airfoil Wake Survey Probe for Flight Testing
	211	PPSE-A-I	Estimating Integrated Mill Effluent Treatability
	212	PPSE-B-I	The Paper Surface Effects of Recycling TMP
	215	PPSE-C-I	The Effects of Styrene Butadiene on the Properties of a Coated Sheet
2:30	205	CMD-A-I	"Mondrian": Unconventional Kitchen Design Concept
	210	ECE	Automated Transmission Test Stand
	209	IME-B-I	Implementation of an Investment Casting System
	208	MAE-A-I	Improvement of the Articulating Endoscopic Cutter's Articulation Linkage
	213	MAE-B-I	Torsion Spring Clutching in Line-Shaft Conveyors

	242	MAE-C-I	Remotely Controlled Aircraft Design for Optimum Range
3	205	CMD-B-I	Surface Hardness Improvement of Aluminum Cast Alloy
	210	ECE	Temperature and pH Sensory System
	209	IME-B-I	Dynamometer Cell System Integration
	208	MAE-A-I	Simplified Control Positioning System for Physically Impaired Individual
	213	MAE-B-I	Overbed Table Tilt Mechanism
	242	MAE-C-I	Installation and Pilot Testing of the Stall Margin System
3:30	205	CMD-B-I	Controlling Surface Properties of Microelectromechanical Systems (MEMS)
	210	ECE	Scrolling Message Board
	208	MAE-A-I	Gear Pump with Alternative Bearing
	213	MAE-B-I	Pump Lubricant Filtering System
4	210	ECE	Micro Mouse - An Autonomous Maze-Solving Robot

CONSTRUCTION ENGINEERING, MATERIALS ENGINEERING, AND INDUSTRIAL DESIGN - A-I

Session Chair - Dmitry Azrikan
Room 205

CHAMELEON: CONCEPT INTERIOR FOR A PASSENGER VEHICLE

by Bryan Fox and Dave Gunnett
Sponsor: Bill Fluharty - Prince Corporation
Faculty Advisor: Dmitry Azrikan
9:00 a.m. to 9:25 a.m., Room 205

Today's fast-paced lifestyles and changing family roles have created the need for a more versatile vehicle. Vehicles must now be able to adapt from picking the kids up at school to a trip to the lumberyard and everything in between. The proposed concept allows the users more options for configuring the interior. A unique manipulation of the seats provides the user with a quick changeover between passenger, recreational, and cargo vehicles.

"METACAR" CONCEPT SEATING

by Robert Laming and Joel Middlebrook
Sponsor: Bill Fluharty - Prince Corporation
Faculty Advisor: Dmitry Azrikan
9:30 a.m. to 9:55 a.m., Room 205

This project included the design of a seating theme for an emerging "utewagon" market. The utewagon is a breed between a sport utility and a station wagon. This design will accommodate any situation that might occur in everyday life. A fold up seating design eliminates strenuous removal of bulky, heavy back seats and allows for full cargo hauling capabilities. With an infinite number of seating positions, many situations can be handled safely and efficiently.

"CONQUEROR" - VERSATILE AUTOMOTIVE PASSENGER SPACE

by Scott D. Wilde
Sponsor: Bill Fluharty - Prince Corporation
Faculty Advisor: Dmitry Azrikan
10:00 a.m. to 10:25 a.m., Room 205

This project included the design of an interior seating system which meets the needs of most user lifestyle situations. This problem was solved by first researching current lifestyles and then creating a seating concept that is capable of morphing into any desired arrangement. The seating is designed to be storable in the overhead ceiling area and functional as either a table surface or as a divider to separate sections of the interior for cargo, pets, or people. The seating can be faced in any 90 degree direction and can be used as either individual seating or latched together to form bench seating.

"FREELINK" INTERACTIVE FURNITURE FOR THE OFFICE

by Winston Jin Beng Tan
Sponsors: Clark Thorp and Jeff Reuschel - Haworth Inc.
Faculty Advisor: Dmitry Azrikan
10:30 a.m. to 10:55 a.m., Room 205

Freelink is a set of mobile furniture that has a different ergonomic environment which caters to both personal and group work. It is designed to get what is not absolutely necessary out of the personal workspace, freeing up the employee so as to control and focus on the task at hand. It merges furniture and technology to enable a person to connect to the online world. Ultimately, it is simple and integrated enough to be used by everyone.

JUNCTION: MOBILE, ADJUSTABLE WORKSTATION

by Jeffrey Heng
Sponsors: Jeff Reuschel and Clark Thorp - Haworth Inc.
Faculty Advisors: Dmitry Azrikan and David Middleton
11:00 a.m. to 11:25 a.m., Room 205

JUNCTION is an office workstation and surrounding environment that facilitates teamwork and allows personal work. It is fully adjustable and portable within building confinements. It uses present power supplies and can be adapted to completely wireless power sources. There is fully mobile space for group work, and personal space is accomplished by partitions.

SOL'O - SOLAR POWERED OFFICE FURNITURE

by Michael Mullen
Sponsors: Jeff Reuschel and Clark Thorp - Haworth Inc.
Faculty Advisors: Dmitry Azrikan, Roman Rabiej, and David Middleton
11:30 a.m. to 11:55 a.m., Room 205

A personal workstation prototype was designed and built, focusing on the user's freedom and group collaboration for work in open spaces. Voice, cable, and power utility access are not required because of wireless technology and solar power, making this design completely portable and environmentally safe. Through the study of human interaction patterns, in conjunction with existing and emerging technologies, a product and office environment was developed. The goal was to create a product that promoted natural discussion and increased worker productivity for the immediate response and continual changes of an organization's demands.

VECTURA: USER INTERFACE FOR HOSPITAL TRANSFER STRETCHER

by Ryan Kwiatkowski and Craig LaCombe
Sponsor: Martin Stryker - Stryker Medical
Faculty Advisor: Dmitry Azrikan
1:00 p.m. to 1:25 p.m., Room 205

In today's hospitals, patients are transferred on stretchers which are uncomfortable to both the operator and the patient. This is a direct result of ergonomics being set aside for engineering considerations. Current stretchers have a medical and intimidating appearance when they should have one of comfort and safety. The Vectura offers a safe alternative to current stretcher designs by focusing on the operator's needs and the patient's comfort.

"SERENE" CRASH CART DESIGN

by Jason M. Pelc
Sponsors: Martin Stryker and Jeff Lewandowski - Stryker Medical
Faculty Advisors: Dmitry Azrikan and David Middleton
1:30 p.m. to 1:55 p.m., Room 205

This project involved creating a crash cart that is designed for the user. It has adjustable heights, no sharp edges and is quiet when transported. The cart is made of plastic to keep down costs and make the cart lightweight and easy to use.

SIBERIAN ENCLOSURE: CONCEPT KITCHEN DESIGN

by Jon Cleckner
Sponsor: Daniel H. Quinlan - Whirlpool Corporation
Faculty Advisor: Dmitry Azrikan
2:00 p.m. to 2:25 p.m., Room 205

The refrigerator has failed to keep up with current technologies and designs. This project involved looking for a new perspective in food storage. The answer is no longer one large box, but many refrigerated units which enable a specific temperature, pressure, and humidity to be set for a certain food or beverage. Food life can be extended significantly when these three factors can be controlled. The style pulls away from hard edges and sharp corners to an organic, free flowing kitchen design. This creates a user friendly atmosphere both aesthetically and physically.

"MONDRIAN": UNCONVENTIONAL KITCHEN DESIGN CONCEPT

by Jeffrey J. Hughes and Mark K. Mulcahy
Sponsor: Daniel H. Quinlan - Whirlpool Corporation
Faculty Advisor: Dmitry Azrikan
2:30 p.m. to 2:55 p.m., Room 205

Through studying the ideal storage conditions for multiple items, it has been determined that the simple two compartment refrigerator/freezer is inadequate to fulfill the requirements of most foods. The "Mondrian" is a complete redesign of the kitchen based on the needs of multiple storage areas considering temperature, humidity, and pressure. The "Mondrian" kitchen is based on a philosophy of many individual sections working together to form a complete unit.

CONSTRUCTION ENGINEERING, MATERIALS ENGINEERING, AND INDUSTRIAL DESIGN - B - I

Session Chair - Pnina Ari-Gur
Room 205

SURFACE HARDNESS IMPROVEMENT OF ALUMINUM CAST ALLOY

by Robert Herr
Faculty Advisors: Abi Olowe and Sam Ramrattan
3:00 p.m. to 3:25 p.m., Room 205

Aluminum is not utilized enough because of its poor surface hardness and wear resistant characteristics. A thorough evaluation of the surface hardness of aluminum was performed. A pack cementation diffusion process was used to adhere a chromium surface layer to the aluminum alloy. These samples were then tested and studied for improved surface hardness, wear resistance, and a visual layer formation with diffusion into the aluminum.

CONTROLLING SURFACE PROPERTIES OF MICROELECTROMECHANICAL SYSTEMS (MEMS)

by Thoa Nguyen
Sponsor: The National Science Foundation, Engineering Division
Faculty Advisor: Vladimir Tsukruk
3:30 p.m. to 3:55 p.m., Room 205

Tribological surface properties of materials depend on three basic categories: friction, adhesion, and wear. Materials can be hydrophilic or hydrophobic with the surface energy related to morphology. The surface properties of a material can be controlled by mixing the materials for fabrication of composite molecular films. This project designed composite molecular films from soft and ridge polymers for boundary lubrication of MEMS (micromotors, microtwizers, microattenuators, etc.). Friction, adhesion, and wear properties were studied using a combination of Atomic Force Microscopy (AFM) and Friction Force Microscopy (FFM).

