A SUMMARY AND REPORT

SABBATICAL LEAVE

Spring Semester 1984

MAURICE C. MOORE

Submitted to

The Salary and Leaves Committee

and

The Board of Trustees

of

Mt. San Antonio College

November 2, 1984

MT. SAN ANTONIO COLLEGE
Salary and Leaves Committee

MT. SAN ANTONIO COLLEGE
1982 DEC -1 PM 3:13
PERSONNEL OFFICE

APPLICATION FOR SABBATICAL LEAVE

Name of Applicant MOORE (Last) MAURICE (First) CLAYTON (Middle)

Address 1510 E. MARBURY (Street) WEST COVINA (City) 91791 (Zip)

Employed at Mt. San Antonio College beginning SEPTEMBER (Month) 1956 (Year)

Dates of last sabbatical leave:

From SEPTEMBER (Month) 1975 (Year) To JUNE (Month) 1976 (Year)

Department PHYSICAL SCIENCE & ENGINEERING Division NATURAL SCIENCE

Length of sabbatical leave requested:

One semester X
Fall ____ Spring X
Two semesters ____
Administrative ____

Purpose of sabbatical leave:

Study ____
Travel ____
Independent Study and Research X
Combination (specify) INDEPENDENT STUDY & TRAVEL

Effective dates for proposed sabbatical leave:

From FEBRUARY 1984 To JUNE 1984

and (if needed)

From ____ To ____

Attach a comprehensive, written statement of the proposed sabbatical activity(ies) including a description of the nature of the activity(ies), a timeline of the activity(ies), an itinerary, if applicable, the proposed research design and method(s) of investigation, if applicable.

Attach a statement of the anticipated value and benefit of the proposed sabbatical activity(ies) to the applicant, his/her department or service area, and the College.

Any change or modification of the proposed sabbatical activity(ies) as evaluated and approved by the Salary and Leaves Committee must be submitted to the Committee for reconsideration.

Maurice C. Moore
Signature of Applicant

Dec. 1, 1982
Date

Applicant's Name MAURICE C. MOORE

The acknowledgment signatures reflect awareness of the sabbatical plan for the purpose of personnel replacement. Comments requested allow for recommendations pertaining to the value of the sabbatical leave plan to the College. Applicants must obtain the signatures of acknowledgment prior to submitting application to the Salary and Leaves Committee.

ACKNOWLEDGMENT BY THE DEPARTMENT/DIVISION

Signature of Department Chairperson A. Leslie Petit Date 12/1/82

Comments: In my view Mr. Moore's sabbatical proposal would greatly benefit the department as well as himself.

Signature of Division Chairperson Barbara Nit Crane Date 12/1/82

Comments: A very timely sabbatical plan and one that should benefit the college

ACKNOWLEDGMENT BY THE OFFICE OF INSTRUCTION

Signature of Vice President/Asst. Superintendent Instructional & Student Services J M Rzyski Date 12-2-82

Comments:

****

FINAL ACTION BY THE SALARY AND LEAVES COMMITTEE:

✓ Recommend approval to the Board of Trustees

_____ Not recommend approval to the Board of Trustees

Walter N. Collins 12-3-83
Signature - Chairperson, Salary and Leaves Committee Date

John D Rubin 11/29/83
Signature - Authorized Agent for the Board Date

myw
10/21/82

PROPOSED PLAN OF STUDY: Sabbatical Leave Request

Maurice C. Moore, 1 December 1982

I. STATEMENT OF PURPOSE:

My sabbatical leave plan has three main objectives which will be of value to the community, the College, my Department, and myself. These objectives are: (1) Gather data to determine criteria for the selection of Computer Graphics equipment that can be interfaced with our computer terminals and/or Apple II computers; (2) gather data on how other schools and colleges teaching engineering are utilizing computers in their engineering classes; and (3) plan how to utilize computers in the courses I teach.

II. BACKGROUND INFORMATION:

I have been a member of the Mt. San Antonio College faculty since 1956. I teach classes in engineering graphics, descriptive geometry, introduction to engineering and surveying. Periodically, I teach one or more classes in mathematics.

Although the name and number of the courses I teach have remained the same for over twenty years, the content, teaching tools and methods continually evolve. A new tool, the computer, has arrived!

We are presently using computers in Physics labs and to a limited degree in surveying. Soon we expect to expand their use into the entire engineering curriculum. Through the tireless efforts of Mr. Blaine Kalar, we have computer terminals and a limited number of Apple II computers. We are in the process of planning and developing a computer facility, now in the planning stage, to be completed in the near future.

III. PROCEDURE:

To accomplish the goals I have established, I propose to: (1) visit schools of engineering and interview faculty and students who use the equipment; (2) attend one or more computer fairs to see new equipment and get information from manufacturers. If feasible, I will try to arrange for equipment demonstrations for our Department and or Division.

I have been promised support by my Department Chairman and others in the Natural Science Division. Too, I have been promised support by a number of members of the American Society for Engineering Education. I expect to spend approximately three (3) months gathering data. This will necessitate a number of trips to various colleges and universities. The remainder of the semester will be devoted to compiling and interpreting data, proposing a revision of applicable courses of study, and writing suggestions as to how we can best utilize our facilities.

I feel this program is worthwhile. Through visitation to engineering schools, I will be able to establish local contacts which will be of value in articulation.

The Department will gain by having another source for input into our new facility. I will personally gain by the contacts and knowledge I will acquire while pursuing these objectives.

Thank you for considering this application.

ADDENDUM TO SABBATICAL LEAVE PROPOSAL

To reply to your points of information request, I have prepared the following responses:

1. I propose to visit the following colleges and/or universities:

   Cal Poly University, Pomona
   Cal State University, Los Angeles
   Cal State University, Long Beach
   Cal State University, Fullerton
   University of California, Los Angeles
   Northern Arizona University, Flagstaff, Arizona

   I also plan to visit some community colleges in the state.

2. Tentative Schedule of Activities:

   February: I plan to make contacts and firm up appointments. I will also be developing and organizing interview questions.

   March, April, and May: I will be visiting colleges and conducting my interviews.

   May and June: I plan to use the last part of May and the month of June for interpreting interview material and writing conclusions and recommendations.

3. I have not developed specific interview questions at this time. My questions, however, will be designed to solicit the information stated in points 1 and 2 under the heading Statement of Purpose in my sabbatical request.

4. I am aware of the work that Mr. George Munday of your committee has been doing. I have spoken to him informally about this and I will certainly use him as a resource person if he consents to assist me.

Thank you again for this opportunity to apply for a sabbatical leave.

MAURICE C. MOORE

MT. SAN ANTONIO COLLEGE

1100 NORTH GRAND AVENUE • WALNUT, CALIFORNIA 91789

Telephone: (714) 594-5611

March 3, 1983

Mr. Maurice C. Moore
Natural Sciences Division
Campus

Dear Mr. Moore:

At the regular meeting of February 24, 1983, the Board of Trustees accepted the recommendation of the Salary and Leaves Committee to approve your sabbatical leave application for the 1983-84 school year.

It is the purpose of a sabbatical leave to improve instruction and other programs at the College. Any change in plans must be submitted in writing to the Salary and Leaves Committee for prior approval. The request for change must state the manner in which the revised proposed study and/or travel will result in benefit to the District. Unauthorized changes, except those beyond the control of the applicant, will constitute a breach of the sabbatical leave agreement.

Employees granted sabbatical leaves should review Article XI, Section K, of the existing agreement between Mt. San Antonio College/Faculty Association for contractual provisions regarding sabbatical leaves. You will be notified in the near future when the contract is ready for signature. Following the sabbatical leave, you must submit a comprehensive report of your activities to the Salary and Leaves Committee. The Committee strongly recommends that you refer to the Sabbatical Leave Report Guidelines developed by the Committee for your use.

We hope your sabbatical program will be an outstanding personnel and professional experience for you and will be of significant benefit to your students.

Sincerely,

Walter W. Collins, Chairperson
Salary and Leaves Committee

myw

cc Salary and Leaves Committee

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INTRODUCTION

PURPOSE OF THE STUDY

As indicated in the application for sabbatical leave, my purpose in making this investigation is to determine how computer-aided design (CAD) will affect the lower division engineering courses in the community college and to make recommendations as to how the Physical Science and Engineering Department of Mt. San Antonio College should respond to this new technology.

BACKGROUND INFORMATION

CAD stands for Computer-Aided Design. The engineer has added the computer to the tools normally employed in design and drafting. Computer-aided design is not new--in fact, the 1965 Ford Mustang was the first computer designed automobile. CAD has also been used in the space program and by the aerospace industry for several years. Because of advances in the field of electronics and computer design, computer-aided design hardware and software is becoming affordable to industry in general. CAD systems are no longer limited to large mainframe computers; in fact, some of the greatest advances are being made in the personal and microcomputer based systems.

