Courses Available in Photogrammetry

Academic degrees are offered at eleven universities in the United States.

ABSTRACT: The course descriptions, the equipment and laboratory facilities, and the computer facilities are listed for eleven universities in the United States offering a degree program in photogrammetry. These are the results of a poll conducted in October 1965 by the Education Committee of the American Society of Photogrammetry.

INTRODUCTION

The American Society of Photogrammetry has reported periodically in the past on the general status of photogrammetric education in the United States\(^1\),\(^2\),\(^3\),\(^4\).

These reports have given summaries of the photogrammetric educational programs in the U.S., and have not attempted to emphasize the actual courses and their contents. One of the tasks of the education committee has been to compile this information in one paper.

The following has been compiled from eleven schools in the United States offering degree programs with a major in photogrammetry.\(^1\) The purpose of this report is to inform all interested persons, whether they be prospective students, members of ASP, or the general public, as to what is available in formal course work in photogrammetry in these schools as of January 1, 1966.

All eleven schools have programs leading to the Master's degree, and California, Cornell, Illinois, Ohio State and Wisconsin presently offer studies leading to the doctorate degree. Syracuse will offer a program leading to the doctorate degree beginning in 1966.

Table 1 gives a summary of the eleven schools reporting, and the addresses of the persons to contact for further information.

It should be noted that course contents, equipment, and computing facilities change continually. It is intended that reports of this

<table>
<thead>
<tr>
<th>College</th>
<th>Further Information Available From</th>
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</thead>
<tbody>
<tr>
<td>California, University of (Berkeley)</td>
<td>Prof. F. H. Moffitt, C. E. Dept., Berkeley, Calif. 94720</td>
</tr>
<tr>
<td>Cornell University</td>
<td>Prof. A. J. McNair, School of Civil Engineering, Ithaca, N. Y. 14850</td>
</tr>
<tr>
<td>Georgia Institute of Technology</td>
<td>Prof. J. A. Eichler, C. E. Dept., Atlanta, Ga. 30332</td>
</tr>
<tr>
<td>Georgia, University of</td>
<td>Prof. M. Prunty, Jr., Geography Dept., Athens, Ga. 30602</td>
</tr>
<tr>
<td>Illinois, University of</td>
<td>Prof. H. M. Karara, C. E. Dept., Urbana, Ill. 61803</td>
</tr>
<tr>
<td>Missouri School of Mines &amp; Metallurgy</td>
<td>Prof. E. W. Carlton, C. E. Dept., Rollo, Mo. 65401</td>
</tr>
<tr>
<td>Ohio State University</td>
<td>Prof. S. K. Ghosh, Dept. of Geodetic Sciences, Columbus, Ohio 43210</td>
</tr>
<tr>
<td>Purdue University</td>
<td>Prof. E. M. Mikhail (Photogrammetry), C. E. Dept., Prof. R. D. Miles (Photointerpretation), W. Lafayette, Ind. 47906</td>
</tr>
<tr>
<td>Syracuse University</td>
<td>Prof. D. C. Merchant, C. E. Dept., Syracuse, N. Y. 13210</td>
</tr>
<tr>
<td>Texas, University of</td>
<td>Prof. R. D. Turpin, C. E. Dept., Austin, Texas 78712</td>
</tr>
<tr>
<td>Wisconsin, University of</td>
<td>Prof. E. C. Wagner, C. E. Dept., Madison, Wis. 53706</td>
</tr>
</tbody>
</table>

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nature occur often enough to keep interested persons informed.

If this information is viewed from a prospective student's standpoint then it is highly recommended that you contact the persons listed in Table 1 for further information. In several cases the individual schools have outlined their programs to considerable length in brochures which are free for the asking.

I would like to thank Professor Dean C. Merchant, who has been very helpful in reviewing this article. I also acknowledge and thank the men listed in Table 1 for their cooperation in forwarding the information for their respective schools.

BIBLIOGRAPHY


University of California, Civil Engineering
Berkeley, California

COURSE DESCRIPTIONS—(Semester Hours)

CE-101 ELEMENTARY PHOTOGRAMMETRY (3 units)

Nature of problems handled by photogrammetric methods; precision cameras and their calibration; comparator measurements; geometry of photograph; ground control for mapping; flight planning; stereoscopy and stereoscopic parallax; geometry of overlapping vertical photographs; radial line plot; mosaics; oblique photography and applications; introduction to stereoscopic plotting instruments. Two lectures and one 3-hour lab per week.

CE-107 AIRPHOTO ANALYSIS AND INTERPRETATION (3 units)

Elements of a photograph for reading, analysis and interpretation. Analysis applied to soils, slopes, geological forms and structures, selection of materials for engineering construction. Elementary planimetric mapping from aerial photos; stereoscopy; mosaic construction; annotations and overlays. Two lectures and one 3-hour lab per week.