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair - John Gesink
Room 210

SAFETY LOCK FOR INDUSTRIAL CHIPPER

by Theodore C. Gardner, Scott D. Thompson, and Joseph E. Wemert
Faculty Advisor: Ikhlas Abdel-Qader
9:00 a.m. to 9:25 a.m., Room 210

An electronic control device was designed to keep the access door of an industrial brush chipper locked until the spinning chipper disk has stopped. The safety lock is designed to work with all different chippers and over a wide range of outdoor temperatures. It also prevents the engine from starting if the chipper door is not locked.

PSYCHOLOGICAL TEST DATA COLLECTION DEVICE

by Erik Dantes, Yuh Jing Ho, and Jake Montes
Faculty Advisor: Raghvendra Gejji
9:30 a.m. to 9:55 a.m., Room 210

Improvements were made to an existing data collection method for this project. Prior to this, an examiner touched a series of squares, and a subject repeated the series. Difficulty arose when the subject repeated very quickly, requiring the examiner to interpret or guess what the series was. In this project, a microcontroller-based device has been designed that can accurately record and manipulate the series that both the examiner and subject press. It then compares the two series and informs the examiner of the degree of correlation between the sequences.

ATD INSTRUMENTATION CONFIRMATION CONTROLLER

by Pamela Rizzo, Doug Schnepp, and Manuel Torne
Sponsors: Fred Anderson, Steve Armstrong, Tom Busacca, and Frank Fiore - AlliedSignal Automotive, Inc.
Faculty Advisor: Lambert VanderKooi
10:00 a.m. to 10:25 a.m., Room 210

Safety restraint engineers required a non-invasive method to verify correct orientation and operation of load cells, accelerometers and potentiometers installed inside Anthropomorphic Test Devices (ATDs), otherwise known as Crash Test Dummies. An instrument was designed, constructed, and tested to verify the ATD sensors. The portable microprocessor-controlled instrument performs two tests on the sensors. One test measures and displays sensor and cable resistance to help diagnose wiring problems. The other test digitally samples and displays the sensor output voltage waveform on a LCD screen when the sensor output exceeds a predetermined trigger threshold setting. Features include: variable voltage gain, adjustable time scale, trigger threshold setting, manual trigger, and DC offset adjustment.

GRINDING TABLE SPEED SENSOR

by Kathleen Knezek, Jason McPherson, and Larry Webb
Sponsor: Terry Dohner - Thomson Bay, Inc.
Faculty Advisor: Janos Grantner
10:30 a.m. to 10:55 a.m., Room 210

The production of rails and carriages used in industry requires high precision and attention to detail. A device was designed, constructed, and tested to monitor the speed of grinding tables used in manufacturing these products. Software was developed using C++ to help program a PLD (programmable logic device) that monitors the grinding table speed sensor, and to enable companies to easily reproduce the device. The device can display the grinding table speed in meters-per-minute or feet-per-minute, and a push button initiates a test of the device's accuracy. Utilization of the grinding table speed sensor increases product quality and reduces waste.

TELEMETRIC TORQUE MEASUREMENT SYSTEM

by Jason Joseph, Francisco Sinta, and Jeffrey Williams
Sponsor: Tim Theriault - Smiths Industries, Aerospace and Defense Systems
Faculty Advisor: John Gesink
11:00 a.m. to 11:25 a.m., Room 210

A telemetric system to measure the torque transmitted by the rotating drive-shaft of a snowmobile was designed, developed, and tested. The system uses strain gages, a signal conditioner and a miniature FM radio transmitter, all mounted on the rotating drive-shaft. The gages convert the shaft strain produced by the torque into a voltage signal. The signal conditioner converts the voltage signal into an audio tone which is then broadcast by the transmitter in the FM radio band. The broadcast audio tone is then received by a standard FM radio. An audio tone to voltage level decoder is then used to convert the received signal back into a voltage proportional to torque.

DATA ACQUISITION (DAQ) SYSTEM ON AN AUTOMOTIVE AUTOMATIC TRANSMISSION (ATX) TEST STAND

by Jim Ignatovich, Kean Sing James Lai, and Chow Yang Chew
Sponsor: John W. Cook - Robert Bosch Corporation
Faculty Advisor: Johnson Asumadu
11:30 a.m. to 11:55 a.m., Room 210

A data acquisition system was designed for an automotive automatic transmission (ATX) test stand. The ATXs to be tested are for passenger car use and come in two models, a 3-speed and 4-speed. The design process consisted of selecting and assembling various transducers, signal conditioning modules, and a data acquisition board. Several transducers were used to monitor speed, torque, temperature, force, and pressure. LabView software was utilized in the acquisition system to monitor and analyze the raw data from the transducers.

INSULIN MEASUREMENT SYSTEM FOR DISPOSABLE SYRINGES

by John Beimler, Eric L. Matteson, Theresa M. Segura, and Lee Y. Velo
Faculty Advisor: Frank Severance
1:00 p.m. to 1:25 p.m., Room 210

Of the millions of diabetics in the United States, a significant percentage are visually impaired. These people cannot independently measure the insulin dosages by which they control their blood sugar levels. A digital electromechanical system has been designed and built that will accurately draw insulin dosages into disposable syringes. Individuals utilize a keypad to specify the proper amount of insulin drawn into the syringe by a stepper motor. An encoder coupled with electronically stored messages confirms the accuracy of the dosage. This system facilitates ease of use and has been thoroughly tested to fall within specifications.

ELECTRONIC MAGNETO-RESISTIVE COMPASS WITH VOICE OUTPUT

by Bhaskar Bhagwanji, Brian Eisenbrandt, Daniel D. Snyder, and James Varughese
Faculty Advisor: Johnson Asumadu
1:30 p.m. to 1:55 p.m., Room 210

An electronic compass with voice output was designed, developed, prototyped and tested. The device determines direction by sensing the earth's magnetic field with magneto-resistive sensors. It uses an electronic tilt sensor to correct for errors which might otherwise result from failure to level the compass during use. The device includes a microcontroller to both process the two sensors' signals and to generate the appropriate voice output. The device is simple to use, reliable, inexpensive (less than $20), and is intended for use by visually impaired individuals.

LIQUID FLOW METER

by Rick Schuitema and Chad Tomlinson
Sponsors: Dan Hausermann and Scott Davis - Ronningen-Petter and Brent Murray - Allen-Bradley
Faculty Advisor: Joseph Kelemen
2:00 p.m. to 2:25 p.m., Room 210

A liquid flow meter is needed within a water filtration system to accurately determine the amount of liquid entering and leaving key process steps. A previous design used components which were unreliable due to particles in the liquid. To achieve greater reliability, a differential pressure orifice-plate flow meter combined with a programmable logic controller (PLC) was designed. The PLC monitors the system performance, providing visual output and user interaction via a keypad and touch screen terminal.

AUTOMATED TRANSMISSION TEST STAND

by Josh Barr, Grant Johnson, and Louise Ryan
Faculty Advisor: Frank Severance
2:30 p.m. to 2:55 p.m., Room 210

A powerful method of automated testing for certain components of medium- and heavy-duty truck transmissions was required. Six specifically designed shifting units were used to model actual transmission wear. Using repeated shifting, wear was then determined and recorded for future design reference. The shifters are controlled by a computer program created using LabView that combines control of all six shifters into one interface. This interface allows the user to select test patterns which the shifting units follow for a specified number of shifts. This project further automates and simplifies the testing of transmission components.

TEMPERATURE AND pH SENSORY SYSTEM

by Tun Seng Ong and Yih Suei Wong
Faculty Advisor: Lambert VanderKooi
3:00 p.m. to 3:25 p.m., Room 210

A microcontroller-based system was stationed outdoors to sense the air temperature and the pH of the environment. The system is powered by a Z-World "Little-PLC" microcontroller. It communicates with a computer that is located more than half a mile away via a radio frequency modem. Through this modem, the obtained information is downloaded to the computer, and summarized reports of the air temperature and pH values are generated. This device will be used in a school as a teaching aid.

SCROLLING MESSAGE BOARD

by Jim Findley, Jon Hotra, and Frank Marcinkiewicz
Sponsor: Rick Carpenter - Kalamazoo Technologies
Faculty Advisor: Raghvendra Gejji
3:30 p.m. to 3:55 p.m., Room 210

A scrolling message board that uses a serial port for the transfer of data from a PC has been designed and built. The system was designed to replace current message boards that require an extra, costly input device. Most households and businesses have personal computers at their disposal, allowing someone to input the desired message through just a serial port and a text editor. The message is displayed in three formats: flashing, scrolling, and slanted.

MICRO MOUSE - AN AUTONOMOUS MAZE-SOLVING ROBOT

by Collin T. S. Chan, Reghuram Rajaseharan, Kwang Wee Sim, and David Ulrich
Faculty Advisors: Janos Grantner and Frank Severance
4:00 p.m. to 4:25 p.m., Room 210

An autonomous electromechanical device was designed and constructed to traverse a maze. It consists of four subsystems: the control, the sensor, the power supply, and the drive system. The control system learns the maze with the microcontroller as its brain. Infrared sensors provide information about the maze. The power is supplied by batteries and stabilized using voltage regulators. The drive system consists of a chassis, a set of motors, and wheels. The Micro Mouse searches for the goal by running a program via the microcontroller with the sensors providing input and the drive system executing the desired movements.