The engineer who is trained in computer-aided design (CAD) need no longer spend hours of time doing slow, laborious calculations. The computer and the accompanying graphics created by the CAD system frees him/her to spend this extra time on creative design and problem solving. Using CAD, the designer can quickly analyze and design a product. CAD allows the designer to produce the design on paper, store it for future

use, as well as recall and modify it for later use. The chief advantage of CAD is that it frees people to do more creative things while increasing their productivity and efficiency.

Dr. Eldon Shaw, Chair of the Computer Science and Engineering Department, San Jose State University, presented the following information regarding increases in productivity as a result of CAD use. This information was presented at a CAD/CAM conference in the spring of 1984.

PRODUCTIVITY INCREASE BY THE USE OF

COMPUTER-AIDED DESIGN

	Output Per Person
Design, Mechanical	4.9 : 1
Drafting	8.1 : 1
Circuit Design	38.0 : 1
Isometrics	13.2 : 1
Charts	4.7 : 1
Composites	6.6 : 1

THE CAD SYSTEM

All interactive computer-aided design systems consist of roughly the same components and they function in pretty much the same way. The engineering workstation (EWS) consists of one or more cathode ray tubes (CRT) for viewing the progress of work, a keyboard for entering instructions, a graphics tablet or digitizer of some configuration, and a device for entering information from the graphics tablet or digitizer (a mouse, trackball, or digitizing pen). Connected to the EWS is the central processing unit (CPU) that contains the memory for the system. On the

outlet side is a plotter that constructs a drawing on paper, vellum, Mylar, or some other drafting medium. Generally, there is a hard copy unit for producing an instant picture of the drawing or text that is being constructed. The hard copy unit is connected to the CPU without going through the EWS. Computers are either mainframe, mini, or micro. The engineering workstation can be a stand-alone (self-contained) or it can be networked (connected to other stations). Networked systems that are microcomputer based are the least expensive systems at the present time. (See appendix for a typical engineering workstation.)

LOWER DIVISION ENGINEERING AND CAD

Lower division engineering in California community colleges is designed for transfer to the UC or CSUC system for engineering, transfer to some branches of the CSCU system for engineering technology, and to provide a broad general science and math background for engineering technicians who plan to terminate their education after two years of community college. The engineering technician will graduate with an Associate of Science in an engineering specialty.

To insure that there is uniformity of courses and course content in lower division engineering education, the Engineering Liaison Committee of the Articulation Council of California meets biannually to review lower division requirements and course content. Over a period of years there has evolved an agreement, called the "Summit Agreement," that lists the core of courses generally required of all transfer students in engineering. There is also the articulation agreement for engineering

technology students. (See copies of these agreements in Appendices III and IV)

The purpose of these agreements is to insure that the community college student is adequately prepared in lower division course work to transfer to the UC or the CSUC system in engineering or the CSUC system in engineering technology and to be able to graduate with a B.S. degree in two additional years. These agreements are not all inclusive, but they do reflect minimum lower division requirements. These agreements are in a constant state of flux, changing in response to the state-of-the-art in engineering and engineering technology. A new technology, computer-aided design (CAD), has emerged that affects lower division engineering.

INVESTIGATION ACTIVITIES

HANDS-ON EXPERIENCE

As suggested by the Salary and Leaves Committee, I contacted Mr. George Munday of the Industrial Studies Division of Mt. San Antonio College to take advantage of the expertise he has acquired in setting up a computer-aided drafting lab in the Industrial Drafting Department. Mr. Munday, Mr. Nimmo, and Mr. Ramos suggested that learning to use their computer-aided drafting equipment would be the fastest way for me to become familiar with the general features of an interactive computer-aided drafting and design system. I took their suggestion and Mr. Nimmo arranged for me to spend several hours a day for approximately three weeks, working in the lab. I sat in on classes taught by Mr. Nimmo and received help and support from the other members of the staff. Mrs. Dyer, the lab technician, was especially helpful and patient. Because of my position as a faculty member, I was also allowed to work in the lab at my own pace. I would rate this experience as one of the most personally satisfying of my sabbatical experiences.

As indicated in my sabbatical proposal, I was also firming up appointments and formulating interview questions during the first three weeks of the spring semester. I read many articles devoted to computer-aided design and its applications in education and industry. By the end of the first three weeks of the semester, I had completed my interview questions, firmed-up interview appointments and dates, and had a basic working knowledge of a computer-aided drafting system.

CIEA CONFERENCE

Mr. George Munday invited me to attend the CIEA conference with him on March 1. The conference was held at the Pasadena Convention Center and ran through March 2. At this convention I saw several computer graphics displays, talked to several computer company representatives and gathered a number of brochures. This particular conference was geared more towards the high school vocational teacher, but I feel it was a worthwhile conference.

CASCADE GRAPHICS, SANTA ANA

To obtain the perspective of the vendor, Mr. Munday, Mr. Nimmo, Mr. Ramos, and I traveled to Cascade Graphics in Santa Ana to see their facilities and watch demonstrations on up-dated versions of Cascade software, Cascade V and Cascade X. We spent the morning at Cascade, touring the facilities and talking to the company representatives and software designers. We were treated to a demonstration by a former Mt. San Antonio College student who is now a full-time employee of Cascade Graphics. She was able to qualify for her present position because of her training at Mt. San Antonio College and her knowledge of Cascade software.

One of the things you learn very quickly about CAD equipment is that, like automobiles, there is a new version coming on the market at least every year. There is always something about the new software and the hardware that is designed to stir your enthusiasm to up-date your system.

It was certainly an eye-opening experience to talk to the software designers. The things that seem so easy when you are operating the equipment may have taken hours of design time. Certainly the trip to Cascade was a worthwhile experience. I now have a much greater appreciation of even the simplest CAD operation than I did before this visit.

AIDD CONVENTION AND TECHNOLOGY EXPOSITION (April 12)

Mr. Nimmo and I attended the American Institute for Design and Drafting's 1984 convention at Anaheim. The exposition featured a number of CAD systems, drawing materials, software, reproduction systems, microfilm, drafting media, and documentaion.

I was interested in CAD systems and spent most of the time at the exposition talking to displayers and gaining information about hardware and software. We saw approximately twenty-five CAD systems as well as the other displayed materials. We collected a large bag of these materials and a number of cards from sales representatives in the area. We placed our names on the mailing lists of at least twenty companies. Conventions are obviously the easiest way to collect data on a number of companies in a short time. I found this to be another interesting and worthwhile activity.

ENGINEERING LIAISON COMMITTEE MEETING, UNIVERSITY OF THE PACIFIC (March 15, 16)

I attended the Engineering Liaison Committee meeting at the University of the Pacific (UOP) March 15 and 16. The Engineering Liaison Committee of the Articulation Council of California has been in operation

for approximately thrity (30) years. It is commissioned to address the problems of articulation in engineering education. The committee meets biannually and is made up of members from the community colleges, the UC system, the CSCU system, and private colleges and universities that offer engineering education. The location of the meetings is rotated between the Northern and Southern sections of the state to provide an opportunity for more people to participate. This is probably the most influential body in the state as far as engineering education is concerned. This committee not only deals with the actual courses that make up the acceptable core of courses at the lower division, but they also recommend actual course content.

The first day of the meeting was devoted to getting acquainted, renewing acquaintenances, and attending committee meetings. I attended the committee meeting dealing with CAD and CAD/CAM labs. Many community colleges reported that they either had installed a CAD lab or were expecting to do so in the next two years. A survey will be conducted in the fall to determine the number of schools with CAD equipment and the type of system they selected. Sam Pritchett, Cal Poly, Pomona, Acting Chair of the Engineering Technolgoy Department, cautioned community college members to stay with basic CAD equipment and basic training programs.

I also attended the meeting of the Guidance subcommittee and the Ad Hoc committee on computer science programs. Mr. Al Borman of Rockwell International gave a national overview of engineering salary and demand. Mr. Borman's report indicated that because of a declining school population, freshmen enrollment in engineering had peaked and that we can expect

a slight downturn. Demand for engineering graduates is on the up-swing and will continue through the foreseeable future. He reported an increase in starting salaries of 8% to 12% over 1983. Of the 443 companies surveyed, it was indicated that there were 25% more openings for new engineering, math, and computer science graduates. Average monthly salary for all disciplines is about $2,140.00/month or $25,680.00 yearly.

Dr. Ray Landis, Director of the Math, Engineering, Science Achievement program (MESA) discussed the basic programs and some concerns about minority engineering enrollment in California.

Robert Kuntz, Executive Director of the California Engineering Foundation, gave a presentation on current bills in the state legislature that would affect engineering education in the state if passed. Mr. Kuntz asked that members of the committee and guests support legislation addressing differential pay for engineering faculty.

I attended the banquet on Friday night that gave members and guests an opportunity to discuss mutual problems in a relaxed atmosphere. I made a number of acquaintances and I was also able to discuss CAD programs and get feed-back from many sources. (If interested, I will be happy to furnish a detailed set of minutes of this meeting.)

CAPE COMMITTEE MEETING (March 30)

CAPE stands for Computer-Aided Production Engineering. I was elected as was Dean Athens of East Los Angeles College, to represent the Engineering Liaison Committee of the Articulation Council of California on the CAPE Committee. We are to report on the activities of the CAPE Committee at

the fall meeting of the Engineering Liaison Committee at the University of California, Santa Barbara. Dean and I attended the spring meeting of the CAPE Committee held at Computervision headquarters, One Market Place, San Francisco.