FORESTRY 132 FOREST PHOTOGRAMMETRY (3 units)

Construction of planimetric and topographic maps from vertical and oblique aerial photographs; the use of aerial photographs in mapping vegetation types and estimating timber volumes and in control of forest fires; construction of mosaics. Two lectures and one 3-hour lab per week.

GEOLOGY 109 TOPOGRAPHICAL PHOTO INTERPRETATION (3 units)

The identification and classification of topographical formations, slopes, gradients, patterns, on aerial photographs; the solution of selected problems in photogrammetry.

CE-198, CE-298 GROUP STUDY IN SELECTED SUBJECTS (1 to 5 units)

Analytic photogrammetry; theory and design of stereoscopic plotting instruments; analysis of systematic and random error propagation in photogrammetric system; stereotriangulation and adjustment; terrestrial photogrammetry applied to rubber membrane analogies, deformation measurements, hydraulics, waves, architecture; photogrammetric optics; camera calibration and lens distortion measurement. Lectures vary from one to five hours per week. Lab work varies from 3 to 9 hours per week.

CE-199, CE-299 INDIVIDUAL STUDY IN SELECTED SUBJECTS (1 to 5 units)

Usually consists of unique application of photogrammetry or photo interpretation to a problem in the general engineering area.

PHOTOGRAMMETRIC EQUIPMENT AND LABORATORY FACILITIES

CIVIL ENGINEERING

1—Multiplex Auxiliary Unit, 3 projectors
1—Wild A5 Autograph with reduction printer and Corr. plates for Metrogon and "distortion-free" photography
COURSES AVAILABLE IN PHOTOGRAMMETRY

1—Balplex 760 Plotter with centering device, 2 projectors
1—Zeiss C4 Stereoplanigraph with "distortion-free" hypergon lenses
1—T30 Wild Phototheodolite
1—Rolleiflex camera with wide angle lens and plate adaptor back
2—K25 Aerial Cameras modified for finite focus and synchronous exposures
1—Universal reduction printer
11—12-inch micro rules
6—12-inch Gurley Rapid Comparators
1—Rolleiflex camera with wide angle lens and plate adaptor back
1—Old Delft scanning stereoscope
6—Wild ST3 mirror stereoscopes with parallax bars
1—Vertical Sketchmaster
1—set Mechanical Triangulators
1—10 in. by 10 in. contact printer
8—Abrams Contour Finder

6—Sterecomparagraphs
1—Kail Radial Planimetric Plotter
Misc. stereoscopes, drafting equipment

FORESTRY
1—KEK plotter
Misc. stereoscopes, drafting equipment

GEOGRAPHY
1—KEK plotter
Misc. stereoscopes, drafting equipment

COMPUTING CENTER FACILITIES
IBM 7090 System, staffed by operators and programmers, but operates on an open shop basis for individual staff and graduate students to develop programs as needed by them. A computer program library service is available which is kept up to date.
IBM 1620, programming by students, operation of computer by regular staff member.

Cornell University, School of Civil Engineering
Surveying Department, Ithaca, New York

COURSE DESCRIPTIONS—(Semester Hours)

CE-2121 ELEMENTS OF PHOTOGRAMMETRY
Credit 3 hours. Fall.
Principles and practice of terrestrial and aerial photogrammetric mapping, including planning flights, control surveys, uncontrolled mosaics, radial-line control, simple stereoplotting instruments, parallax distortions, graphical tilt determination, trimetrogen charting, and economics. A Balplex projection stereoplotter with three projectors is available for use.

CE-2122 ADVANCED PHOTOGRAMMETRY
Credit 3 hours. Spring.
Lectures, reading, and laboratory work. An advanced study of photogrammetric principles including controlled mosaics, rectification, graphical, mechanical, and analytical, space orientation. Readings and reports from current technical literature. The principles of many photogrammetric plotters are studied together with the economic relation of these instruments to density of field control, office methods, and personnel. The Balplex plotter is available for study and use.

CE-2141 PROJECT: ANALYTICAL PHOTOGRAMMETRY
Credit 3 hours. Graduate students.
Analysis of such analytical aerotriangulation as: space resection and orientation methods; co-linearity relationships; co-planarity relationships; vector representations; matrix representations; assembly of stereopairs, triplets, strips, and blocks; two- and three-dimensional coordinate transformations of linear-, second-, and higher-degree, error propagation. Special short courses offered at irregular intervals. No academic credit. Emphasis depends upon particular demands and varies from 100% airphoto interpretation to 100% advanced photogrammetry.

CE-2142 GEODETIC OR PHOTOGRAMMETRIC ENGINEERING RESEARCH
On demand. Prerequisites will depend upon the area of studies to be pursued. Special problems in error analysis, geodesy, and photogrammetry as may be arranged.
CE-2143 SEMINAR IN GEODESY OR PHOTOGRAMMETRY
Credit 1-6 hours.
On demand. Open to specially selected seniors or graduate students. Abstraction and discussion of technical papers and publications in the geodetic or photogrammetric field.