INDUSTRIAL AND MANUFACTURING ENGINEERING - A-I

Session Chairs - Liwana Bringelson and Sam Ramrattan
Room 204

REDESIGN OF THE VARIABLE PUMP SUB-ASSEMBLY PROCESS

by Jeff Dugan, Monique Ligons, Chee Low, and Tim Vandervest
Sponsor: Ken Horton - Parker-Hannifin, Hydraulic Pump Motor Division
Faculty Advisors: Liwana Bringelson and Sam Ramrattan
9:30 a.m. to 9:55 a.m., Room 204

The variable pump sub-assembly area is very labor-intensive and highly repetitive. Numerous variations in the finished products require different set-ups for each sub-assembly. Pareto analysis was used to identify where the resources were used the most. Motion and time studies were used to find areas with the greatest opportunity for improvement with regards to ergonomics and time savings. The proposed recommendations reduced manual labor and set-up times by implementing the use of easily changed fixtures and improved procedures. These improvements will increase the throughput of this area, while reducing production costs and improving employee safety.

INJURY REDUCTION IN THE PUMP MARKING PROCESS

by Marguerite Hutchins and Bryan C. Thompson
Sponsor: Rusty Newhouse - Parker-Hannifin Corporation, Fluidpower Pump Division
Faculty Advisors: Liwana Bringelson and Sam Ramrattan
10:00 a.m. to 10:25 a.m., Room 204

A world leader in the production of motion control products produces various models of fixed displacement hydraulic gear pumps. Models are identified through product codes which were previously stamped onto the pumps by means of a hammer and punch. Worker injury problems, several of which required surgery, resulted from this process. Through intensive research and creative design, a new method was devised to eliminate these problems. The primary advantage of this design was that it virtually eliminates the use of manual force.

LAYOUT AND WORKCENTER DESIGN OF NEW DEPARTMENT

by Stephanie Haga, Mohammed Hassan, John Roberts, and Marcus Yong
Sponsor: Chuck Wendling - Durametallic Corp.
Faculty Advisors: Liwana Bringelson and Sam Ramrattan
10:30 a.m. to 10:55 a.m., Room 204

Due to a management decision, a new department was created to assemble, test, and package made-to-stock complete seals. Prior to this, the assembly and testing was done in the inspection department while the packaging was done in the shipping department. A capacity analysis was done to determine the number of workcenters needed to meet the expected demand. Standard times and assembly methods were used along with ergonomic considerations to design the individual workcenters. A new workcenter layout was designed to efficiently perform the complete seal assembly.

INCREASING THE EFFICIENCY OF MATERIAL HANDLING FOR ASSEMBLY LINES

by Samir Deliormanli, Jamie Stoutenburg, and Bob Sutedja
Sponsors: Lynn Whittaker, Moravia C-Smead, and Dave Haase - Bosch Braking Systems
Faculty Advisors: Liwana Bringelson and Sam Ramrattan
11:00 a.m. to 11:25 a.m., Room 204

The sponsor company is a foundry and manufacturing facility for vehicular braking systems. In its brake assembly department, brakes are assembled, tested, inspected, and packed for shipment to domestic and international automobile manufacturers. The project focused on four major assembly lines that supply brakes for medium- to heavy-duty trucks and sport utility vehicles. Inefficient material flow and handling in this area caused unnecessary delay, down time, and worker stress. The utilization of lift trucks, assembly line capacities, communication between line workers and material handlers, and quality control inspection locations were evaluated. Material flow, time study, process charting, computer simulation, and scheduling analysis aided to increase the efficiency and productivity of the assembly system.

OPTIMAL PARAMETER SETTING IN CORN FLAKE DRYER

by Masbah Ahmmed, Brian Bottorff, and Kimberly Pence
Sponsor: Michael Monfore - Ralston Foods
Faculty Advisors: Liwana Bringelson and Sam Ramrattan
11:30 a.m. to 11:55 a.m., Room 204

A breakfast cereal company recently installed a new dryer for its corn flake manufacturing process. This machine's optimal operating parameters were determined with respect to producing a quality product at an acceptable rate. Quality was determined by characteristics such as moisture, temperature, and color of the product. Several variables were tested for having an effect on product quality, and experiments were conducted using statistical methods.

IMPLEMENTING A LOAD POINT CONSOLIDATION PROGRAM

by Wade Irvine, Todd Nickel, Jennifer Pierce, and Warren Smith
Sponsor: Gary Vredenburg - Steelcase North America
Faculty Advisors: Liwana Bringelson and Sam Ramrattan
1:00 p.m. to 1:25 p.m., Room 204

This project evaluated a proposed Load Point Consolidation (LPC) program at one of the world's leading office furniture manufacturers. LPC involves transporting the components of an order to a centralized distribution center which allows an order to be loaded from a single point. The team gathered and examined information concerning traffic patterns, manufacturing throughput, material handling, and manpower utilization. Recommendations were made based on the determined capacity and constraints of the system along with the financial analysis.

REDESIGNING OF A WORKCENTER TO MEET FLUCTUATING DEMAND

by Jason Kee, Stacy Maslowski, and Scott Werner
Sponsor: Mark Wallace - Hi-Lex Corporation
Faculty Advisors: Liwana Bringelson and Sam Ramrattan
1:30 p.m. to 1:55 p.m., Room 204

A local subsidiary of the world's largest producer of cable required the redesign of an assembly process. Because of global logistics and the company's desire to better serve their customers, the manufacturer sourced some products to manufacturing facilities closer to its customers. This relocation of product required that the current assembly line be redesigned. Time studies, line balancing, statistical analysis, ergonomics, and simulation analysis were used to obtain the required flexibility and efficiency needed to meet a fluctuating demand. The methods, results, and recommendations were implemented and documented for future study.

INDUSTRIAL AND MANUFACTURING ENGINEERING - B - I

Session Chair - Ralph Tanner
Room 209

ISOLATING THE EFFECTS OF NON-RETURN VALVES IN INJECTION MOLDING MACHINES

by Steve Haeske, Brian Laurain, and Dan Matthews
Sponsors: Russ Malik and Jay Shumaker - Premier Class Injection Molders
Faculty Advisor: Paul Engelmann
9:00 a.m. to 9:25 a.m., Room 209

A non-return valve is an integral part of plastic injection molding. The study looked at the non-return valve in an injection molding machine as both a governor and a shut-off valve and its effect on product consistency. In order to make this research applicable to all plastics four resins were tested. Test methods were developed to help quantify new valves' performance in industry. Valves were evaluated for through-put, screw torque requirements, their effect on melt temperature, and part attributes. The goal of this project was to develop concrete components of a procedure to aid in evaluating valve performance.

DETACHABLE CUP HOLDER WITH HEATING DEVICE FOR AUTOMOBILES

by Tengku Fadil Hisham Tengku Hashim, Masahiro Ishii, and Keita Minagawa
Faculty Advisors: Tycho Fredericks and Jorge Rodriguez
9:30 a.m. to 9:55 a.m., Room 209

A cup holder was designed with a heating device to keep warm drinks, such as coffee or tea, at a comfortable drinking temperature. The objective was to design a cup holder for automobiles which do not have a cup holder. The cup holder is powered by the cigarette lighter adapter via an electrical cord. The cup holder and its support were tested for structural strength to ensure stability in accommodating the weight of the drinks being placed in it. The cup holder was designed to accommodate a range of drinks such as 6 oz (small coffee cups) to 22 oz (plastic pop bottles) and was targeted for use in popular passenger cars made from 1989 to 1993.

THE TEE-IT-UP!

by Eric M. Boersma, Matthew C. Greene, and Brett C. Stasa
Sponsors: Jeffrey Boersma and Gerald Beckman
Faculty Advisor: Mitchel Keil
10:00 a.m. to 10:25 a.m., Room 209

With so many people suffering from lower back pain, Team Tee-it-Up came up with an idea to help alleviate unnecessary stress placed on the lower back while golfing. Since the majority of bending at the waist while golfing comes from placing the golf ball and tee into the ground, we designed and manufactured a portable product that will allow the golfer to accomplish this without having to bend over. The Tee-it-Up allows golfers to enjoy the game without having to worry about their backs.

TUTORIALS FOR FINITE ELEMENT ANALYSIS (FEA)

by Matt Leclercq, Ben Lowell, and Keith Rodewald
Faculty Advisor: Jorge Rodriguez
10:30 a.m. to 10:55 a.m., Room 209

Finite Element Analysis (FEA) has become an important analysis tool in all areas of engineering. This project created a series of tutorials to aid in the learning of three FEA software packages: ANSYS, I-DEAS, and Pro-E/Mechanica. The tutorials demonstrate how to construct and analyze two- and three-dimensional objects. Each of the tutorials emphasizes great detail, ensuring that individuals with no FEA knowledge will attain a clear understanding of the concepts and procedures introduced.

INTERACTIVE MANUFACTURING COMPUTER GAME

by Marie Dudek and Katie Mathieu
Faculty Advisor: Ralph Tanner
11:00 a.m. to 11:25 a.m., Room 209

An interactive computer game was developed to teach users the fundamentals of manufacturing systems. The game includes a simulated manufacturing plant which the user is responsible for. The user is faced with such decisions as when to hire new employees and when to order new materials. The game also offers the option of purchasing manufacturing improvement projects (such as Statistical Process Control) to better the company. These projects have been implemented in such a way that the user must understand how they work in order for them to be effective, making the game an educational tool.

DATA ACQUISITION AND CONTROL SYSTEM FOR ENGINE TESTING

by Jason Jensen, Tom Michalski, and William Walmsley
Faculty Advisor: James VanDePolder
11:30 a.m. to 11:55 a.m., Room 209

This project updated one of the University's automotive engine testing cells. Today's industry requires hands-off testing with automatic datalogging. A computerized data acquisition and control system was developed and implemented for programming, monitoring, and recording engine data. A current industry software package was utilized for control of engine speed and load. Relevant data may also be acquired through the use of this system. This technique is useful for repeating tests with greater consistency than previous methods. The new system allows for additional sensors to be installed in the future for more detailed testing.