Membership in CAPE is made up of representatives of the following CSCU campuses: San Diego, Long Beach, Pomona, San Luis Obispo, Los Angeles, Northridge, San Francisco, Fresno, San Jose, the CSCU Chancellor's office, East Los Angeles College, and Mt. San Antonio College.

The basic purpose of the committee, as defined by committee chair, Dr. LeCureaux, is to function as a user group to provide information on what each campus is doing in the field of computer-aided design and production.

The major areas of discussion were: hardware, software, grants, resources available from the Chancellor's office, course offerings using CAD equipment, and problems involved in setting up centers for computer-aided design and production. Each campus presented a report on equipment, course offering, projected course offerings, educational goals, software, equipment, and special problems related to their centers for computer-aided design.

The representatives reported a variety of problems. Financing was the most often mentioned problem. Because of a lack of funds from the state, the colleges are dependent on grants from private industry to establish their centers. Other problems cited were: the high cost of maintenance for sophisticated systems, a shortage of faculty, present faculty not

trained in computer-aided design techniques, no release time for training faculty, and no funds for training faculty.

Chico reported eighteen (18) full-time faculty and thirty-five (35) part-time faculty teaching eleven hundred (1,100) students in their computer science department. Fullerton reported that one-third of their faculty are part-time faculty.

There were a number of suggestions as to how faculty could be trained in the use of CAD equipment. It was suggested that some industrial firms, TRW in particular, will furnish instructors at no charge to train faculty. It was agreed that other companies should be approached to offer the same type of service. It was reported that a number of companies are offering summer employment for faculty members who are interested.

The general philosophy of the committee members is that computer-aided design has arrived as a tool in engineering. The committee members emphasized that CAD should be a broad experience with students being exposed to many levels of equipment. The committee members also agreed that community college students should be given instruction in the use of CAD before they transfer to CSUC system. The committee members suggested that CAD be integrated into Engineering Graphics and Descriptive Geometry as a natural first step in integrating CAD into all applicable courses.

Computervision demonstrated some of their newest equipment for the committee. The software demonstrated was designed for an architectural and engineering application. The demonstration showed the use of CAD to check for errors and omissions. The program is capable of showing every level of a structure and allows the architect and engineer to check their

work almost instantly. The program also does calculations of area, volume, etc. The price of the system demonstrated was $250,000. (for one station).

This particular committee assignment afforded me an opportunity to meet with and discuss CAD and CAD/CAM with CSUC professors who are the directors of the centers for computer-aided design. I subsequently visited with five members of this committee on their campuses to see their centers in action.

OVERVIEW OF VISITS TO SELECTED COLLEGES AND UNIVERSITIES

During the months of March, April, and May, I visited a number of selected colleges and universites for the purpose of interviewing the professors responsible for the computer-aided design equipment and facilities at their campuses. All appointments were scheduled well in advance, and the topic of the interview was made known at the time of making the appointment.

The procedure at each campus followed pretty much the same pattern. I arrived on campus and, after locating my assigned parking, I made my way to the office of the Dean of Engineering or to the Office of the Director of the Center for Computer-Aided Design. After introductions, I was invited to proceed with the interview. The atmosphere was cordial and friendly and the interviews went well in all cases. The Deans or CAD directors were very enthusiastic about their facilities and the plans they have for the future of their centers. (Interview questions and responses are contained in a separate section of this report entitled "Interviews.")

After the formal questions were asked and discussed, we discussed the problems of transfer to their particular college or university, the articulation agreement between Mt. San Antonio College and their institution as it affects engineering and/or engineering technology, and topics of general interest. I toured the engineering facilities of all the institutions I visited and was introduced to faculty in several engineering disciplines. It was interesting to me to note that our facilities seemed roomier and more attractive than theirs.

The high-light of these tours was a visit to their centers for computer-aided design. In all cases but one, the centers were separate facilities and had a full-time lab technician. The equipment contained in these centers ranged from Apple II systems to sophisticated stand-alone engineering workstations. I was invited to try the equipment and was given demonstrations of various tasks. I had an opportunity to visit with students in the lab and discuss with them the projects they were working on. I also had an opportunity to discuss the operation of the lab from the perspective of the lab technician.

One of the questions I asked the Deans pertained to the number of Mt. San Antonio College students enrolled in upper division engineering/ engineering technology. Several of the Deans had this information, and it was not surprising to me that schools outside the Southern California area had few, if any, former Mt. San Antonio College students. The largest concentration of Mt. San Antonio College transfers in engineering and engineering technology is at Cal Poly State University, Pomona. Other schools that regularly have Mt. San Antonio College transfers in engineering are Cal State University, Los Angeles, Cal State University, Long Beach, and Cal State University, Fullerton. These schools report that our transfer students are well prepared if they have completed the lower division core of courses.

Dr. Barkley Gilpin, Director of Graduate Engineering Studies and the Center for Computer-Aided Design at Cal State University, Long Beach, related some of the problems of the CSUC system. He is apprehensive that ABET (Accreditating Board of Engineering and Technology) may not grant

accreditation because of the large number of part-time faculty, overcrowding of classes and laboratories, and other deficiencies caused by a lack of funding. He commented that he was pleased with the quality of community college transfers snd that Cal State University, Long Beach has 5,000 engineering students and at least 2,500 of these are community college transfers.

Northern Arizona's Dean of Engineering and Technology, Dr. Michael Householder, explained his philosophy of CAD. He stated that every engineering and engineering technology student at NAU is required to take a CAD class as a part of their core of courses. He wants to provide a wide variety of CAD equipment so that students will be familiar with many levels of CAD and will be able to adapt to various industry systems. It is his opinion that CAD is another tool that all engineers and technologists should be prepared to use.

UCLA's Assistant Dean of the School of Engineering and Applied Science, Dr. Christian Wagner, had some interesting comments about their engineering program. He stated that they have more high school applicants in engineering with 4.0 GPA's than they can admit. He explained that UCLA awards 5 points for an A grade in an honors class, making it possible for students to attain a GPA higher than 4.0. Dr. Wagner expressed a desire to possibly return to the tri-partite system of higher education that was practiced some years ago. Under this system, the top 10% of a high school graduating class was eligible to attend the UC system directly from high school, while the top 33% of the high school graduating class was eligible

to attend the CSUC system directly from high school, and the rest of the high school graduating class was required to attend a community college for the first two years of their education or seek admission to a college or university in the private sector. Dr. Wagner commented, "You people at the community college can do a better job for the lower division student than we can. You have the time and the patience to help them succeed." He also commented that UCLA would like to have more well-qualified minority engineering students especially those with Spanish surnames. With regard to CAD, he stated that he expects all engineering transfers to be literate in the areas of computers before they transfer to UCLA.

University of the Pacific teaches CAD in the computer science lab. Dr. Dale Dunmire is in charge of the Computer Science and Electrical Engineering Department. UOP is interested in getting more community college transfers from the southern part of the state. They accept the "summit agreement" core of courses as preparation for junior standing. An intersting aspect of their engineering curriculum is the work-study program. All engineering students participate in this program, which necessitates a fifth year to graduate with a B.S. degree in engineering. Dean of Engineering, Dr. Robert Heyborne, stated that because of the work experience their students receive, they are in higher demand than most engineering graduates.

Cal State University, Los Angeles' Dean of Engineering, Dr. Ram Manvi, would like to have more students transferring to his program from

Mt. San Antonio College. He stated that they were not impacted and that students will get more individual attention in the smaller classes offered at Cal State, Los Angeles. Dr. Manvi asked to be allowed to come to Mt. San Antonio College to speak to my Intro to Engineering classes and present his case for transfer to Cal State, Los Angeles.

One of the high-lights of traveling to other schools was my visits to other community college campuses. I found that we have so many areas of common interest and concerns that we could have spent hours discussing them. We discussed matters of curriculum, working conditions, pay, fringe benefits, and a number of other topics.

At San Joaquin College, I met the Dean of the Industrial Studies Division and a friend of Irv Colt. He insisted on taking me for a walking tour of their campus that lasted approximately an hour. If their campus had been as large as Mt. San Antonio College's campus, I never would have finished the tour! When we arrived at the Engineering Department, the Chair of the Department, Helms Haas, rescued me and took me for a tour of their facilities. I was introduced to other members of the engineering faculty and given a demonstration of their CAD equipment. Their system was a networked micro system, using NorthStar computers and a software package that was designed for them by a technican from Laurence-Livermore Laboratory. The system worked very well and was easy to learn. The most detrimental thing about their system was no warranty or maintenance contract.

Bakersfield College received money from the California "Investment in People" grant to establish a CAD lab to train CAD operators. They have

trained a number of CAD operators to date according to Bob Parsons, the CAD teacher. He stated that they were also training their engineering and engineering technology transfers under the same program. Bakersfield chose IBM PC computers networked together.