CE-2621 ANALYSES AND INTERPRETATION OF AERIAL PHOTOGRAPHS
Preregistration required. Credit 3 hours.
Fall-Spring 2 lectures, 1 laboratory.
A study of the soil and rock areas of the United States and the patterns present in aerial photographs. Fundamental elements of soil patterns are analyzed to permit determination of soil texture, type of bedrock, and drainage properties. Field training in selected test areas.

CE-2622 ADVANCED INTERPRETATION OF AERIAL PHOTOGRAPHS
Preregistration required. Credit 3 hours.
On demand.
Organization of course depends upon fields of interest. Special problems; four each on ground water, engineering projects, agricultural soils mapping, irrigation and geology.

CE-2631 PHYSICAL ENVIRONMENT EVALUATION
Credit 3 hours. On demand.
2 lectures, 1 laboratory. Intended for graduate students or upperclassmen in engineering and planning. Permission of the instructor.
A study of physical environment factors affecting engineering and planning decisions and the evaluation methods of these factors. Physical factors include the climate, soil and rock conditions, and water sources in different parts of the world. Evaluation methods include air and ground reconnaissance, interpretation of meteorological, topographic, geological, and soil maps, aerial photography, engineering data, and subsurface exploration records.

CE-2632 ADVANCED PHYSICAL ENVIRONMENT
Credit 3 hours. On demand.

PHOTOGRAMMETRIC EQUIPMENT AND LABORATORY FACILITIES
1—Balplex—3 projectors
1—Fairchild Stereocomparator
3—Abrams Height Finders
50—Stereoscopes (mirror and lens types)
1—Old Delft Scanning Stereoscope
1—Set Abrams Lazy Daisy Radial Triangulator (40 photo)
1—Slot Cutter
1—Kail Radial Planimetric Plotter
1—Abrams Oblique Sketchmaster
1—Abrams Vertical Sketchmaster
5—24 x 30" Fluorescent light tables
1—Wild Trilateration Computer, TC1

Special control photography of campus at 5 scales varying from 1:3000 to 1:20,000. World-wide air photo coverage in photo interpretation Laboratory. Photos classified according to location, drainage pattern geology, soils type, and land form. Photographic dark room and laboratory. By arrangement facilities of the Photo Science Department are available for use which include special printing and projection equipment.

COMPUTER CENTER FACILITIES
A fully staffed and operating Cornell Computing Center is available for electronic digital computing of any size or type. Special analog computer laboratories also may be used. Digital computer equipment includes:
Control Data Corporation 1604
Control Data Corporation 160A
Control Data Corporation X-Y Plotter 165
Collating, tabulating, high-speed printing, and all other ancillary equipment necessary for the operation of a large modern computing center are available. An individual key punch machine is located in the same building as the photogrammetry laboratories. Students, after a brief training period with a demonstrated competence may make arrangements to operate the computers on their own problems. All computing is done for or by students at no charge.
COURSES AVAILABLE IN PHOTOGRAMMETRY

Georgia Institute of Technology, School of Civil Engineering
Atlanta, Georgia

Course Descriptions—(Quarter Hours)

CE-438 ELEMENTARY AERIAL PHOTOGRAMMETRY

History and development of photogrammetry. Fundamental principles. Aerial cameras, Photo reading. Principles of stereoscopy and stereoscopic instruments; radial line plotting; topographic mapping by Balplex and Plotter. Parallax measurement and formulas.

CE-444, CE-445, CE-446 UNDERGRADUATE SPECIAL PROBLEMS
CE-704, CE-705, CE-706 GRADUATE SPECIAL PROBLEMS

The special problems in both the graduate and undergraduate level are of the analytical type. They are concerned with the new theories and applications of photogrammetry and they allow the student to pursue problems and ideas in which he has a special interest.

PHOTOGRAMMETRIC EQUIPMENT AND LABORATORY FACILITIES

1—Balplex Plotter
7—Sketchmasters
5—Stereocomparagraphs
15—Mirror Stereoscopes
4—Parallax Bars
8—Desk Calculators
2—Key punches for computer

Computing Center Facilities

Burroughs 220
Burroughs B-5500

The computing center is available at all times for both graduate and undergraduate students.

The University of Georgia, The George Foster Peabody School of Forestry, Athens Georgia

Course Descriptions—(Quarter Hours)

420 USE AND INTERPRETATION OF AERIAL PHOTOGRAPHS

5 laboratory periods.

Theory and procedures in use of aerial photos for mapping, planning, terrain and contour identification, forest and vegetation identification. Procedures in correction of photo errors, for preparation of base-maps. Training in use of standard photogrammetric instruments, and in planning of photo-reconnaissance of sample areas.