REMOTE IDENTIFICATION OF METAL CASTINGS

by Jeffrey Altimus, Matt Luegge, and Van Johnson
Faculty Advisor: Sam Ramrattan
1:00 p.m. to 1:25 p.m., Room 209

The process of assigning serial numbers to metal castings has been and always will be a necessity. The problem is that identification tags and stampings can be destroyed or altered. The use of internal radio frequency identification (RFID) devices would solve this problem. The objective of the project was to implant the RFID device into a casting so that no part of the tag or sensor would be exposed to external damage. During the testing, group members looked for materials that would be able to withstand the high melt temperatures and have long life spans.

DESIGN, CASTING, AND TESTING OF A ZERO IRON GOLF CLUB MADE FROM LOW COST ALLOYS

by Kevin Blue, Ryan Lindholm, and Matthew Pastrick
Sponsors: Jilda Hartman - Colonial Metals, Tony Zacker - KVCC, and Jim Hetzner - GM Powertrain Group
Faculty Advisor: Sam Ramrattan
1:30 p.m. to 1:55 p.m., Room 209

This project investigated which type of material would be best suited for producing a low cost golf club. It resulted in the design and development of the Zero Iron golf club. The design was developed on Pro-Engineer and was used to rapid prototype a wax pattern of the club head. The wax pattern was used to prepare molds in which the molten metal was poured. This process was repeated, using a variety of different low cost alloys. One club head was cast out of each type of alloy and was tested to measure actual driving distance.

DRIVER SEAT VENTILATION SYSTEM

by Ryan Mollard and Sean Palmer
Faculty Advisor: James VanDePolder
2:00 p.m. to 2:25 p.m., Room 209

Improving occupants' comfort level in today's vehicles is an ever-changing area of research. Modern vehicles use a variety of materials in the design and construction of the automobile seat. Due to the materials and design of the seat, there is often a lack of air and ventilation exposed to the upper and lower portions of the back. This project proposed a driver seat ventilation system designed to prevent discomfort within the back region. The driver seat ventilation system was incorporated into an original manufacturer's heating, ventilating, and air conditioning (HVAC) system.

IMPLEMENTATION OF AN INVESTMENT CASTING SYSTEM

by Doug Tran, Hung Tu, Brad Walbridge, and Mike Wright
Faculty Advisor: Sam Ramrattan
2:30 p.m. to 2:55 p.m., Room 209

This project involved the implementation of a lost wax investment casting system in Western Michigan University's Cast Metals Laboratory. Investment casting begins with a wax replica of the part to be produced. The wax was dipped into a ceramic slurry and coated with sand stuccoing. Dipping and stuccoing were performed using a robot. When the ceramic dries, the wax is melted out, leaving a hollow mold. The mold was then filled with molten metal to produce the casting.

DYNAMOMETER CELL SYSTEMS INTEGRATION

by Jin-Suk Choi, Scott Howe, and James Steidle
Faculty Advisor: James VanDePolder
3:00 p.m. to 3:25 p.m., Room 209

A programmable engine control unit, dynamometer controller, and data acquisition computer were integrated in order to perform tests on a Ford 4.6 Liter V-8 engine. Through experimental methods, the fuel and ignition requirements for the test engines were determined. These values were used to set the engines' base operating parameters. Dynamometer control and data acquisition software were then modified to allow for the sampling of engine data and for control of the engine/dynamometer from the computer keyboard. The data obtained from these tests were used to construct curves representing how engine performance was effected as the base operating parameters were changed.

MECHANICAL AND AERONAUTICAL ENGINEERING A-I

Session Chair - Judah Ari-Gur
Room 208

OMEGA CLIP REDESIGN

by Kristie A. Kubinski and Monica J. Neckermann
Sponsors: Martin Schultz, Warren Terry, Rob Tresh, and Larry Wirgau - Summit Polymers, Inc.
Faculty Advisor: Dennis VandenBrink
9:00 a.m. to 9:25 a.m., Room 208

A local manufacturer of plastic automotive interior components wanted to improve the design of vehicle heating and cooling vents. The force required to rotate the vents to direct air flow was not consistent throughout vehicle life. This was caused by localized areas of stress concentrations around the diameter of the clip. The geometry was redesigned and improved through finite element analysis to reduce the stress concentrations. A mold cavity was built, and the redesigned parts were tested and verified.

PRESSURE ASSEMBLY FOR ACCUMULATION CONVEYOR

by Mark A. Pritula and Thomas J. Wenzel
Sponsor: Ricardo Schiesser - Rapistan Demag Corp.
Faculty Advisor: Dennis VandenBrink
9:30 a.m. to 9:55 a.m., Room 208

Pressure assemblies located along roller conveyors utilize pneumatic actuators to force a drive belt up against the bottom of the rollers activating the system. Occasionally, the air pressure is set above the specified range, causing the belt to bind between the actuator and rollers. The pressure assembly was redesigned so that the force applied by the actuator does not exceed the specified limit over a broad range of air pressures. An analysis was performed to determine the performance of the system as a function of the pneumatic pressure.

IMPROVED COUPLING SYSTEM FOR TORSIONAL TESTING

by Xiaoli Gao and Tsin-Ik Lim
Sponsor: John Gaultieri - Eaton Corporation
Faculty Advisor: Dennis VandenBrink
10:00 a.m. to 10:25 a.m., Room 208

The spline teeth of an input shaft of a transmission are tested by applying a torsional load to the shaft through a coupling that fits over the spline. The testing is constrained to one direction of loading because of an imperfect fit of the coupling on the spline, resulting in shock loading when the load is reversed. A coupling system was designed to reduce the shock loading during alternating torsional load testing.

DEMONSTRATION OF ACOUSTIC CHARACTERISTICS OF A PASSENGER VEHICLE

by Nathan S. Hartman and Fred M. Jackson
Faculty Advisor: Koorosh Naghshineh
10:30 a.m. to 10:55 a.m., Room 208

The high level of low frequency noise heard in many passenger cars is usually due to the acoustic modes of the passenger cabin. These modes can be excited in many ways including the engine noise/vibrations transmitted to the cabin through the firewall panel. To demonstrate these effects, the low frequency acoustic modes of a 1989 Chrysler Sundance were identified through experimental measurements. A two-dimensional model of the passenger cabin was then fabricated and shown to exhibit the scaled acoustic modes of the actual vehicle. A metal panel representing the firewall was used to demonstrate the transmission of engine noise into the passenger cabin.

A NEW TRANSITION CONVEYOR SYSTEM

by Brian P. Kennedy and Kevin B. Pelka
Sponsor: Jim Brumels - Rapistan-Demag
Faculty Advisor: Koorosh Naghshineh
11:00 a.m. to 11:25 a.m., Room 208

Transition conveyor systems are used in packaging plants to transport products through changes in elevation and flow direction. This project involved the redesign of a transition conveyor system. This system stops bins full of packages so that they are manually unloaded and returned to an outgoing conveyor. Due to over-design, the U-shape system required a large area and presented an unsafe working environment caused by pinch points. It was replaced by a simpler over-under configuration, thus minimizing space and providing a safer working environment.

DISHWASHER PUMP TEST RIG FOR SOUND MEASUREMENT

by Jonathan C.Y. Chong and Christopher J. Lennon
Sponsor: Victor M. Vukorpa - Whirlpool Corporation
Faculty Advisor: Koorosh Naghshineh
11:30 a.m. to 11:55 a.m., Room 208

The pump in the dishwasher is the main source of unwanted noise. A test rig was fabricated to allow for the measurement of this noise. The test rig was built to contain the water in a normal operating cycle so that sound measurements could be taken around the pump. A piping system was designed to deliver water from the outlet to the inlet of the pump at specific flow rates and pressures. The data collected using this test rig will help to improve the noise characteristics of future dishwasher pump designs.

VENEERED WOODEN SHIFTER KNOB

by Timothy Chuong and Tom Le
Sponsor: Herb Scheer - Berh Industry Corporation
Faculty Advisors: Roman Rabiej and Judah Ari-Gur
1:00 p.m. to 1:25 p.m., Room 208

The wooden shifter knob was made by CNC and overlayed with bird's-eye maple veneer. The curved shape of the shifter knob may cause veneer cracking. A process was developed for lamination of the veneer to the surface of the knob without cracks. All the details of the tools, moisture level, press time, and die material were investigated.

PROGRAM FOR ANALYSIS OF HEAVY TRUCK AXLE HOUSINGS

by Jason M. Honhera and Christopher M. Ngiau
Sponsors: Jay Chakraborthy, Patxi Garcia, and Leo Wenstrup - Eaton Corporation
Faculty Advisor: Judah Ari-Gur
1:30 p.m. to 1:55 p.m., Room 208

A new program was developed for stress analysis of heavy truck axle housings. A parametric model was prepared and interfaced with the ANSYS Finite Element Analysis package. The program accuracy was compared with both lab tests as well as a mechanics of materials theoretical approach, and verified. The program was designed to run through a convenient interface program so that any generic housing could be analyzed and presented graphically. A new and improved axle housing was then designed using this program.

JACK APPARATUS TO RELOCATE AFFIXED WHEEL ASSEMBLAGE

by Michael Beem and Jon Buddemeier
Sponsor: Craig McDonald - McDonald's Towing and Rescue
Faculty Advisor: Judah Ari-Gur
2:00 p.m. to 2:25 p.m., Room 208

The existing apparatus includes a ratchet, roller, and dolly assemblage. This device, which is actuated by a cast aluminum foot pedal, allows the wheel assemblage to be raised off the pavement and repositioned for towing purposes. The main problem was catastrophic failures in the foot pedal due to static and dynamic loads. The problem was solved by redesigning the system to withstand the worst loading scenario by conducting stress and fatigue analysis.