East Los Angeles College used VEA money to purchase a Tektronix stand-alone system. Engineering Department Chair, Dean Athens, suggested that in retrospect he would probably purchase a networked system with CADAPPLE software if he were given the opportunity.

Citrus College doesn't have CAD equipment, but they are teaching CAD theory on campus and have made arrangements to use the equipment of a local firm off campus for lab experience. Chair of the Physical Science and Engineering Department, Bob McDonald, stated that it certainly wasn't the ideal way to teach a class. "We do the best we can with what we have," Bob said.

There is a wide variety of hardware and software at the different campuses I visited. To illustrate the type and variety of systems that might be found in a center for computer-aided design, I have included a list of hardware, peripherals, and software from the campus of Cal Poly University, San Luis Obispo. (See appendix IV)

I have included this account of some of the activities in which I engaged during the spring semester to help the reader perceive the value of my investigation to Mt. San Antonio College and myself.

COMPUTER-AIDED DESIGN DEMONSTRATION

As indicated in my sabbatical proposal, I arranged a computer-aided design (CAD) demonstration for the Natural Sciences Division of Mt. San Antonio College. The demonstration was held at noon, May 3. Several members of the Division watched Mr. Maurice Flora of MGD Unlimited and an assistant demonstrate Robographics CAD I and AutoCad.

The Robographics CAD I package includes a controller, software, a user manual, and an interface module that plugs into the games connector on the Apple II or IIe computer. The software is on a single floppy disk.

Mr. Flora and his assistant pointed out many features of both systems and demonstrated a number of tasks to show the systems' versatility. He emphasized the versatility of the system and the relatively low cost, noting that we could use the present computers we have in the lab and add the CAD I package.

This demonstration allowed members of the division, some of whom had never before seen CAD function, an opportunity to expand their knowledge of how computers can be used in the design and drafting process.

COMPUTER GRAPHICS '84

In May, I attended Computer Graphics '84 at Anaheim Convention Center. It was estimated that more than 34,000 people attended this exposition and were able to view products from more than 250 displayers in a display area that contained more than 300,000 square feet (seven-+ acres)! Engineering workstations dominated the displays with new systems by CalComp, Chromatics, Saber Technology, and Westward Technology getting a lot of attention.

There was a wide assortment of peripherals on display, especially low-cost hardcopy devices. Plotters were in abundance. These ranged from the simple, low-cost Six Shooter from Enter Computers to Benson's 508-dpi electrostatic plotter, the industry standard setter.

Other peripherals of special interest included an automatic digitizer from Skantek, a clear digitizing tablet from Scriptel Corp., and a high-sensitivity light pen from Digital Technology.

Human factors are being considered more often in the design of engineering workstations as evidenced by the number of ergonomically designed, adjustable stations on display.

I spent most of my time at the exposition looking at the low-cost CAD equipment and getting brochures and information from vendors in the southern California area. I met one company representative whose company specializes in used equipment. This company, based in Dallas, Texas, will arrange contact between buyers and sellers of used equipment for a percentage of the sales price.

Although the sheer amount of hardware and software displayed and demonstrated seemed to overwhelm one, I found the exposition to be very interesting and educationally enlightening.

INTERVIEWS

During the month of February, I developed a number of questions for the professors of engineering that I was to interview. The questions were designed to elicit responses in the following areas:

1. Should the community colleges plan to teach computer-aided design as a part of the lower divsion engineering program?
2. What criteria should be used in selecting a computer-aided design system?
3. How is computer-aided design taught in your lower division engineering program?

Interviews were arranged by direct phone contact, or in person, at the fall meeting of the Engineering Liaison Committee meeting at Cal State University, Los Angeles. In selecting schools to visit and professors to interview, I used the following criteria:

1. Select a representative cross-section of Calfornia colleges and universities.
2. Select colleges and universities to which Mt. San Antonio College's engineering and engineering technology students most often transfer.
3. Select professors to inverview on the basis of their knowledge of computer-aided design and/or their direct involvement in establishing a center for computer-aided design.

The following people were interviewed at their respective institutions:

Dr. Dean Athens, Chair, Engineering
East Los Angeles College, Montebello

Dr. Klaus Bauch, CAD Coordinator, Mechanical Technology Department
California Polytechnic University, Pomona

Dr. Ram Manvi, Dean of Engineering
California State University, Los Angeles

Dr. Barclay Gilpin, CAD Coordinator and Director of Engineering Graduate Study
California State University, Long Beach

Dr. Mohinder Grewal, Chair, Electrical Engineering Department and Head of CAD Program
California State University, Fullerton

Dr. William Horton, Dean of Engineering and Technology
California State Polytechnic University, San Luis Obispo

Dr. Dale Dunmire, Chair, Electrical Engineering and Computer Science
University of the Pacific, Stockton

Dr. Fred Reardon, Assistant Dean of Engineering
California State University, Sacramento

Mr. Richard Latimer, Coordinator, CAD/CAM Laboratory
California State University, Sacramento

Dr. Michael Householder, Dean, School of Engineering and Engineering Technology
Northern Arizona University, Flagstaff, Arizona

Dr. Chris Wagner, Assistant Dean, School of Engineering and Applied Science
University of California, Los Angeles

Helms Haas, Chair, Engineering
San Joaquin Delta College, Stockton

Bob Parsons, Engineering Instructor
Bakersfield College, Bakersfield

QUESTIONS AND RESPONSES

Because of the nature of the questions and responses, I have summarized the responses and indicated a majority opinion when there was a clear majority, a concensus opinion when there was clear concensus, and a minority opinion when one or more of the responders clearly disagreed with the majority.

Question:

In your opinion, is it necessary for the community college student majoring in engineering, to have a computer-aided design experience before transfering to your college or university?

Majority Answer:

Yes. The community college student needs some experience in computer-aided design to prepare him/her to enter our institution with junior standing and compete on an equal basis with our native students.

The need for CAD experience is most critical in mechanical and electronics engineering, while mechanical, electronics and manufacturing are the most critical areas in engineering technology.

Minority Answer:

UCLA has not required this course of our own students, but there is a computer-aided design lab on campus. The course is being taught for no credit, but I understand that the classes are filled and have a waiting list.

Question:

Should CAD be a separate course, or should it be integrated into another course or courses?

Majority Answer:

CAD is simply another tool that designers have at their disposal. CAD should be treated like any other tool that the engineer uses. If you are training CAD operators, your objectives are different from those of engineering. Training CAD operators or CAD technicians would necessitate a separate course, but for engineering, CAD should be integrated into all courses where it can be used profitably.

Minority Answer:

CAD is a separate course on our campus. To qualify for the "Investment in People" grant from the state, we agreed to establish a CAD laboratory for training CAD operators. We have been training CAD operators, but we have also had good success in training our transfer students in the same way.

Question:

How much time should be devoted to "hands-on" experience in learning to use CAD equipment?

Majority Answer:

The minimum amount of time required to become comfortable with most CAD systems would be three weeks of formal instruction with classes meeting three times weekly for periods of two or more hours. Eighteen to twenty-four of formal training would meet minimum requirements,

assuming that students will have an open lab available for individual study and projects.

Minority Answer:

Two weeks of formal training with classes meeting three times weekly for periods of two hours should be adequate time for an engineering student to become reasonably competent on a CAD system. There should be an open lab for practice and projects.

Question:

Is instructor training a high priority when setting up a CAD laboratory?

Concensus Opinion:

Yes! If the instructor is well versed in the system, student training will most likely be a successful experience for both faculty and students. Instructor training is worth the time and money involved. The CAD manufacturer should arrange training at their facilities as well as on-site training. A successful start and a good experience for the first students who take the class is very important to the success of future training. Instructors who take CAD training will probably be expected to teach other instructors at your college. Instructor training should be given a high priority.

Question:

In your opinion, is necessary for a CAD system to be two-dimensional or three-dimensional?

Concensus Opinion:

A three-dimensional system is not necessary to learn the principles of CAD. Two-dimensional systems are certainly adequate for a first experience. In defense of the three-dimensional system, it does produce true pictorial drawings in isometric, dimetric, trimetric, and perspective. If you are training engineering technicians, you may want to consider updating software to accomplish this task.

Question:

Is it necessary to have some hardware and software comparable to that used in the high tech industries; i.e., McDonnell-Douglas, Hughes, and TRW?

Majority Answer:

No. Most of the hardware and software used in these industries are much more sophisticated and powerful than is necessary for the community college transfer student. The UC and CSUC schools have a variety of hardware and software used in the high-tech industries and, in some cases, have a direct computer link to these industries. The community college transfer student will not generally find difficulty in adapting to the more sophisticated system if he/she has minimum training in CAD.

Minority Answer:

Yes. At least one engineering workstation should be provided that has more sophisticated capabilities. You shouldn't teach electronics using vacuum tube theory!

Question:

Is there any particular hardware and software that you would recommend?