422 ADVANCED PHOTOGRAMMETRY LABORATORY

5 laboratory periods.

Laboratory instruction on individualized photogrammetric problems related to the major interests of the students. Mastery of advanced photogrammetric instruments.

Photogrammetric Equipment and Laboratory Facilities

50—lens stereoscopes
10—mirror stereoscopes
10—vertical sketchmasters
6—oblique sketchmasters
4—parallax bars
10—stereometers
1—Salzman overhead projector
1—Kelsh plotter
Light tables
Drafting equipment and map reproduction equipment (ozalid)
3—electric calculators

2 air conditioned labs in new building, each seating 20 students at individual drafting tables. In addition, a research lab for the Kelsh plotter and other research equipment.

Computing Center Facilities

1—IBM 7094
1—IBM 7040
1—IBM 1401

Plus conventional tabulating, and collating equipment.
University of Illinois, Department of Civil Engineering
Urbana, Illinois

Course Descriptions—(Semester Hours)

CE-297 Special Problems
Undergraduate Credit: up to 4 sem. hours

Individual investigations or studies of any phase of civil engineering selected by the undergraduate student and approved by the department.

CE-299 Thesis
Undergraduate. Credit: up to 3 sem. hours

Investigation or design. May be substituted for certain technical subjects in any of the majors in the senior year.

CE-302 Photogrammetric Engineering
Credit: 3 sem. hours for undergraduates and ½ unit for graduates.

A study of metrical photography in civil engineering practice; characteristics and interpretation of aerial and terrestrial photographs; stereoscopic compilation of maps from photographs; mosaics; economics of photogrammetry.

CE-307 Terrestrial Photogrammetry
Credit: 3 sem. hours for undergraduates and ½ unit for graduates.

A basic study of metrical photography in other than the aerial case; theory of errors of terrestrial photogrammetry; special cameras and restitution equipment for terrestrial, close-range, micro, and celestial photogrammetry; considerations about planning and design of photogrammetric projects in such cases.

CE-308 Photographic Interpretation
Credit: 3 sem. hours for undergraduates and ½ unit for graduates.

Descriptive interpretation of photographic images with emphasis on interpretation of aerial photographs; applications of aerial photography and photographic interpretation to the solution of problems in the major field of the individual student.

CE-403 Photogrammetry
Credit: 1 grad. unit—equivalent to 4 sem. hours

Study of the principles of stereoscopy and geometrical optics; aerial cameras, their design and calibration and operation of stereoscopic plotting machines; mathematics of stereoscopic orientation and model deformations.

CE-404 Photogrammetry
Credit: 1 grad. unit—equivalent to 4 sem. hours.

Theory of errors of stereoscopic photogrammetry; aerotriangulation (spatial and radial), its theory and applications to various civil engineering problems; electronics in photogrammetry.

CE-405 Analytical Photogrammetry
Credit: 1 grad. unit—equivalent to 4 sem. hours.

A basic study of analytical photogrammetry with emphasis on the recent developments in this field; analytical solutions of single and multiple camera stations; analytical aerotriangulation of photographic strips; and blocks of strips; ballistic and satellite camera applications of analytical photogrammetry.

CE-497 Special Problems
Graduate—Credit: up to 4 grad. units—equivalent to 16 sem. hours.

Individual investigations or studies in any phase of civil engineering selected by the student and approved by his advisor and the staff member who will supervise the investigation.

CE-499 Thesis Research
Credit up to 8 grad. units—equivalent to 32 semester hours.

Photogrammetric Equipment and Laboratory Facilities

1—Wilk STK-1 Stereocomparator, complete with Wild EK-6—IBM 026 readout system
1—Nistri Photocartograph V. Stereoplotter
1—Zeiss SEG IV Rectifier
1—Zeiss Stereotope with diapositive attachment
1—Wild PUG 3 Point Transfer Device
1—Set of Zeiss Marking Device, Setting Instrument and 2 Snap Markers
2—Zeiss Stereoscope with Dove Prism
2—Old Delft Scanning Stereoscope
20—Zeiss and Wild Parallax Bar
2—Zeiss Sketch Master
Also a collection of minor photogrammetric equipment (Lazy Daisy, Slotted Templet Cutter, Stereocomparagraph, Contour Finder, Pocket Stereoscopes, microrulers, etc.)

Computing Center Facilities
1—IBM 7094-1401 electronic data processing system
1—IBM 1620 electronic computer
1—ILLIAC II electronic computer

Course Descriptions—(Semester Hours)

CE-8 ROUTE, TOPOGRAPHIC AND AERIAL SURVEYING
3 credit hours. Lectures and Laboratory.

The first half of the semester is devoted to the theory and use of simple curves, spirals, superelevations, vertical curves and earthwork computations as applied to railroad and highway surveying. The remainder of the semester covers the elementary principles of photogrammetry with emphasis on map making uses of aerial photographs. Also to be covered are the uses and preparation of topographic maps by transit-stradia and plane table and alidade. Sophomore year, either semester, two lectures and three laboratory hours per week.