IMPROVEMENT OF THE ARTICULATING ENDOSCOPIC CUTTER'S ARTICULATION LINKAGE

by Juan D. Gonzalez and Mark Snelling
Sponsor: Jeff Oberlin - Richard-Allan Medical Industries
Faculty Advisor: James Kamman
2:30 p.m. to 2:55 p.m., Room 208

An Articulating Endoscopic Cutter (AEC) is a surgical instrument used to staple and separate tissue in laparoscopic surgery. The current AEC articulation linkage design has a tendency to deform, causing a reduction of the articulation range, and sometimes failure of the articulating linkage occurs. The new design improves the range of articulation and will not fail during use.

SIMPLIFIED CONTROL POSITIONING SYSTEM FOR PHYSICALLY IMPAIRED INDIVIDUAL

by Leong Yik Hoo and Kae Jeng Ng
Sponsor: Vicky Terry - Van Buren Intermediate School District
Faculty Advisor: James Kamman
3:00 p.m. to 3:25 p.m., Room 208

A student with cerebral palsy has a limited control of his limbs and head, restricting his ability to operate a communication device. Electrical engineering and mechanical engineering students designed a positioning control system to help him with the communication device. This system device allows the student to easily maneuver the communication device to a comfortable position to operate it. The positioning system is able to handle a weight of 20 lbs. and can move in two directions. It is powered by a 12-volt rechargeable battery.

GEAR PUMP WITH ALTERNATIVE BEARING

by Daryl S. Kreskowiak
Faculty Advisor: James Kamman
3:30 p.m. to 3:55 p.m., Room 208

An alternative gear pump was researched, developed, and tested. The pump was redesigned by incorporating the gear shaft bearings into the gear teeth. This resulted in a smaller pump producing the same output flow rate.

MECHANICAL AND AERONAUTICAL ENGINEERING B-I

Session Chair - Parviz Merati
Room 213

DIFFERENTIAL PRESSURE LEAK TESTING OF A PNEUMATIC FILTER

by Brian W. Binning and Jonathan R. Fox
Sponsor: Thomas M. Wessel - Parker-Hannifin Corporation
Faculty Advisor: Jerry Hamelink
9:00 a.m. to 9:25 a.m., Room 213

Pneumatic filters were previously tested for leakage by an operator through a visual water immersion test. To eliminate this slow method of testing, an automated test stand controlled by a programmable logic controller was designed and constructed. The differential pressure leak test was found to be an accurate and cost effective method of testing the filters for external leakage.

A DEVICE FOR MEASURING THE FORD F SERIES EXTERIOR DOOR HANDLE SPRING

by Peter Dang and Tom Nguyen
Faculty Advisor: Jerry Hamelink
9:30 a.m. to 9:55 a.m., Room 213

A better method for measuring the dimensions of a handle spring for the Ford F series exterior door was needed. The company is now using a caliper and comparator for checking the spring. These measurements are inconsistent, inaccurate, and time consuming. We chose the gauge method for the new measurement system. Using the gauge method provides accurate measurement, consistency, and cost reduction.

WIRE BENDING MODULE FOR USE IN SLIP RING PRODUCTION

by Karun Dansiri and Paul J. Fernandez
Sponsor: David Benedict - Aero-Motive Company
Faculty Advisor: Jerry Hamelink
10:00 a.m. to 10:25 a.m., Room 213

This new process in the manufacturing of slip rings improves the contact between the wires and the copper alloy ring. The previous design utilized soldering to connect wires to the ring, which left a poor contact. The new design uses ultrasonic welding to reduce production time and provide better bonding between the wire and ring. This required the wire to be bent in two planes to fit into the current phenolic insulator. A module was developed to shape the wire into the desired dimensions.

VARIABLE SPEED CONTROL TO IMPROVE POWER PLANT EFFICIENCY

by Daniel C. Brunet and Damien J. Hagaman
Faculty Advisor: Jerry Hamelink
10:30 a.m. to 10:55 a.m., Room 213

The prime movers of the power plant at Western Michigan University were responsible for unnecessary energy losses. For the fixed-speed motor-driven systems of the fans and pumps, throttling devices such as dampers and valves were required to meet flow demands. When system demand was reduced, the excess energy was wasted. Variable speed control was implemented to eliminate these losses and increase overall plant efficiency. Life expectancy of the prime movers was also increased by the "soft start" nature of these devices along with savings in maintenance costs.

SMART CHUCK DESIGN FOR AUTOMATED WELDER

by Michael J. Bommarito and Nathan Spahn
Sponsors: Wayne Seeds, Chris Ersig, and Ted Joy - American Axle & Manufacturing
Faculty Advisor: Jerry Hamelink
11:00 a.m. to 11:25 a.m., Room 213

A Smart Chuck was developed to allow a new welding process known as Magnetic Arc Welding (MAW) to replace existing methods in the assembly of propshafts (automotive drive shafts). The manufacturing change to MAW on the propshafts was needed to increase production rates and weld strengths of the propshafts. The assembly of a propshaft consists of welding two weld yokes on the ends of a steel tube. The Smart Chuck design had to withstand a six ton forging force while holding a squareness tolerance of 0.20 mm between the weld yoke and tube of the propshaft.

MASS FLOW METER TEST STAND REDESIGN

by Timothy S. Reed
Sponsors: Gary Baumgardner, George Peletis, and John Spitzner - Parker-Hannifin Corporation
Faculty Advisor: Iskender Sahin
11:30 a.m. to 11:55 a.m., Room 213

Mass flow meters are used to measure flow rate in fluid (air) systems. The mass flow meter test stand was inefficient and outdated. The test stand was redesigned to meet the technological demands. The redesign incorporated three different flow meters into the test stand and automated the controlling of the test stand.

NANODESIGN OF COMPOSITE LUBRICATION FILMS FOR MICROELECTROMECHANICAL VIBROMOTORS

by Shih Hwang John Wu
Sponsors: National Science Foundation, Division of Civil and Mechanical Systems, and Mark Everson - Ford Motor Company
Faculty Advisors: Valery Bliznyuk, Parviz Merati, and Vladimir Tsukruk
1:00 p.m. to 1:25 p.m., Room 213

Microelectromechanical Vibromotor (MEMV) is a forefront micromachine, with applications in data acquisition, microsurgery, and microelectronics. However, several durability factors impede ideal performance, such as transitory life cycles, adverse wear rate and high friction. Due to their minute size, vibromotors cannot be lubricated through conventional means. This project focused on developing composite layer films, consisting of rigid polymers chemically attached to the surface as an alternative method to lubricate these systems. Properties such as surface topography, adhesive forces, and friction coefficient (μ) were measured and examined through Scanning Probe Microscopy (SPM). Through these results, improved methods of MEMV production, reduction in friction, and enhanced wear resistance can be achieved.

HEATED BALL BEARING GREASE TESTER

by Jeffrey W. Karger and Jason L. Stanton
Sponsor: Alan Ives - The Johnson Corporation
Faculty Advisor: Philip Guichelaar
1:30 p.m. to 1:55 p.m., Room 213

A tester was designed to evaluate greases for heated ball bearing applications. Heat transfer analysis and machine design techniques were used to develop a tester capable of variable shaft speeds and temperatures while applying radial and axial bearing loads. The tester will be used to identify greases that extend the life of bearings in heated rotary joint applications.

DURABILITY TESTER FOR GLOVE COMPARTMENT DAMPER

by Sharnessa R. Bland and Jacquelynne D. Burge
Sponsors: Mary J. McCombs and Steven H. Keith - SUSPA Inc.
Faculty Advisor: Philip Guichelaar
2:00 p.m. to 2:25 p.m., Room 213

A durability tester that performs life tests on gas spring suspension devices used in the glove compartment door of 1997 Ford Taurus cars was redesigned to increase reliability. To simulate usage conditions, the gas spring was pulled to its full extension and then allowed to retract by itself. The final design operates with a minimal level of noise, withstands the required loading forces, and sequentially records the number of completed cycles.

TORSION SPRING CLUTCHING IN LINE-SHAFT CONVEYORS

by David J. Rozema and Eric O. Stimer
Sponsor: Creative Handling Incorporated
Faculty Advisor: Philip Guichelaar
2:30 p.m. to 2:55 p.m., Room 213

Line-shaft conveyors use friction-driven rollers to move products. When products are stopped, multiple rollers stop, resulting in slippage on the line shaft. This results in excess frictional energy losses. Optimization techniques were used to investigate the possibility of reducing the energy losses by implementing a positive torsion spring clutch to replace the friction drive. The resulting clutch design reduced the energy losses by expanding the weight carrying capability of the conveyor.

OVERBED TABLE TILT MECHANISM

by Joseph Beck and Mark Chan
Sponsor: Mark E. Borton - Am Fab Inc.
Faculty Advisor: Philip Guichelaar
3:00 p.m. to 3:25 p.m., Room 213

Current models of overbed tables do not incorporate a split-top design which would permit multiple activities to be done concurrently. A tubular joint mechanism was designed to allow one third of the table top to remain horizontal while the rest can incline at selected angles in both directions. The joint mechanism is easy to operate, inexpensive, and withstands a load of 50 pounds.

PUMP LUBRICANT FILTERING SYSTEM

by Heather Henderson and Daniel L. Krueger
Faculty Advisor: Molly Williams
3:30 p.m. to 3:55 p.m., Room 213

A bearing frame lubricating oil filtration system has been designed for a centrifugal pump. The filtration is accomplished by tapping into the bearing frame housing, drawing the oil to a separate pump which pushes the oil through the filter to remove any contaminants. The clean oil is then returned to the bearing frame housing through another tap.