Concensus Opinion:

The brand is not as important as how the components function as a system. Select the system on the basis of the tasks to be performed. A good starting place is to establish your educational goals and then establish the criteria for the selection of a system. We have a large number of Apple computers that are reliable. We also have IBM, Victors, and a number of others. CAD Apple and Robographics are both good software packages. There are many good systems on the market and more are coming on-line all of the time.

Question:

What are the specific characteristics I should look for in a CAD system?

Concensus Opinion:

The system should:

1. Be "user friendly"--easy to learn
2. Be "turnkey"--one vendor supplies the entire system
3. Be easily expandable--add more stations easily and economically
4. Be two-dimensional, expandable to three-dimensional
5. Offer reasonable training and support from the manufacturer
6. Meet minimum standards of performance

7. Have a service contract that includes a guaranteed down-time maximum and a maximum annual cost of 5% - 10% of the cost of the system.

Question:

Are there any special problems with the maintenance of CAD equipment?

Concensus Opinion:

Yes. Until the "bugs" are eliminated from a system there will be some problems. Eliminating the "bugs" is generally not a major problem. The major problem is the cost of maintenance contracts. The following is one illustration that was cited. San Jose State University considered a stand-alone, turnkey system from IBM, that had an initial cost of $170,000.00 to purchase. The annual maintenance contract cost an additional $21,500.00

Question:

Where should a CAD system be housed, i.e., in a special laboratory?

Majority Answer:

A laboratory that houses only CAD equipment seems to be the best solution. A CAD lab assumes space availability and adequate technical supervision for security and student assistance. The major advantage of a separate lab is availability. Labs that are a part of other labs are not as available to students for practice and projects.

Minority Answer:

We integrated our CAD system into our grahics lab. We are very pleased with our arrangement.

Question:

In what lower division courses are you presently using CAD?

Majority Answer:

Engineering Graphics and Descriptive Geometry

Minority Answer:

We are not teaching any courses at the present that utilize CAD equipment. We do expect to have it in the next year.

Question:

In what courses do you expect to use CAD in the future?

Concensus:

We will be integrating CAD into all courses in which it has applications.

Question:

Should the Community College consider offering a separate CAD course for engineering technicians?

Majority Answer:

Only if you are offering an engineering technician major in CAD. There is a need for CAD specialists with the kind of math and science background the engineering technician gets. An engineering technician

program that trains CAD specialists would require two or more courses of intensive CAD training.

Information from these interviews was used as a guide in developing criteria for the selection of CAD equipment for the Physical Science and Engineering Department of Mt. San Antonio College. The information was also used in planning proposed courses of study changes.

CRITERIA FOR THE SELECTION OF
A COMPUTER-AIDED DESIGN (CAD) SYSTEM
FOR THE
PHYSICAL SCIENCE AND ENGINEERING DEPARTMENT OF
MT. SAN ANTONIO COLLEGE

The following criteria for the selection of CAD equipment is based on my research in the spring semester of 1984. My research was done over a period of approximately three and one-half months and reflects input from a wide spectrum of sources. The criteria are general in nature and are not meant to be all-inclusive:

1. A computer-aided design system (CAD) should be selected on the basis of educational goals. My educational goals for CAD are:
   - Provide CAD experience for all engineering transfer students.
   - Provide CAD experience for all engineering technology transfer students.
   - Provide CAD training for engineering technicians
   - Provide CAD training for instructors in the Department/Division.
   - Integrate CAD into all applicable courses in engineering and science.
   - Provide courses in support of industry (training and/or re-training of engineers, engineering technologists, and engineering technicians).
2. The system should be "user friendly."

   The system should be easily learned. Prompts should be displayed on the screen simultaneously with the drawing. A separate screen may be provided for this purpose, but it is unacceptable to remove the drawing from the screen to replace it with the "menu" and vice versa.

3. The system should be a networked, microcomputer-based system.

I chose this approach because of the cost factor and the educational goals I expect to accomplish. Networking appears to be the least expensive system to install and operate. Too, the college and university professors I interviewed recommended this approach. Another consideration that convinced me to choose this approach, was the purpose for which the system will be used. Our system will be used for training, and does not need to be as sophisticated as an industry system. Experience has shown that students can adapt quite readily to a more advanced system if they have had previous experience on a basic CAD system. Durability is another major consideration in selecting a CAD system because many untrained operators will be using the system.

4. The system should be "turnkey."

The system should be purchased as a complete package installed in the lab. This approach is more expensive in some instances than specifying each item separately and going out to bid, but it also eliminates the "escape clause" for manufacturers when something does not function properly. Using this approach eliminates the problems of missing cables, incorrectly designed connectors, etc. It is the responsibility of the vendor to see that all of the necessary items are in place and function properly as a system.

5. The system should be two-dimensional, upgradable to three-dimensional.

The standard software package that comes with less-expensive CAD systems is generally a two-dimensional system. Three-dimensional

drawings can be drawn by manipulation, but true isometric, dimetric, trimetric, and perspective are taught in the design process. The software should be upgradeable to this level. It is not necessary to have three-dimensional solids modeling capabilities when learning the basics.

6. The system should be expandable.

Additional terminals should be easily and economically added to the system. Most processors (central processing unit) will accommodate several stations simultaneously. Twenty-four students can be trained on twelve stations. Twelve students work at the stations while twelve observe. At the end of a specified time, the observers change places with the operators.

7. Processing and output capabilities of the system should meet minimum standards.

The processing and output capabilities of the system must meet minimum standards of mean access time, drawing rate, and plotting rate. Mean access time should be no less than seventy milliseconds. (Mean access time is the average time lapse between the time data is called up from storage and the instant it because available for use.) Drawing rate should be 12,000 inches per second or better. (Drawing rate is the rate at which images can be produced on the display screen.) The plotting rate should be sixteen to twenty inches per second. (Plotting rate is the rate at which drawings are created on the plotter.) Minimum standards are necessary to

insure that there are no long delays between the time the information is requested and the time the information is viewed on the screen.

8. The software package should cover the basic applications.

I expect to cover applications in Enginnering Graphics, Descriptive Geometry, and Civil, Mechanical, and Electrical Engineering.

9. There should be automatic up-date of software.

Up-dating of software for a period of at least one year should be automatic and a part of the contract. Experience has shown that most software will contain "bugs," and it takes a period of time before some of these faults are discovered.

10. The system should relate well to the systems used in industry.

CAD is one of the fastest growing industries today. There are approximately eighty systems available at the present, and more are coming on the market almost daily. The large companies in our area are purchasing equipment from Calma, Intergraph, Computervision, IBM, and others. The system should relate well enough that students in an engineering technician program should be able to adjust to the more sophisticated systems of industry.

11. Instructor and lab technician training should come with the system.

The system should provide for an acceptable training program for instructors and lab technicians. Training facilities should be within a thirty-mile radius of the campus. The manufacturer should provide on-site training, as well as advanced training at a nominal

cost. The manufacturer should make available training manuals in quantities desired and at a reasonable rate (comparable to text-books).

12. Manufacturer must provide after-installation services.

Assistance with special problems should be handled by the manufacturer's representative at the installation site. A "hot-line" should be provided to handle minor problems. The manufacturer should also provide information about "user groups" who have this equipment.

13. The manufacturer must provide a maintenance contract.

A maintenance contract must be available from the manufacturer at a reasonable rate. (A reasonable rate should be a yearly contract for a cost of five to eight percent of the cost ofthe equipment.) The maintenance contract should specify the acceptable "down time" of the system. A "down time" of not more than three working days would be acceptable.

PERSONAL CONTACTS MADE

Personal contacts at the UC and CSUC schools are very important in the areas of articulation and assisting our students in being accepted at the transfer institution. I made a number of contacts as I traveled to meetings, served on committees, and interviewed professors at their college or university. I am including a list of contacts I made, their position, and their college or university.

University of California

UC Berkeley	Associate Dean of Engineering	Dr. Arthur Bergen
UCLA	Assistant Dean of Engineering	Dr. Christian Wagner
UC Santa Barbara	Associate Dean of Engineering	Dr. Roger Wood

California State Universities

Pomona	CAD Coordinator	Dr. Klaus Bauch
Pomona	Acting Dean of Engineering	Dr. Anthony Tilmans
Pomona	Acting Chair, Engineering Tech.	Samuel L. Pritchett
San Luis Obispo	Acting Dean of Engineering	Dr. Bill Horton
San Luis Obispo	Director of Computer-Aided Production Center	Dr. Mark Cooper
Chico	Professor of Computer Science	Dr. Jim Murphy
Fullerton	Chair, Electrical Engineering	Dr. Mohinder Grewal
Fullerton	Professor, Mechanical Engineering	Dr. Floyd Thomas
Long Beach	Director of Graduate Engineering Studies, Mechanical Eng.	Dr. Barclay Gilpin
Los Angeles	Dean of Engineering	Dr. Ram Manvi
Sacramento	Associate Dean of Engineering and Computer Science	Dr. Fredrick Reardon

California State Universities (Continued)

Sacramento	Coordinator, CAD/CAM Mechanical Engineering Technology	Mr. Richard Latimer
Sacremento	Director, Center for CAD, Engineering and Computer Science	Dr. Floyd LaCureux
San Jose	Dean of Engineering	Dr. Jay Pinson
San Jose	Associate Dean of Engineering	Dr. James Lima

CONCLUSIONS

Computer-Aided Design (CAD) is a tool that all engineering, engineering technology, and engineering technician students should be trained to use. CAD will probably not be a separate course in the lower division core of courses, known as the "summit agreement" for engineering and engineering technology, but will be integrated into all applicable engineering courses. It is very important for our transfer students in engineering and engineering technology to have had some CAD training before transferring to the UC or CSUC system. Without CAD training, our community college students will not be prepared to compete on an equitable basis with UC or CSUC native students. CAD should first be integrated into Engineering Graphics and Descriptive Geometry, and then into all applicable engineering, engineering technology, and engineering technician courses.