CE-305 AERIAL MAPPING
Lectures and laboratory

A continuation of the work started in course CE-8. The principles of photogrammetry are applied with reference to radial line plot and traverse, controlled mosaics, stereoscopic plotting instruments. A topographic map is made from aerial photos, using the stereocomparagraph and contour finder. Tilt determinations are studied to some extent. Senior or graduate, either semester. Credit variable. Elective.

GEOLOGY 254 AIRPHOTO AND MAP INTERPRETATION
2 credit hours. Lectures and Laboratory.

Reading and interpreting of geologic history and structure from topographic and geologic maps, aerial photographs, geologic sections, structure contour maps and other means of depicting geology. Junior or senior year, first or second semester, one lecture, three laboratory hours per week.

GEOLOGY 445 PHOTOGEOL OGY
3 credit hours. Lectures and Laboratory.

The construction of geologic maps from data on aerial photographs and the geologic interpretation of features shown on aerial photographs. Graduate, second semester, two lecture and three laboratory hours per week. Elective.

Photogrammetric Equipment and Laboratory Facilities
2—Complete Multiplex Units with 2 projectors each
2—Abrams Contour Finders
2—Abrams Vertical Sketch Masters Model VE-1
1—Stereocomparagraph
36—Pocket Stereoscopes
1—Saltzman Projector (for enlarging and reducing)
2—Mirror Stereoscopes
1—Parallax Bar

Geology Department
2—Sketchmasters
7—Mirror Stereoscopes
1—Mahan Plotter
1—K.E.K. Radial Plotter
1—Kail Reflecting Projector
1—Radial Templet Set
1—Large Format Prism Lens Stereoscope (9" x 18")
3—Parallax Bars
1—Stereocomparagraph

Computing Center Facilities

Two IBM 1620 computer systems with punched card input-output, 60,000 digit positions of core storage, variable word length, indirect addressing, automatic divide and floating point hardware.

A General Precision LGP-30 computer system with a photoductive paper tape reader and a tape typewriter as input, with a typewriter and high speed paper tape punch as output.

Auxiliary equipment includes IBM card punch machines, card sorter, paper tape preparation equipment, modern desk calculators, graph plotter and a line printer. A large coding and programming room, offices for the Computer Center personnel, and two classrooms occupy the remainder of the floor.
Note: The School of Mines and Metallurgy is only about 5 blocks from the Regional Office of the U.S.G.S. Topographic Branch which has charge of map making for most of the Midwest States. The Topographic Branch has a very complete line of photogrammetric equipment, and are very cooperative in giving tours and instruction to the university students.

The Ohio State University, Department of Geodetic Science
Columbus, Ohio

COURSE DESCRIPTIONS (Quarter Hours)

Note: All the courses except the first one are of Graduate level.

521 PHOTOGRAMMETRY I
2 hours lecture and 3 hours laboratory each week. 3 credit hours (under-graduate).


622 PHOTOGRAMMETRY II
2 hours lecture and 3 hours laboratory each week. 3 credit hours.


623 PHOTOGRAMMETRY III
2 hours lecture and 3 hours laboratory each week. 3 credit hours.


625 PHOTO-INTERPRETATION
2 hours lecture and 3 hours laboratory each week. 3 credit hours.

Principles of photo-interpretation; various techniques; equipment. Human factor in photo-interpretation. Aerial photography used for photo-interpretation; sharpness of aerial photographs, contrast properties, the effect of sunlight, choice of films and filters, infrared photography, choice of season for aerial photography. Photo-interpretation for planning purposes including highway design. Application of archaeological research. Application for military purposes.

688 FIELD WORK IN PHOTOGRAMMETRY
5 credit hours.

Field identification and interpretation for various mapping purposes. Signalization of ground control points and boundary points, aerial photogrammetry and terrestrial photogrammetry. Photography with phototheodolite. Location and determination of photogrammetric baselines in terrestrial photogrammetry. Location and determination of ground control points in aerial and terrestrial photogrammetry. Use of microwave distance measuring equipment.

721 AERIAL AND TERRESTRIAL PHOTOGRAPHY
2 hours lecture and 3 hours laboratory each week. 3 credit hours.

Optical and photographic properties of photogrammetric cameras. Interior and exterior orientation of photographic pictures. Camera Calibration. Resolution. Practical use of photogrammetric cameras. Various types of photogrammetric cameras, phototheodolite, aerial cameras, stellar cameras,
ballistic cameras, artificial satellite-tracking cameras. Photogrammetric flight mission, survey, airplanes, navigation, etc. Photographic laboratory.