MECHANICAL AND AERONAUTICAL ENGINEERING C-I

Session Chair - Richard Hathaway
Room 242

TRANSMISSION CASE LIFTING EYE TENSILE TEST BLOCK

by Rhonda S. Hornak and Sean P. Kelly
Sponsors: Eric A. Samuelson and James M. Walker - Eaton Corporation
Faculty Advisor: Daniel Kujawski
9:00 a.m. to 9:25 a.m., Room 242

The new design of a transmission case lifting eye has been integrated into the transmission case casting. The current lifting eye is a removable component that can be tested separately. The new transmission case was analyzed with Algor® Finite Element Analysis (FEA) software to find the required test specimen. A test block was designed, constructed, and analyzed to accommodate the test specimen. A safe test procedure was then developed, conducted, and documented. This new design utilized only a small sample of the case to be tested.

WIND TUNNEL CALIBRATION MODEL

by Wendi M. DeWitt and Catherine A. Lavin
Faculty Advisor: John Valasek
9:30 a.m. to 9:55 a.m., Room 242

The new closed-loop wind tunnel will require a calibration model to prepare it for future testing. Using specifications for the current open-loop wind tunnel, a calibration model was built for lift, drag, and pitching moment analysis. The model calibrated the open-loop wind tunnel. Principles of similitude were then used to design a model for use in the larger closed-loop wind tunnel, enabling students to build a scaled model based on this design.

COMPUTER CODE OF AERODYNAMIC FORCES AND MOMENTS MATRIX

by Todd A. Carriveau and Jefferson L. Davis
Sponsor: Troy Downen - Raytheon Aircraft Company
Faculty Advisor: John Valasek
10:00 a.m. to 10:25 a.m., Room 242

An effective tool was needed to acquire aerodynamic coefficients from a lateral directional and longitudinal forces and moments matrix, as well as construct the matrices from coefficients. A computer code was developed to perform two functions using given aircraft parameters. First, the matrix was constructed by solving the matrix equations. Next, the matrices were broken down to derive the stability and control derivatives using the state-space method. Coefficients resulting from the computer code were verified and compared with known aircraft data. The results obtained from the program will be used in aircraft analysis and design of stability and control systems.

UNIVERSAL JOINT ASSEMBLY TOOLING DESIGN

by Robert Middleton and Ronald Middleton
Sponsors: Kevin Secord and Jeff Fowler - American Axle and Manufacturing
Faculty Advisor: Richard Hathaway
10:30 a.m. to 10:55 a.m., Room 242

The current universal joint assembly process was modified by designing tooling to assemble the universal joint components to new customer specifications. The universal joint is the mechanism in automobiles that allows for substantial misalignment in drive shafts. The function of the tooling was to spread the universal joint to allow the components to be assembled with the required tolerances. The tooling was designed, prototyped, and tested to satisfy all required specifications. The final design provides the required clearances for the universal joint components during assembly.

ADJUSTABLE SUSPENSION OF A SUPERMODIFIED RACE CAR

by Ling Foong Kok and King Wa Ricky Lai
Sponsor: Page Racing Enterprises
Faculty Advisor: Richard Hathaway
11:00 a.m. to 11:25 a.m., Room 242

A lightweight, compact, adjustable suspension device was designed to provide roll stiffness adjustment via spring spacing adjustment for improved high speed cornering on a race car. The manually adjustable mechanism was built to improve cornering and accommodate future plans for motorized adjustment. The device can be easily adjusted to suit the driver's needs without changing torsion bar size fever and length or wheel location. Changing the effective separation between the springs allows the vertical compliance of the suspension to remain constant while the roll stiffness is changed.

V-6 ENGINE BLOCK ROLLOVER STATION

by Paul C. Kuhn and Noel V. Ranka
Sponsor: Visi-trol Engineering
Faculty Advisor: Richard Hathaway
11:30 a.m. to 11:55 a.m., Room 242

The existing automotive V-6 engine rollover station has failed due to the forces caused by the rotation of the engine block. A redesign of the bushing/shaft set-up was necessary, while keeping the existing base structure and tight tolerances to the assembly line. The fixture loads on the system were analyzed, and new design criteria were established. Alternatives to the bushing/shaft set-up were tested, and the station was redesigned. The down-time for the station was significantly decreased.

HIGH LIFT WING FOR A SUPERMODIFIED RACE CAR

by Robert Barta and Stevan Vučković
Sponsor: Willard Stutzman - Stutzman Racing of Elkhart, Indiana
Faculty Advisors: Richard Hathaway and Art Hoadley
1:00 p.m. to 1:25 p.m., Room 242

The existing race car wing does not produce enough down force for winning cornering speeds. A new, multi-element, high lift coefficient wing was designed using numerical analysis and wind tunnel experiments. A mobile test bed was designed and built to evaluate and compare the performance parameters of the current and the newly designed wing. The new wing was built and tested to assure that it would give the vehicle at least a 10% higher cornering speed. The results of these experiments, such as down force, drag, and the location of the aerodynamic center, were also provided to the customer in order to optimize the car chassis setup.

AIRBORNE THRUST CELL DESIGN AND EVALUATION

by Ed Bartley and Dong Eun Kim
Faculty Advisor: Art Hoadley
1:30 p.m. to 1:55 p.m., Room 242

There is a need to measure thrust of an aircraft in flight to determine thrust, aircraft and propeller efficiency and drag coefficient at zero lift. These measurements provide valuable data for improvements. By measuring the displacement of the aircraft engine in its mounts, the thrust was determined. The thrust cell design reduces the effect of torque, pitch, and yaw on the thrust measurement. The cell was installed without affecting the structural integrity or function of the existing aircraft propeller or engine.

AIRFOIL WAKE SURVEY PROBE FOR FLIGHT TESTING

by Aaron W. Dentel and Dana L. Kemppainen
Faculty Advisor: Art Hoadley
2:00 p.m. to 2:25 p.m., Room 242

The existing system used to measure the pressure distribution at the trailing edge of the wing of the WMU experimental aircraft was mechanically unstable and difficult to attach to the aircraft. An under-wing pod that contains a single pressure transducer and a probe that rotates through the trailing edge flow field was designed. The process included testing a scaled model in the wind tunnel for flutter and calculating the aerodynamic loads imposed during flight. The approved design will be used on the experimental aircraft as a learning tool for future aeronautical engineering students.

REMOTELY-CONTROLLED AIRCRAFT DESIGN FOR OPTIMUM RANGE

by Michael T. Bierod and Daniel D. Doyle
Sponsor: Gregory S. Page - American Institute of Aeronautics and Astronautics (AIAA)
Faculty Advisor: Art Hoadley
2:30 p.m. to 2:55 p.m., Room 242

A remotely-controlled electrically-powered aircraft model with an optimum range was designed. Finite element analysis software was utilized to determine optimal weight, while a two-dimensional computational fluid dynamics program was used to increase the lift to drag ratios. The result was an aircraft weighing approximately 17.5 lbs. with a seven foot wing span that was capable of carrying a 7.5 lb. payload.

INSTALLATION AND PILOT TESTING OF THE STALL MARGIN SYSTEM

by Layne L. Connelly Jr. and Jaewan Park
Faculty Advisor: Art Hoadley
3:00 p.m. to 3:25 p.m., Room 242

A stall margin indication system was installed on a flight simulator. Western Michigan University student pilots from the aviation flight science program then tested the system. Pilot/system interaction was evaluated for pilots with a range of flying experience to optimize the system for a wider range of use on different aircraft. The system was also designed for use with WMU's flight test aircraft.

PAPER AND PRINTING SCIENCE AND ENGINEERING - A-1

Session Chair - Raj Aravamuthan
Room 211

EFFECTS OF CHLORIDE AND ALUM ON CORROSIVITY OF WHITE WATER WITH CLOSURE

by Daniel A. Pesko
Faculty Advisor: John Cameron
9:00 a.m. to 9:25 a.m., Room 211

This project explored the effects of temperature on the corrosivity of white water on mild, 304, and 316 stainless steel. It also investigated the economic feasibility of adding equipment to effect process white water temperature. Temperature was utilized as the controlled variable. In this experiment, a white water solution was emulated within the laboratory and placed within a constant temperature bath. Metal coupons of mild, 304, and 316 stainless steel were immersed within the white water solution. Corrosion of the coupons was evaluated at various chloride and alum levels.

A STUDY OF SEMI-CHEMICAL PULPING WITH BORAX

by Daniel Hebner
Faculty Advisor: John Cameron
9:30 a.m. to 9:55 a.m., Room 211

In recent years, a large number of new pulping processes have been introduced into the paper industry. In semi-chemical pulping processes, a chemical pretreatment of pulp is followed by a mechanical fiberizing stage. The primary goal is to achieve a significant increase in yield compared to traditional chemical pulping processes. Sodium carbonate (with or without sodium hydroxide) is commonly used as the pulping chemical. This study determined the effects of the addition of borate to sodium carbonate/hydroxide cooks. Using WMU's laboratory digester, borate was added to the chemical pulping process. The effects on pulp yield, residual lignin content of the pulp, and final paper properties were analyzed.

THE EFFECTS OF SILICA SURFACE AREA ON MICROPARTICLE RETENTION AID SYSTEMS

by Jason P. Hoffmann
Faculty Advisor: John Cameron
10:00 a.m. to 10:25 a.m., Room 211

First pass retention has always been a concern in the paper industry. The current trend in improving retention is the use of microparticle retention aids. This study explored the effects of silica surface area on microparticle retention aid systems. A 2^5 factorial design experiment was used to determine the interactions between varying cationic polymer and anionic microparticle dosages. Other variables included shear rate and stock temperature. The goal of this project was to determine a correlation between specific surface area of silica and first pass retention efficiency. More specifically, experiments were conducted to see if the amount of surface area of the silica added per ton of paper can be used as a measure of the amount of first pass retention expected. First pass retention and first pass ash retention were measured.