I recommend the following:

1. That the Physical Science and Engineering Department of the Natural Science Division prepare a proposal for the establishment of a CAD laboratory.
2. That the CAD system be selected on the basis of the general criteria contained in this report.
3. That the purchase and installation of a CAD system be made a high priority of the Physical Science Department and the Natural Science Division.

4. That the revised courses of study for the courses Engineering Graphics 22 and Descriptive Geometry 23, contained in the appendix of this report, be approved at the time of purchase and installation of CAD equipment.
5. That the CAD lab be housed in a separate area of the present computer lab or be incorporated into the present Graphics Lab.

This past semester has been an interesting and exciting time. I have had the opportunity to learn a great deal about something relatively new to me. I hope this report will convince those who read it of the value of this experience to me and to the College. I expect the Physical Science and Engineering Department to have a Computer-Aided Design Laboratory in the near future.

The experience I gained in this study of Computer-Aided Design systems will be of great help in selecting a system that will meet the needs of the Deaprtment and the Division. The contacts I made at the UC and CSUC system should prove invaluable in helping students in matters of transfer and the Department in matters of articulation.

I have returned to the classroom with a new feeling of purpose and excitement for my assignment. Because of my sabbatical involvement this past semester, I feel I will be of more value to the College, my colleagues, and my students.

I wish to thank the Salary and Leaves Committee for recognizing the value of my proposal and recommending it be accepted by the Board of Education. Finally, I would like to extend my sincere thanks to the Mt. San Antonio College Administration and the Board of Trustees for making this sabbatical leave possible.

Maurice Moore

Typical Hardware and Software Center for Computer-Aided Design

Cal Poly University, San Luis Obispo

CENTER FOR COMPUTER AIDED DESIGN

RESOURCE REPORT FALL 1983

HARDWARE

1 MEGATEK 7250

SYSTEM INFORMATION

* 16 simultaneous colors
* 4096 possible color combinations
* 4096 by 4096 pixel range
* 512 by 512 video display
* local segments
* local 2D/3D rotates/scales/clipping

PERIPHERALS

* joystick

SOFTWARE

* TEMPLATE
* PATRAN

3 TEKTRONIX 4113A's

SYSTEM INFORMATION

* 16 simultaneous colors
* 4096 possible color combinations
* 4096 by 4096 pixel range
* 4096 by 4096 video display
* local segments
* local pan/zoom

PERIPHERALS

* digitizing tablet (4096 by 4096)
* ink jet printer
* dual 8 inch disks (CPM 86)

SOFTWARE

* TEMPLATE
* PATRAN
* PLOT 10
* MOVIE BYU
* LOCAL (CPM 86), IGL

2 AED 512's

SYSTEM INFORMATION

* 256 simultaneous colors
* 16.2 million possible color combinations
* 512 by 512 pixel range
* 512 by 512 video display
* local pan/zoom

PERIPHERALS

* joystick

SOFTWARE

* PATRAN
* PLOT 10
* MOVIE BYU
* DISSPLA

6 RAMTEK 6211's

SYSTEM INFORMATION

* 16 simultaneous colors
* 4096 possible color combinations
* 512 by 640 pixel range
* 512 by 640 video display
* local *COLOR GRAPHICS LANGUAGE*

PERIPHERALS

* screen printer
* light pen

SOFTWARE

* TEMPLATE
* PATRAN
* PLOT 10
* MOVIE BYU
* ARTIST
* DISSPLA

3 TEKTRONIX 4010's

SYSTEM INFORMATION

* monochrome terminals
* 780 by 1024 pixel range
* storage tube video display

SOFTWARE

* TEMPLATE
* PATRAN
* PLOT 10
* MOVIE BYU
* DISSPLA

2 ZETA PLOTTER's

SYSTEM INFORMATION

* LOCAL: plotting area 11 inches by 144 feet
  8 colors
* REMOTE: plotting area 11 by 11 inches
  4 colors

SOFTWARE

* TEMPLATE
* DISSPLA
* ZETA

1 HP1000

SYSTEM INFORMATION

* minicomputer

PERIPHERALS

* 3 graphics terminals
* 3 non graphics terminals

SOFTWARE

* IMAGE 1000 database
* GRAPH 1000 graphics package
* PAGE 1000 engineering package

SOFTWARE

TEMPLATE

TEMPLATE is a new device independent graphics package. *TEMPLATE* runs on almost any terminal, even those with little or no graphics capability. The only requirement is that the terminal be attached to the local CYBER through the campus computer network. *TEMPLATE* is very powerful, and allows the easy construction of FORTRAN FIVE or PASCAL programs that generate anything from simple pie charts and bar graphs to complex three dimensional rotating objects.

PATRAN

PATRAN is a finite element modeling package. This package is also device independent, and will work on most terminals. *PATRAN* is a color compatible package and contains many powerful modeling commands. This package requires no programming, this is an application program.

DISSPLA

DISSPLA is a device independent package that can be used to create graphs, three dimensional objects, and charts. *DISSPLA* can only be used with FORTRAN FOUR programs.

PLOT 10

PLOT 10 is an older package for plotting charts and graphs that can only be used on TEKTRONIX type devices. *PLOT 10* can be used with FORTRAN FIVE or PASCAL programs.

ZETA

ZETA software works only on the two ZETA plotters, and only works with FORTRAN FIVE programs.

MOVIE BYU

MOVIE BYU is a monochrome finite element modeling system that works on TEKTRONIX type devices.

ARTIST

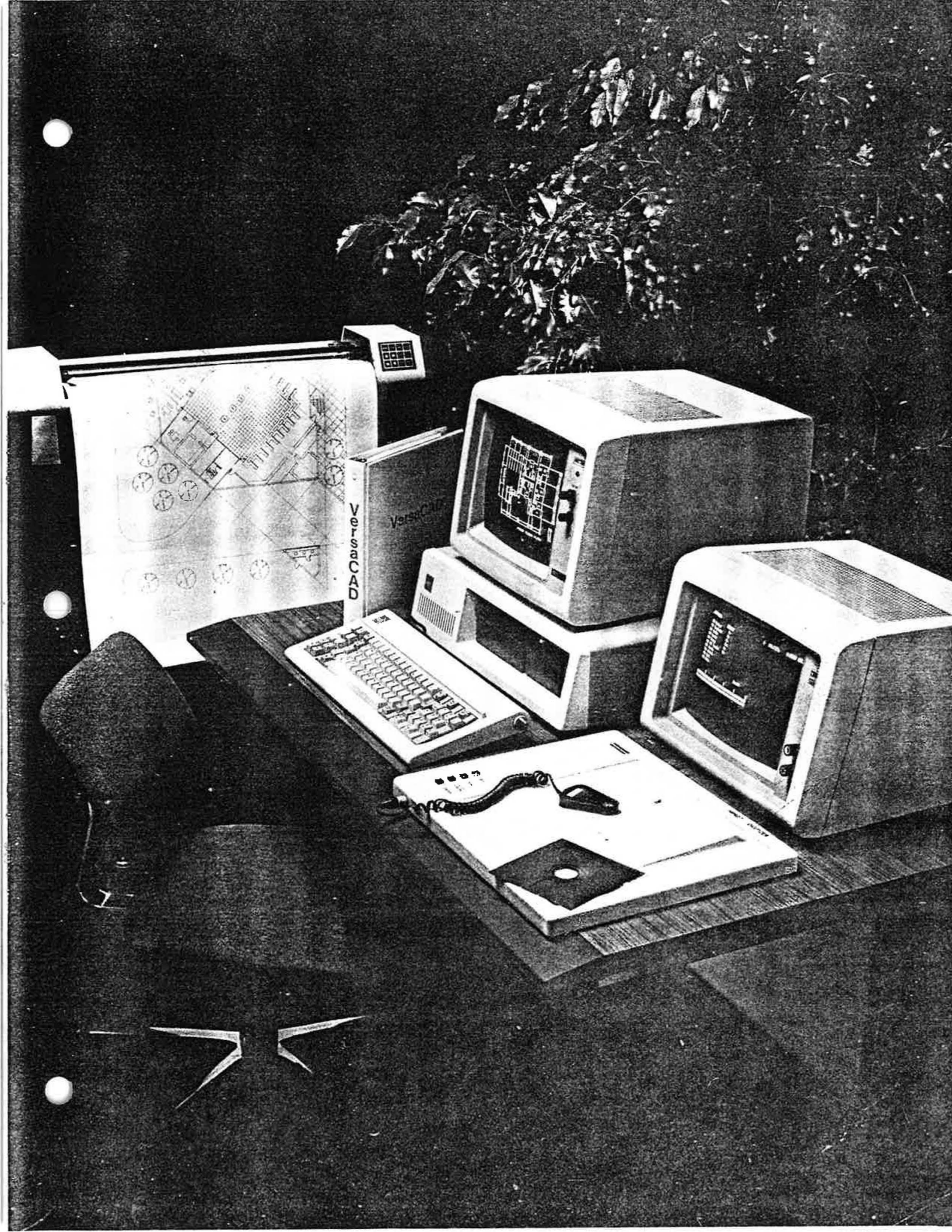
ARTIST is a custom designed program that allows a non programmer to quickly and easily make graphics designs and get a print out in color. *ARTIST* requires no programming and is a menu driven interactive program.