723 STEREOPHOTOGRAVMETRY I
3 hours lecture and 3 hours laboratory each week. 4 credit hours.


725 PHOTOGRAMMETRY IN PRACTICE
2 hours lecture and 3 hours laboratory each week. 3 credit hours.


794 SPECIAL STUDIES IN GEODETIC SCIENCE
3 to 9 credit hours.

Assigned reading, laboratory, or field work, under the guidance of a staff member, arranged to meet the requirements of individual students.

795 SEMINAR IN GEODETIC SCIENCE
1 to 3 credit hours.

Seminar in Geodetic Science

823 STEREOPHOTOGRAVMETRY II
3 hours lecture and 3 hours laboratory. 4 credit hours.


824 AERIAL TRIANGULATION
2 hours lecture and 3 hours laboratory each week. 3 credit hours.


825 ANALYTICAL PHOTOGRAMMETRY
2 hours lecture and 3 hours laboratory each week. 3 credit hours.


950 RESEARCH IN GEODETIC SCIENCE
Research for thesis or dissertation purposes only.

PHOTOGRAMMETRIC EQUIPMENT AND LABORATORY FACILITIES

1—Wild Aerial Camera RC 5
1—Wild Photothcodolite T 30
1—Wild Stereometric Camera 40 cm
1—Wild Autograph A7 with electric coordinate printer
1—Nistri Stereocomparator TA 3
1—Kelsh Plotter
1—Bausch and Lomb Multiplex
1—Bausch and Lomb Rectifier
1—Zeiss Multiplex
1—Zeiss Rectifier
1—Zeiss Stereotope
1—Ryker Plotter
1—Viewer for Sonne Camera Stereofilm
1—Enlarger
PHOTOGRAMMETRIC ENGINEERING

1—Third-Order Stereoplotter
—Wild and Delft Mirror Stereoscopes with parallax bars
1—Reproduction camera
—Small Equipment
—11 offices and laboratories
—Complete set of I.T.C. Bibliography cards

Computing Center Facilities
1—IBM 7094 Computer System
1—IBM 1620
1—GE 635
30 Electric Desk calculators

Purdue University, School of Civil Engineering
Lafayette, Indiana

Course Descriptions (Semester Hours)

CE-205 ENGINEERING SURVEYS II
Sem. 1 and 2. 2 class hours and 3 laboratory hours each week. 3 credit hours.
Second course of basic surveying for undergraduates, which includes a short introduction (3 weeks) in photogrammetry.

CE-503 PHOTOGRAMMETRY
Sem. 1. 2 class hours and 3 laboratory hours per week. 3 credit hours.
Theory and construction of photographic materials and cameras; terrestrial photogrammetry; geometry of photograph; rectification, mosaics, radial line triangulation; theory of parallax; theory and construction of parallax measuring instruments and optical and mechanical projection systems; interior, relative and absolute orientations; map compilation and engineering applications.

CE-603 ADVANCED PHOTOGRAMMETRY
Sem. 2. 2 class hours and 3 laboratory hours per week. 3 credit hours.
Theory of orientations for vertical and convergent photography; theory of errors and error propagation in photogrammetry; calibration of photogrammetric instruments; various aero-triangulations—their application and error propagation; determination of maximum bridging distances and economical considerations.

CE-604 ANALYTICAL PHOTOGRAMMETRY
Summer Session. 2 class hours and 3 laboratory hours per week. 3 credit hours.
Theory and design of analytical photogrammetric instruments; analytical orientations; space resections and intersections; analytical aero-triangulation; automation in computations; stellar photogrammetry.

CE-567 ENGINEERING USES OF AERIAL PHOTOGRAPHY
Sem. 1. 2 class hours and 3 laboratory hours per week. 3 credit hours.
Air photo interpretation and application to engineering surveys for city planning, highways, airports, and transportation in general, with emphasis on interpretation of land forms and their influence on location studies.

CE-667 AIRPHOTO INTERPRETATION OF SOILS AND ROCKS
Sem. 2. 1 class hour, 6 laboratory hours each week. 3 credit hours.
Principles and techniques of airphoto interpretation applicable to the identification and evaluation of soils and rocks; use of aerial photography in the location of materials of construction. Three field trips are required with transportation cost involved on two, and transportation and three-day subsistence involved on the third.