THE EFFECT OF DEINKING VARIABLES ON FLOTATION DEINKING OF ELECTROGRAPHIC TONERS

by Joel Jacobs
Faculty Advisor: Raja Aravamuthan
10:30 a.m. to 10:55 a.m., Room 211

Flotation deinking has become a popular way to deink paper, reduce waste, and achieve a relatively white pulp without cutting down more trees and operating a bleach plant. With the rise of photocopiers and laser printers, the amount of electrographic toner in recycled paper has increased dramatically. This project centered on how best to remove these inks from paper. The effects of pH, surfactant concentration, and surfactant charge (cationic or anionic) on deinking efficiency for electrographically printed paper were evaluated. The paper was printed with either positively- or negatively-charged toner, and an evaluation of this variable was also done.

FEASIBILITY OF SODIUM CARBONATE PULPING OF KENAF FOR CORRUGATING MEDIUM

by Jennifer A. Lechlitner
Faculty Advisor: Raja Aravamuthan
11:00 a.m. to 11:25 a.m., Room 211

The waste paper stream continuously loses its strength on repeated recycling. To maintain a high percentage of recycled fiber in paper, approximately 70% virgin fiber must make up for this strength loss; therefore, an alternative fiber source may be necessary to act as a hardwood replacement in corrugating medium to increase the strength properties. Kenaf, a nonwood fiber source, could be such a replacement. This experiment involved pulping kenaf fiber with sodium carbonate, analyzing the spent black liquor, and determining strength properties from resultant handsheets. Strength improvements obtained by mixing different amounts of kenaf with OCC were documented and analyzed to study the feasibility of such use.

DEINKING RECYCLED PULP BY CROSS-FLOW FILTRATION

by Matthew Walters
Sponsors: Scott Davis and John Rishel - Ronningen-Petter
Faculty Advisor: Raja Aravamuthan
11:30 a.m. to 11:55 a.m., Room 211

Cross-flow filtration is used in process stream filters in order to remove oversized contaminants and clean up a liquid stream. This project examined the possibility of using this method to deink a pulp slurry with minimal effluent water. A large quantity of water is used to deink wood pulp by conventional washing methods. The vessel constructed for this project allows pulp to flow through the inner part of a cylindrical screen while removing water, ink, and some filler from the slurry and thus deinking the pulp with a minimum of water usage.

THE DETECTION OF STICKIES USING INFRARED THERMOGRAPHY

by Daniel Finkler
Faculty Advisor: William Forester
1:00 p.m. to 1:25 p.m., Room 211

An idea was developed to use infrared thermography to make the detection of contaminants in a paper mill stock stream quicker and easier. This project took the development of this test one step further by measuring contaminants of known size and thickness. Sample pads were made from a mixture of contaminants and wood fiber, then heated in a laboratory oven to 105°C. When the pads were removed from the oven, the temperature change was measured using an infrared camera. This project determined which contaminants were stickies once each material's heat capacity was known.

THE EFFECT OF REPEATED RECYCLING ON PAPER STRENGTH

by William Thomas Byrd
Faculty Advisor: Ellsworth Shriver
1:30 p.m. to 1:55 p.m., Room 211

The societal demand for recycling has added many variables to the science of papermaking. The effect of increasing the percentage of secondary fibers on the strength of the resulting paper is one of these variables. To study this parameter, handsheets were produced from four sources of secondary fiber. By repulping and producing new sheets through five stages of recycling, tests showed a consistent trend of decreased strength with successive recycles. By contrasting the extent to which this strength decrease occurs with different grades of paper, the impact on the strength of the resulting sheet may be predicted with increased accuracy.

ESTIMATING INTEGRATED MILL EFFLUENT TREATABILITY

by Sara Cox
Faculty Advisor: Van Maltby
2:00 p.m. to 2:25 p.m., Room 211

This project estimated treatability of internal process streams as a function of BOD and COD. This is important to the paper industry because of increased regulations placed on the effluent discharged from pulp and paper mills. This helps to show what processes are most effective on which process streams, identifies the major source of COD, and determines the treatability of the major sources. Samples from five different process streams within an integrated, bleached kraft mill were analyzed using BOD and COD tests on both filtered and unfiltered samples. The process streams include the kraft mill (including bleach plant), the RMP mill, the coater, the paper machines, and a final combined effluent.

PAPER AND PRINTING SCIENCE AND ENGINEERING - B - I

Session Chair - Thomas Joyce
Room 212

THE STUDY OF HEADBOX STREAKS AND MICRO FIBER FLOCCULATION

by Erik Michael Standerfer
Faculty Advisor: Dewei Qi
9:00 a.m. to 9:25 a.m., Room 212

Higher speed, better quality, more cost effectiveness, and more control have led to a great concern over small Cross Direction (CD) variations in the coated paper industry. Due to the inability of the industry to measure these variations, they remain a problem. Large mill trials were conducted and evaluated along with computer simulations of headbox flow variations. Two-dimensional models of various headbox arrangements were created and their effectiveness in altering velocity vectors within the headbox was studied. Combining this experience with past research offers possibilities for elimination of paper defects in the future. Spherical particle interaction was applied to fiber-to-fiber interaction, resulting in an explanation of micro flocculation and the mechanisms involved in floc formation.

BEATING EFFECTS ON MECHANICAL RECYCLE

by Richard M. Verbrugge
Faculty Advisor: Dewei Qi
9:30 a.m. to 9:55 a.m., Room 212

The effects of beating on mechanical recycle were unknown. This project investigated these effects by testing the properties of fiber strength and bonding strength through subsequent recycles. These recycles consisted of low intensity beating, high intensity beating, and no beating for the optimization of recycled sheet properties. Evaluation of the data provided the trends that were relevant. This project yielded information regarding the number of times a mechanically treated fiber can be recycled, the yield loss, the effect of air drying, and the degradation of strength in both paper and individual fibers.

THE EFFICIENCY OF SURFACTANTS ON XEROGRAPHIC INK

by Andrew McLaughlin
Faculty Advisor: Dewei Qi
10:00 a.m. to 10:25 a.m., Room 212

Surfactants are used in the deinking process for the dispersion of ink particles, collection of ink particles, and reduction of surface tension. Xerographic inks are difficult to deink by conventional means due to their particle shape and size after deinking. Therefore, the evaluation of the efficiency of surfactants on xerographic toner particles is critical to optimizing a deinking process and improving selection of deinking surfactant candidates. Using the results of image analysis and particle size distribution, surfactant efficiency was reported and correlated to the surfactant HLB (hydrophile-lipophile balance) values.

THE EVALUATION OF SURFACTANT PARAMETERS ON FIBER YIELD AND FIBER LENGTH DISTRIBUTION

by Kevin J. Kryszak
Faculty Advisor: Dewei Qi
10:30 a.m. to 10:55 a.m., Room 212

Flotation deinking and chemical surfactants have long been important tools in the recycling of paper. It is commonly known that flotation deinking is not a perfectly efficient process. Some percentage of viable papermaking fibers are always removed with the ink rejects stream. With reasonable knowledge about what factors affect the yield of the process, questions remain about the type of fibers that are being removed. This experiment tested the effects of surfactant charge, pH and process retention time on the different fiber lengths that are lost in the rejects of the process.

OPTIMIZATION OF RECYCLED TMP PAPER USING FRACTIONATION

by Michael Felker
Faculty Advisor: Dewei Qi
11:00 a.m. to 11:25 a.m., Room 212

The continued recycling of pulp leads to the gradual shortening of fibers. This in return diminishes the overall paper quality. This project exposed a TMP pulp to several recycles and fractionated the pulp at each recycle. From each fractionation, sheets were made using different percentages of long and short fiber. Adding different percentages of long and short fiber led to a recycled sheet with properties similar to the original. This was confirmed by testing the basic strength properties (tensile, tear, and burst), porosity, opacity, brightness, and zero-span tensile strength.

EFFECT OF TEMPERATURE ON RECYCLABILITY OF MECHANICAL PULP

by Jeffry Joseph Collegnon
Faculty Advisor: Dewei Qi
11:30 a.m. to 11:55 a.m., Room 212

With recycling becoming an important issue in today's culture it is important that the paper industry develop good processes that will enhance the quality of future recycled paper products. In this project, handsheets were made from virgin mechanical pulp and dried at three different temperatures. The sheets were then recycled three different times. Various strength tests were performed after each recycle to determine the effects of varied drying temperatures on the strength of handsheets.

THE EFFECT OF INCREASED BEATING ON THE RECYCLING POTENTIAL OF MECHANICAL PULPS

by Bill Draze
Faculty Advisor: Dewei Qi
1:00 p.m. to 1:25 p.m., Room 212

The advent of increased recycling is pushing today's paper mills to make better use of reclaimed fiber. Chemically pulped fibers have been proven to act in a distinct manner when recycled, unlike mechanically pulped fibers. By recycling a pure mechanical pulp four times and testing strength properties after each recycle, the effects and causes of increased recycling were discovered. The effect of softening enhanced bonding ability and strength until the fourth recycle. At this point the fibers started to harden, causing a decrease in bonding ability and strength.

THE EFFECTS OF RECYCLING ON THE HYGROEXPANSIVITY OF MECHANICAL PULP

by Derek M. Depuydt
Faculty Advisor: Dewei Qi
1:30 p.m. to 1:55 p.m., Room 212

The recycling of fibers leads to irreversible hornification, a stiffening or hardening of the fibers that causes reduced bonding. This project investigated the possibility that the loss of fiber flexibility and plasticity is due to the reduced swelling capacity of the fiber once it has been made into paper. The hygroexpansivity test raised the relative humidity within the instrument and measured the amount the sample extended due to the absorption of the humidifying solution, barium chloride. It was found that as the number of times the sheet was recycled increased, the amount the sample extended decreased. The smaller extension means the sheet became more dimensionally stable as the number of recycles increased.