CD 2000

CD 2000 is a application system that allows the interactive design of parts on TEKTRONIX type devices.

Typical Engineering Workstation

courtesy T & W Systems, Inc.


VersaCAD

ENGINEERING ARTICULATION AGREEMENT

ENGINEERING LIAISON COMMITTEE SUMMIT AGREEMENT*

The Engineering Core (These are minimum)	Semester Units / Quarter Units
Math (beginning with Anal, Geom. & Calculus)	16 / 24
Chem (for engineers) one term with lab	8 / 12
Physics (for engineers) full lab sequence	12 / 18
Statics	3 / 4
Graphics (incl. descrip. geom.)	3 / 4
Computer Programming (Fortran or Pascal)[1]	2 / 3
Orientation, Motivation, & Introduction	1 / 1
Properties of Materials	3 / 4
Electric Circuits & Devices	3 / 4
[2]Electives	11/15 - 17/23
Total	62/66 - 91/97

[1]Selection should be made from among the following engineering courses. Choice would depend upon the engineering major requirements (including general education) at the school where graduation is expected. No order of priority is intended.

Surveying	Manufacturing Processes	Strength of Materials
Statistics	Engineering Measurement	Dynamics

[2]See your Advisor for details.

*From Minutes of 14 November 1980.

ENGINEERING TECHNOLOGY ARTICULATION AGREEMENT

ENGINEERING LIAISON COMMITTEE
ARTICULATION IN ENGINEERING TECHNOLOGY - Revised 17 March 1978

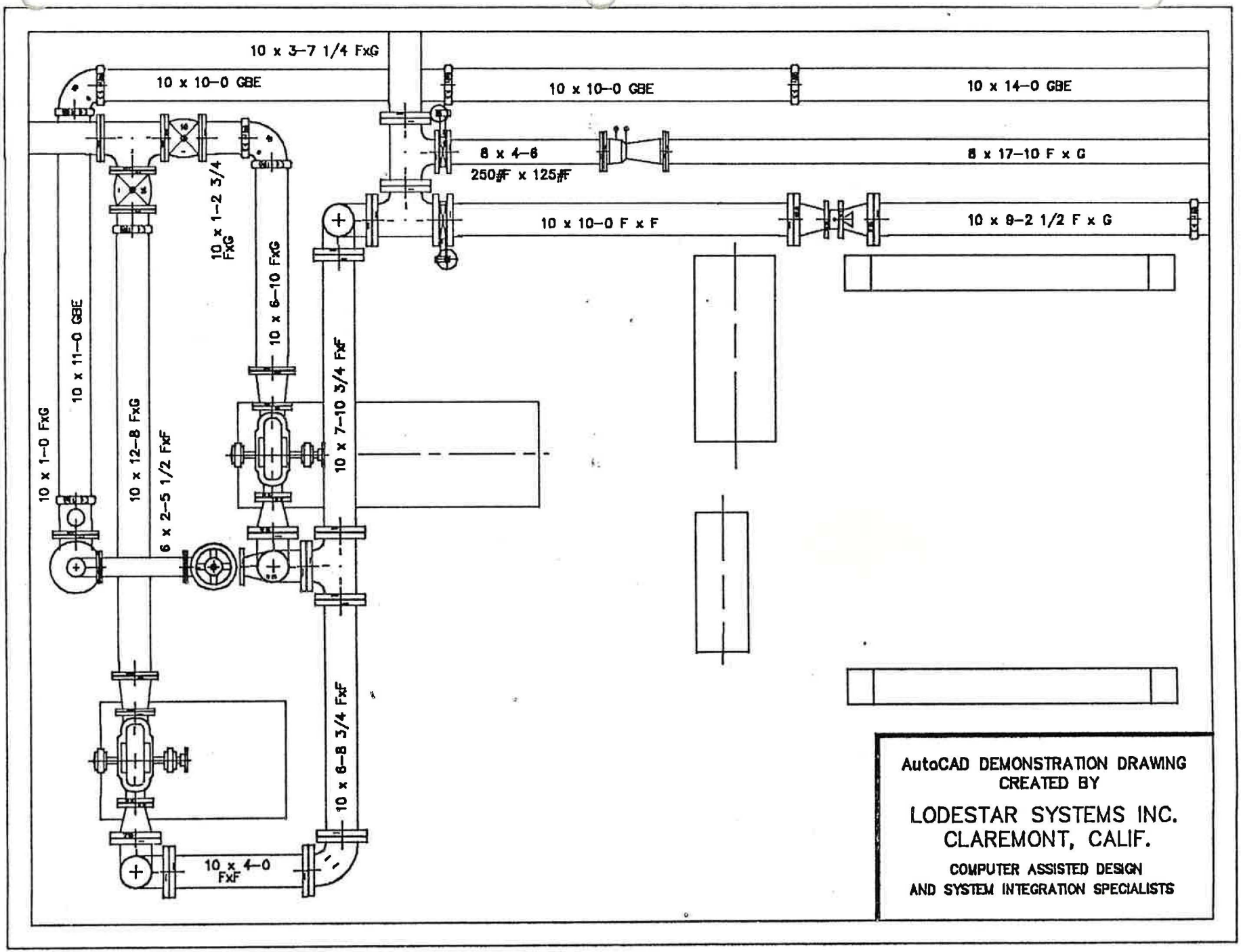
Any combination of courses listed up to a maximum of 70 semester units for 105 quart units is acceptable for transfer to a baccalaureate program.

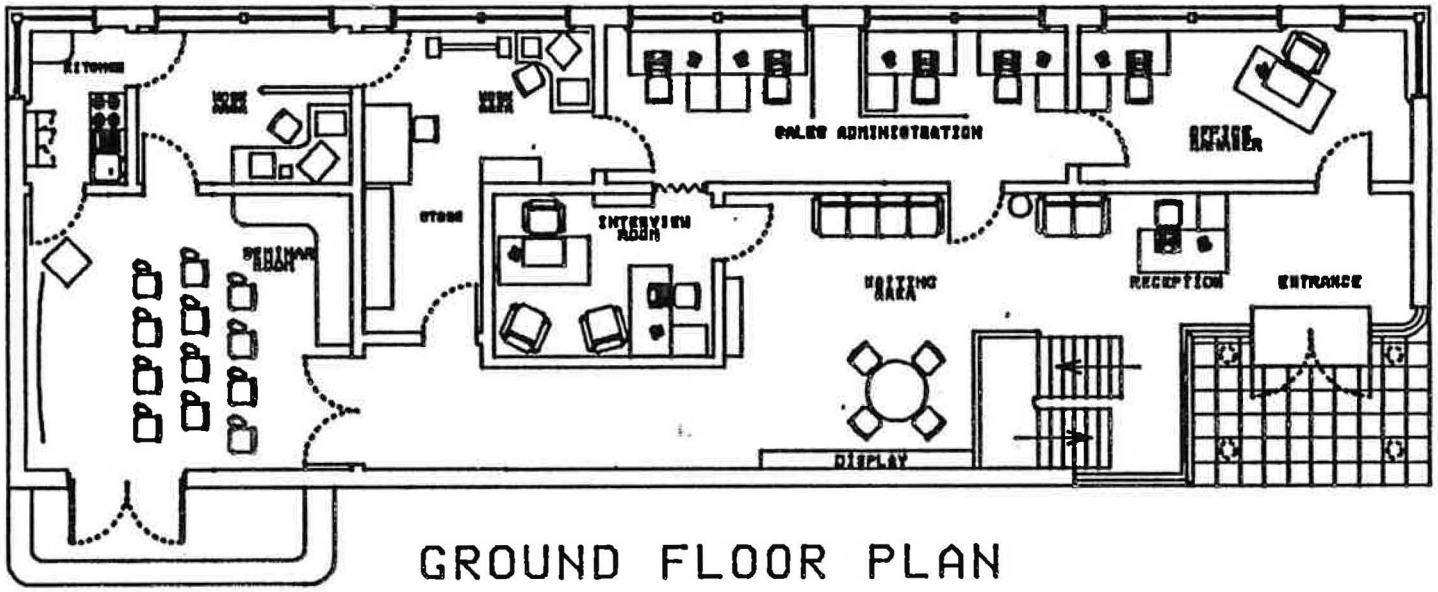
	Semester Hrs.	Quarter Hrs.
Manufacturing Processes Fabrication, Turning, Drilling, Casting, Molding, Joining, Cutting, Arc Welding, etc.	4	6
Electrical Circuits & Introductory Electronics with Laboratory, Shop Practices and Instrumentation	6	9
Solid Mechanics Scalar Statics, Scalar Dynamics, Strength of Mat'ls.	8	12
Metallurgy or Properties of Engineering Materials	3	4.5
Digital Computer Programming and Applications	3	4.5
Courses in the selected option or specialty	18	27
Accounting, Production Cost Estimating	3	4.5
Communications English Composition, Public Speaking, Engineering Drawing, Technical Writing	10	15
Other General Education Government, History, Humanities, Psychology, Humanities, Health and Physical Education, Life Sci.	12	18
*Mathematics College Algebra and College Trigonometry, Technical Calculus, Statistics	12	18
**College Physics - General or Technical (incl. lab.)	8	12
Inorganic Chemistry	3	4.5