Computing Center Facilities
1—IBM 7094 Computer System
1—LGP-30 Electronic Computer
21—Electric Desk Calculators
COURSES AVAILABLE IN PHOTOGRAMMETRY

Syracuse University, Department of Civil Engineering
Syracuse, New York

<table>
<thead>
<tr>
<th>COURSE DESCRIPTIONS—(Semester Hours)</th>
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</thead>
<tbody>
<tr>
<td>CE-101G  PHOTOGRAMMETRY</td>
</tr>
<tr>
<td>3 Credit Hours. One term.</td>
</tr>
<tr>
<td>A beginning course in photogrammetry</td>
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<tr>
<td>which includes introduction to</td>
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<tr>
<td>photogrammetry, aerial cameras,</td>
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<tr>
<td>geometry of the single vertical</td>
</tr>
<tr>
<td>photograph, stereoscopy and parallax,</td>
</tr>
<tr>
<td>geometry of overlapping vertical</td>
</tr>
<tr>
<td>photographs, planning aerial</td>
</tr>
<tr>
<td>photography, ground control, radial</td>
</tr>
<tr>
<td>line plotting, mosaics, geometry of</td>
</tr>
<tr>
<td>the tilted photograph, scale point</td>
</tr>
<tr>
<td>method of tilt determination,</td>
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<tr>
<td>introduction to stereoscopic plotting</td>
</tr>
<tr>
<td>instruments including Contour Finder,</td>
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<tr>
<td>Stereocomparator, Multiplex, Balplex,</td>
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<tr>
<td>and Kelsh Plotter, photo interpretation. Laboratory exercises include the use of the Contour Finder, Stereocomparator, Reed Auto Focus Projector, and Saltzman Projector.</td>
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</tbody>
</table>

| CE-210  ANALYTICAL PHOTOGRAMMETRY I   |
| 3 Credit Hours. One term.              |
| An introduction to analytical         |
| photogrammetry including Church       |
| resection and orientation,            |
| trimetrogon, and 4 pt. control        |
| extension; triangulation methods of G.|

| CE-211  ANALYTICAL PHOTOGRAMMETRY II  |
| 3 Credit Hours. One term.              |
| Continuation of CE-210: An introduction |
| to the algorithms of Schmid and Brown, |
| analytics of panoramic and strip       |
| photography, stellar camera calibration.|

| CE-212  INSTRUMENTAL PHOTOGRAMMETRY I |
| 3 Credit Hours. One term.              |
| This course is concerned with the study |
| of the mathematical theory of the       |
| stereo model as appropriate to the      |
| plotting instrument, and with the      |
| various methods of instrumental        |
| triangulation along with auxiliary     |
| devices such as the statoscope and      |
| A.P.R. During the laboratory the       |
| student is able to use the Multiplex,  |
| Kelsh, Balplex Stereotope and           |
| Ryker plotters.                        |

| CE-213  INSTRUMENTAL PHOTOGRAMMETRY II|
| 3 Credit Hours. One term.              |
| This course includes the theory and    |
| design of the major photogrammetric    |
| plotting instruments, camera           |
| calibration, and photogrammetry        |
| applied to highways, cadastral         |

| CE-214  TERRESTRIAL AND NON-TOPOGRAPHIC PHOTOGRAMMETRY |
| 3 Credit Hours. One term. |
| The course is concerned with applications of photogrammetry to other than the aerial case. The subjects include the photo-theodolite, the short focus precision camera and its calibration, object space coordinate errors as a function of errors in elements of interior and exterior orientation. Laboratory exercises include use of the Wild Photo-theodolite, Wild C-12 fixed base stereocamera, the Zeiss stereocomparator and the Mann Comparator. |

| CE-301 and CE-302  SPECIAL INVESTIGATIONS |
| 3 Credit Hours. One term. |
| For students with a special interest in pursuing some phase of photogrammetry or geodesy to a greater depth than possible in normal courses. In the past students have done work in photogrammetry in highway work, camera calibration, analytical triangulation. |

| CE-397  THESIS IN PHOTOGRAMMETRY   |
| 6 Credit Hours.                     |
| The following photogrammetry courses are available through the College of Forestry, of the State University of New York at Syracuse University. |

| FOREST MANAGEMENT 120  PHOTOGRAMMETRY |
| (MENSURATIONAL)                        |
| 3 Credit Hours. One term.              |
| Stereoscopic examination of aerial      |
| photographs. Methods of measuring tree |
| heights; estimation of forest areas,    |
| types, condition classes, and timber    |
| volume from aerial photographs. Ground  |
| work pertaining to cull, volume tables, |
| composition of species and related      |
| factors. Flying specifications. Recent  |
| developments.                           |

| FOREST MANAGEMENT 121  (LAND MANAGEMENT) |
| 3 Credit Hours. One term. |
| Photogrammetric engineering methods in forest land management, cadastral mapping, property control, tax problems, protection, timber and range management, multiple use planning. Location and preliminary planning of transportation systems and other engineering functions. |
PHOTOGRAHMETRIC EQUIPMENT AND
LABORATORY FACILITIES

1—Mann Comparator Type 422C
1—Kelsh Plotter
1—Balplex Plotter
1—Multiplex Plotter—3 projectors
1—Zeiss Stereotope
1—Ryker PL-4 Plotter
1—Saltzman Projector
1—Reed Autofocus Projector
1—Zeiss Stereocomparator for Terrestrial
Photography
1—Zeiss Photo-Theodolite and Subtense Bar
1—Wild Photo-Theodolite and Subtense Bar
1—Wild C-12 Stereometric Camera (120 cm.
base)
1—Zeiss Hand Held Aerial Camera
1—K-24 Aerial Camera
2—Modified K-21 Cameras for Close Range
Photography
2—Wild Pug II Point Marking Instrument
Also numerous small equipment such as
contour finders, stereo-comparographs,
sketchmasters, etc.