THE PAPER SURFACE EFFECTS OF RECYCLING TMP

by Jeremy James Teachman
Faculty Advisor: Dewei Qi
2:00 p.m. to 2:25 p.m., Room 212

The push for the use of secondary fibers in papermaking has opened new areas of research. This study aimed to evaluate the recycling of Thermomechanical pulp (TMP) and the resultant effects to the paper surface. The properties examined were smoothness, porosity, pore size distribution, and water contact angle. An understanding of the surface effects of recycling TMP could be applicable in the production and use of lightweight coated paper.

PAPER AND PRINTING SCIENCE AND ENGINEERING - C - I

Session Chair - Brian Scheller
Room 215

CLOSING THE WHITE WATER LOOP USING AN AEROBIC TRICKLING FILTER

by Brent Jones
Faculty Advisor: David Peterson
9:00 a.m. to 9:25 a.m., Room 215

To meet stricter EPA requirements, it is becoming increasingly important to limit effluent discharge in the paper industry. The white water from a paper machine is a large source of easily treatable waste water. Previous methods of closure produced numerous problems with deposits, corrosion and bacteria build-ups. By treating the white water before re-using it these problems can be controlled. A laboratory model of an aerobic trickling filter was built and used to test the removal efficiency of organic waste from a synthesized white water solution. A comparison was made on the untreated white water and treated water by using tests for COD, pH and TSS.

THE EFFECT OF AEROBIC BIOLOGICAL TREATMENT ON ODOROUS HYDROGEN SULFIDE EMISSIONS

by Linh Ly
Faculty Advisor: David Peterson
9:30 a.m. to 9:55 a.m., Room 215

Sulfides from kraft mills and other processes are an odor problem. An aerobic biological reactor (with an inert packing to support bacteria) can be used to absorb and degrade these gases. This would reduce the quantity and improve the quality of effluent gases. Spun glass wool was used as substrate to initiate a thiobacillus culture growth before the injection of the hydrogen sulfide through the biologically active area. Exhaust gases were then analyzed for content using a detection device to determine the feasibility of using an aerobic biological reactor to degrade these gases.

USE OF AN AEROBIC WOOD BASED BIOREACTOR TO OXIDIZE HYDROGEN SULFIDE

by Wade C. Rayner
Faculty Advisor: David Peterson
10:00 a.m. to 10:25 a.m., Room 215

This experiment consisted of a single biological reactor packed with moist wood chips (pine) and seeded with thiobacillus, a sulfide oxidizing bacterial strain. Hydrogen sulfide mixed with air was introduced into the reactor at varying concentrations approximating those present in the kraft pulping process. Exit gas analysis was used to determine if biological oxidation and subsequent odor reduction was feasible with this growth medium.

VIABILITY OF WOOD PALLETS AS A SIGNIFICANT FIBER SOURCE

by Marcus J. Tirconi
Faculty Advisor: David Peterson
10:30 a.m. to 10:55 a.m., Room 215

Responding to strong demand for secondary wood fiber due to timber harvesting restrictions and governmental regulations, efforts to obtain wood from the waste stream need to be increased. The experimental design for this study was as follows: wood pallets, representing typical wood waste found in landfills, were chipped, screened, and pulped using an M/K digester. The resultant pulp was then screened and refined so paper could be made. The paper was tested for various strength properties and the results compared to some "typical values" to determine if paper made from wood pallets is indeed a significant and viable secondary fiber source.

THE EFFECTS OF BASE SHEET PROPERTIES ON BLADE FORCES IN BEVELED BLADE COATING

by Derek Denzer
Sponsors: Glenn VanHarken - Rhone-Poulenc Inc., and James River Corp.
Faculty Advisor: Brian Scheller
11:00 a.m. to 11:25 a.m., Room 215

When coating on a beveled blade coater, the coat weight applied to the base paper is influenced by the doctoring action of the blade. The final coat weight varies as a function of the blade deflection. The blade deflection is determined by a balance between blade forces and dynamic forces. The dynamic forces are derived from the pressure forces (speed induced), the impulse force (momentum dependent) and the hydrodynamic forces. How the roughness of the base sheet affects the blade force is unknown. By measuring the blade deflection while coating on films with varying roughness, the interaction was studied under dynamic conditions. Experimental measurement of blade deflection was carried out on a Cylindrical Laboratory Coater, using a position detector mounted on a blade.

THE EFFECT OF PIGMENT AND LIQUID ON COATING RHEOLOGY AND DEWATERING

by Steven C. Payne
Faculty Advisor: Brian Scheller
11:30 a.m. to 11:55 a.m., Room 215

The end properties of a coated paper are influenced by the rheology and dewatering of the applied coating. For this project, the rheological properties of several ink jet coating formulations were studied at various shear rates using Brookfield and Hercules viscometers. The dominant pigment and binder in each formulation was silica and polyvinyl alcohol respectively. In addition to rheology measurements, each coating formulation had its water retention measured with a water retention meter that is based on pressure filtration. By varying the concentration of coating components, it was possible to determine which component(s) had the most influence on coating rheology and dewatering.

THE EFFECTS OF DIRECTIONAL DRYING ON BINDER MIGRATION

by Bruce Johnston
Faculty Advisor: Brian Scheller
1:00 p.m. to 1:25 p.m., Room 215

Binder migration causes various printing defects. Extra dryer capacity cannot be utilized in drying the paper due to excessive binder migration at high drying rates. For this project, a base sheet was coated with a formula containing styrene-butadiene as the binder. After doing a drawdown with the coating, the sheet was dried with a specially built dryer to dry the sides of the sheet separately. After varying the amount of drying on each side of the sheet, samples were evaluated by UV analysis for binder migration. The objective was to find a top to bottom side drying ratio that immobilizes the binder and minimizes migration.

IMAGE ANALYSIS AND RATING OF INK JET PRINTING

by Wendy S. Woodbury
Faculty Advisor: Brian Scheller
1:30 p.m. to 1:55 p.m., Room 215

Current methods exist to analyze ink jet print quality. These methods are adequate, but are often subject to human judgment. A quantitative method that could be used throughout the industry would be beneficial to those attempting to make paper acceptable for ink jet printing. Correlation between image analysis measurements and visual ranking was established. Human rating was determined by the use of an all-pair comparison. NIH image analysis software and a scanner were used to analyze printed samples. This project defined a quantitative correlation of image analysis to human ratings and established which image-based factors give the highest correlation.

THE EFFECTS OF STYRENE BUTADIENE ON THE PROPERTIES OF A COATED SHEET

by Bryan Wiltzius
Faculty Advisor: Brian Scheller
2:00 p.m. to 2:25 p.m., Room 215

Advances in knowledge and technology are being made every year in the area of paper coating to keep up with the demands of customers. Styrene-butadiene (SBR) is a common binder for optimizing optical properties. Previous research has characterized how SBR affects the optical properties, especially gloss. However, there is little information on how SBR affects the physical properties of the coating, including cracking, abrasion resistance, pick strength, water resistance, smoothness, and ink receptivity. This research project characterized the effect of a varying latex binder on these physical characteristics, along with the optical properties of opacity, brightness, and yellowing from ultra violet exposure.

THANK YOU

The College of Engineering and Applied Sciences is grateful to these firms which have provided or cooperated in Senior Engineering Design Projects being presented in April 1997. If you have a project for our students or if you would like more information, please call Yvonne Steffler at (616) 387-4017.

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Kalamazoo Technologies
Kalamazoo Valley Community College
McDonald's Towing and Rescue
National Science Foundation, Division of Civil and Mechanical Systems
National Science Foundation, Engineering Division
Page Racing Enterprises
Parker-Hannifin Corporation Fluidpower Pump Division
Parker-Hannifin Corporation Hydraulic Pump Motor Division
Parker-Hannifin Corporation Schrader Bellows Pneumatic Division
Premier Class Injection Molders
Prince Corporation
Ralston Foods
Rapistan Demag Corporation
Raytheon Aircraft Company
Rhone-Poulenc, Inc.
Richard-Allan Medical Industries
Robert Bosch Corporation

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Ronningen-Petter
Smiths Industries, Aerospace and Defense Systems
Steelcase North America
Stryker Medical
Stutzman Racing of Elkhart, Indiana
Summit Polymers, Inc.
SUSPA Inc.
Thomson Bay, Inc.
Van Buren Intermediate School District
Visi-trol Engineering
Whirlpool Corporation

The College of Engineering and Applied Sciences offers a wide variety of programs.

School of Aviation Sciences

- Aviation flight science
- Aviation maintenance technology
- Aviation technology and operations

Construction Engineering, Materials Engineering, and Industrial Design

- Construction engineering and management
- Industrial design
- Materials engineering

Electrical and Computer Engineering

- Computer engineering
- Electrical engineering

Industrial and Manufacturing Engineering

- Automotive engineering technology
- Engineering graphics and design technology
- Engineering management
- Industrial engineering
- Industrial management
- Manufacturing engineering technology

Mechanical and Aeronautical Engineering

- Aeronautical engineering
- Mechanical engineering

Manufacturing Engineering

- Manufacturing engineering (Muskegon only)

Paper and Printing Science and Engineering

- Paper engineering
- Paper science
- Printing

The **master of science in engineering** is offered in computer, electrical, mechanical, and industrial engineering.

The **master of science** is offered in engineering management, manufacturing science, materials science and engineering, operations research, and paper science and engineering.

The **Ph.D.** is offered in industrial and in mechanical engineering.

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