*All prerequisite mathematics necessary to start calculus at the 4-year institution and in some cases one course in calculus, must be completed at the community colleg before transfer in order to be able to complete the B.S. degree program in two addi tional years at the 4-year institution.

**Recommended for all mandatory for some 4-year institutions.

DRAWINGS CREATED BY CAD


10 x 3-7 1/4 FxG
10 x 10-0 GBE
10 x 10-0 GBE
10 x 14-0 GBE
8 x 4-8
250#F x 125#F
8 x 17-10 F x G
10 x 10-0 F x F
10 x 9-2 1/2 F x G
10 x 1-2 3/4 FxG
10 x 6-10 FxG
10 x 11-0 GBE
10 x 1-0 FxG
10 x 12-8 FxG
6 x 2-5 1/2 FxF
10 x 7-10 3/4 FxF
10 x 8-8 3/4 FxF
10 x 4-0 FxF
AutoCAD DEMONSTRATION DRAWING
CREATED BY
LODESTAR SYSTEMS INC.
CLAREMONT, CALIF.
COMPUTER ASSISTED DESIGN
AND SYSTEM INTEGRATION SPECIALISTS



GROUND FLOOR PLAN

Drawn with Robographics CAD-1
Drafting System for the Apple II.

DISTRIBUTED BY:
LODESTAR SYSTEMS, INC
CLAREMONT, CALIF.
714-625-7941

PROPOSED CHANGES IN ENGINEERING GRAPHICS

MT. SAN ANTONIO COLLEGE

(INSTRUCTION OFFICE USE ONLY)

Office of Instruction

MSAC No.: _____ State Code: _____
C.I.D. Code: _____ CSU G.E.: _____
Instr. Type: _____ MSAC Grad 1983: _____
Irreg. Weeks: _____ Grading Code: _____
Times Taken: _____ Competency: _____
Effective Sem.: _____ Class Limit: _____
Committee Action Date: _____
Ticket No(s).: _____
Date Prepared: _____

Division: Natural Science

Department: Physical Science Engineering

Course Prefix/Number: 1543/ 22

Program: Engineering

Course Title: Computer Aided Design Graphics Units Per Sem.: 3

Hours Per Week: Lec. 2 Lab. 4 Activity _____ Independent Study 2

Course Length (Weeks): 18 May Be Taken 1 Times for Credit

Grading (Check One): Letter Grade ☒ CR/NC ☐ Option ☐ Yr./Sem. Initial Offering: _____

If Proposed for MSAC Competency Requirement, Specify Category: _____

If Proposed for MSAC Graduation Requirements, Specify Category: _____

Proposed CSU Transfer Course: Yes ☒ No ☐

If Proposed for CSU General Ed., Specify Category: _____

Prerequisite: One year high school drafting or Engineering 18

Corequisite:

Prereq/Coreq: Plane geometry(math 52)

Course Description: Orthographic projection, sketching, auxiliary first and second, sections and conventions, developed surfaces and intersections, pictorial representation, perspective, graphs and instruction in computer aided design. Special emphasis will be placed on the use of computer aided design in the solution of problems and projects.

If Vocational Course, Indicate Program Placement:

1. _____ Major ☐ Cert. ☐

Required Course ☐ Restricted Elective ☐ Recommended Elective ☐

2. _____ Major ☐ Cert. ☐

Required Course ☐ Restricted Elective ☐ Recommended Elective ☐

Reviewed by: Division Dean: _____ Date: _____

Instruction Office: _____ Date: _____

COURSE OBJECTIVES:

To develop good analytical and spatial visualization. The ability to analyze and communicat graphically. To develop facility in free-hand sketching, lettering, instrument drawing and computer aided design. To develop personal characteristics such as neatness, onesty and industry.

TOPICAL OUTLINE

Week	Topic or Class Activity
1	Introduction to the engineering profession. The role of graphics. The role
	of the computer in graphics; free-hand lettering and sketching.
2	Review of orthographic projection and sketching. Log on/off procedure.
3	Orthographic drawing continued. Related information. Castings, machining,
	use of finish marks. Use of interactive edits.
4	Exam. Pictorial sketching methods.
5	Auxiliary views,primary. True length, grade and bearing of line segments.
6	Auxiliary views, second. Point view of line segments, normal views of plances, normal and edge views.
7	Test. Introduction to sections. Full, half, rotated, aligned. Review of first CAD project.
8	Conventional practices.
9	Test. Intersection of surfaces
10	Surface development, ruled: transitions, developable and non-developable
11	Exam. Pictorial projections. Isometric, dimetric, and trimetric.
12	Perspective drawing. Review of second CAD project.
13	Dimensioning, basic
14	Dimensioning, true position
15	Tolerancing
16	Test. Production drawings
17	Charts and graphs, computer generated
18	Final examination
	* Students will spend two hours per week in the CAD laboratory

PROPOSED CHANGES IN DESCRIPTIVE GEOMETRY

MT. SAN ANTONIO COLLEGE

(INSTRUCTION OFFICE USE ONLY)

Office of Instruction

MSAC No.: _____ State Code: _____
C.I.D. Code: _____ CSU G.E.: _____
Instr. Type: _____ MSAC Grad 1983: _____
Irreg. Weeks: _____ Grading Code: _____
Times Taken: _____ Competency: _____
Effective Sem.: _____ Class Limit: _____
Committee Action Date: _____
Ticket No(s).: _____
Date Prepared: _____

Division: Natual Science

Department: Physical Science, Engineering

Course Prefix/Number: 1544/23

Program: Engineering

Course Title: Descriptive Geometry and Computer Graphics Units Per Sem.: 3

Hours Per Week: Lec. 2 Lab. 4 Activity _____ Independent Study 4

Course Length (Weeks): 18 May Be Taken 1 Times for Credit

Grading (Check One): Letter Grade ☒ CR/NC ☐ Option ☐ Yr./Sem. Initial Offering: _____

If Proposed for MSAC Competency Requirement, Specify Category: _____

If Proposed for MSAC Graduation Requirements, Specify Category: _____

Proposed CSU Transfer Course: Yes ☒ No ☐

If Proposed for CSU General Ed., Specify Category: _____

Prerequisite: Engineering Graphics 22

Corequisite:

Prereq/Coreq: CSCI 12

Course Description: The theory of the projection of points, lines, planes, curved surfaces and their application to three-dimensional problems encountered in the various fields of engineering. Problems are solved graphically on the drawing board and/or computer. Special attention is given to the ability to visualize spatial relationships.

If Vocational Course, Indicate Program Placement:

1. _____ Major ☐ Cert. ☐

Required Course ☐ Restricted Elective ☐ Recommended Elective ☐

2. _____ Major ☐ Cert. ☐

Required Course ☐ Restricted Elective ☐ Recommended Elective ☐

Reviewed by: Division Dean: _____ Date: _____

Instruction Office: _____ Date: _____

COURSE OBJECTIVES:

To develop good analytical and spatial visualization. The ability to "think-through" a problem. To develop the ability to communicate graphically, both manually and through computer aided design equipment. The ability to convey design concepts. To develop an effective means of expressing ideas. To develop good personal characteristics such as neatness, honesty, industry and self-reliance.

TOPICAL OUTLINE

Week	Topic or Class Activity
1	Class introduction
2	Points, lines and planes
3	Points, lines and planes continued
4	Use of CAD laboratory
5	Successive primary auxiliary views. Project 1, Computer Graphics
6	Test. Revolution
7	Intersection of planes. Dihedral angle
8	Developments
9	Vector quantities, vector diagrams
10	Co-planar forces, concurrent forces
11	Non-concurrent forces, basic principles, special cases
12	Examination Project # 2, CAD
13	Intersection of clyinders, cones, helical convolute
14	Special problems
15	Special problems
16	Final CAD project, Screws and fasteners
17	Final project
18	Final examination
	* Students will spend two hours per week in the CAD laboratory