Two plotting rooms are available and a
photographic laboratory.
A mensuration laboratory with controlled
environment enables analytical studies of
high precision to be conducted.

Computing Center Facilities

1—IBM 7070-1401 Computing System
1—Royal McBee LGP 30
1—Burroughs E-101

The University of Texas, Department of Civil Engineering
Austin, Texas

Course Descriptions (Semester Hours)

CE-268, 368 Analytical Photogrammetry
2 or 3 credit hours.
Geometry of photographs, tilt analysis,
orientation study, stereoscopic model defor-
mation, and photogrammetric instrumenta-
tion.

CE-368K Photogrammetry and Mapping
3 credit hours.
Geometry of aerial photographs, planimet-
ric and topographic measurements, map
compilation, and mapping processes using
photographs.

CE-392K.1 Photogrammetry Applied to
Engineering and Science Research
3 credit hours.
Photography, measurements from photo-
graphs and evaluation and interpretation of
photographic measurements applied to re-
search projects. Projects may be selected by
the student.

CE-392K.2 Aerial Photographic Inter-
presentation and Evaluation
3 credit hours.
Principles and methods of photographic
interpretation. Problems include vegetation,
hydrology, soils, geology; planning for in-
dustry, cities, and transportation systems.

CE-397.4 Special Studies in Civil Engineer-
ing
Sec. 4, 2 to 6 credit hours.
Surveying and photogrammetry

GEO 377K Maps and Air Photos*
3 credit hours
GEO 391.3 Seminar in Geology, Structural Geology and Geomorphology*
3 credit hours
GEO 394.3 Research in Geology, Structural Geology and Geomorphology*
3 credit hours
AST. 392 Procedures on Observational
Astronomy*
3 credit hours.

Photogrammetric Equipment and
Laboratory Facilities

1—Two-Projector Multiplex
2—Two-Projector Balplex (One instrument
in Civil Engineering and one in Geology)
1—Coordinate measuring instrument

Computing Center Facilities

1—Control Data Corporation 1604
1—IBM 1620
1—LGP 30

* Geology and Astronomy Courses may involve
considerable photogrammetry and/or photo inter-
pretation but varies from year to year.
The University of Wisconsin, Department of Civil Engineering
Madison, Wisconsin

COURSES AVAILABLE IN PHOTOGRAMMETRY

Course Descriptions—(Semester Hours)

**CE-400 PHOTOGRAMMETRY**
3 credit hours.

The geometry of the aerial photograph; factors in flight planning; ground control for aerial mapping; principles of radial line plotting; stereoscopy and parallax; geometry of overlapping vertical photographs, elements of photo-interpretation; mosaics.

**CE-402 ADVANCED PHOTOGRAMMETRY**
3 credit hours.

Cameras and photography, terrestrial photograph, stereoscopic plotting instruments, map compilation; oblique photographs; mapping from oblique photographs; rectification; convergent photography; analytical photogrammetry; photogrammetry applied to research.

**CE-404 ENGINEERING APPLICATIONS OF AIR-PHOTO INTERPRETATION II**
3 credit hours.

Determination of soil, bedrock and drainage characteristics of land areas by airphoto interpretation; engineering characteristics of landforms; use of airphoto interpretation for engineering soil surveys, construction materials surveys, and site and route location.

**CE-699 ADVANCED INDEPENDENT INVESTIGATIONS**
Credit hours variable.

Research problems with opportunity for independent work.

**GEOGRAPHY 630 ELEMENTARY AIR PHOTO INTERPRETATION**
3 credit hours.

Use of air photos as tools for topical research in the social and physical sciences. Field work.

**Photogrammetric Equipment and Laboratory Facilities**

1—Nistri Stereoplotter
1—Wild Photo-theodolite
20—Stereocomparators, Fairchild
2—Metal, Slotted templet, radial line plotting sets
4—Vertical Sketchmasters
1—Saltzman opaque projector
2—Comparators

Normal Lens, mirror and prism stereoscopes

Laboratory facilities include a photo library, laboratory for photo interpretation courses, photographic dark room with standard dark room equipment, laboratory for mosaic and large layout work, map library, shop facilities for instrument repair and construction of special equipment.

**Computing Center Facilities**

Control Data Corporation 3600
Control Data Corporation 1604
Control Data Corporation 160
International Business Machine 1460
International Business Machine 1620 Model I (Engr. Comp. Center)
International Business Machine 1620 Model II (Engr. Comp. Center)