1964

1964-1965 Southern Illinois University Bulletin Carbondale Campus (School of Technology)

Southern Illinois University Carbondale

Southern Illinois University

Bulletin

School of Technology

CARBONDALE CAMPUS 1964-65

Objectives of Southern Illinois University

TO EXALT BEAUTY

IN GOD,
IN NATURE,
AND IN ART;
TEACHING HOW TO LOVE THE BEST
BUT TO KEEP THE HUMAN TOUCH;

TO ADVANCE LEARNING

IN ALL LINES OF TRUTH
WHEREVER THEY MAY LEAD,
SHOWING HOW TO THINK
RATHER THAN WHAT TO THINK,
ASSISTING THE POWERS
OF THE MIND
IN THEIR SELF-DEVELOPMENT;

TO FORWARD IDEAS AND IDEALS

IN OUR DEMOCRACY,
INSPIRING RESPECT FOR OTHERS
AS FOR OURSELVES,
EVER PROMOTING FREEDOM
WITH RESPONSIBILITY;

TO BECOME A CENTER OF ORDER AND LIGHT

THAT KNOWLEDGE MAY LEAD
TO UNDERSTANDING
AND UNDERSTANDING
TO WISDOM.

School of Technology

Announcements for 1964-1965

SOUTHERN ILLINOIS UNIVERSITY BULLETIN
Volume 6 Number 1 January, 1964
Second-class postage paid at Carbondale, Illinois.
Published by Southern Illinois University, monthly, except June and July.

The following issues of the *Southern Illinois University Bulletin* may be obtained without charge from Central Publications, Southern Illinois University, Carbondale, Illinois 62903.

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All intending students should have the General Information bulletin (issued once a year), plus the special bulletins of the various educational units in which they are most interested.

Composed and printed by Printing Service
Southern Illinois University
Carbondale, Illinois

Board of Trustees

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This Bulletin

covers in detail questions concerning the School of Technology. To obtain complete information about Southern Illinois University and its various academic units, please refer to page ii of this bulletin for a list of the separate issues of the University's catalog.

This issue supersedes Volume 2, Number 4.

Table of Contents

A School of Technology building group, soon to be constructed, will provide the most modern technological facilities available.

School of Technology

Southern Illinois University was established in 1869 as Southern Illinois Normal University. The shortened name became official in 1947 by action of the state legislature. The University now operates two major campuses, located at Carbondale and Edwardsville.

Technology has been a part of the educational program at Southern Illinois University since 1908 when courses in manual arts were offered primarily for those preparing to teach in the public schools.

In 1945 technological activities at Southern had increased sufficiently to be considered an integral part of the College of Vocations and Professions. The School of Applied Science was established in 1959, by action of the Board of Trustees. Two years later the school was renamed the School of Technology.

Within the School of Technology, the responsibility to co-ordinate and facilitate "the development of curricula, to provide instruction and to stimulate research in the entire spectra of technology" has been established.

OBJECTIVES

The School of Technology seeks to attain through each graduate certain broad objectives. Its curricula are designed to effect an educational philosophy in all areas of technology. The school is dedicated to the task of providing education, research, and consultative services. Motivated by the characteristics of Southern Illinois and its potential for industrial development, the school is developing a program to meet the present and anticipated technological needs of the area.

Increasingly, the achievements of our technological leaders derive more from a mature and imaginative exploitation of today's scientific knowledge than from ingenuity or tinkering, no matter how skillful these may be. Through the coupling of deep scientific skill with purposeful technological motivation, a host of new machines and new materials has evolved, leading

to spectacular systems of transportation, communication, power, and propulsion and providing the tools for the automated mass production of consumer goods of many kinds.

In terms of personal interest, in terms of adequate financial reward, and in terms of service to mankind, the technological professions are most rewarding.

FACULTY

Professors J. L. Amoros, John H. Erickson, Ralph O. Gallington, Julian H. Lauchner, J. Henry Schroeder, H. J. Stoever. *Associate Professors* Charles A. Bunten, Maria L. Canut, Herbert A. Crosby, E. Leon Dunning, C. M. Moeller, John M. Pollock, Wayne S. Ramp, James R. Jenkins. *Assistant Professors* George R. Glenn, Marvin E. Johnson, Mark E. Klopp, C. Raymond Nowacki. *Instructors* Robert Armbrust, Edwin R. Ashworth, Dale H. Besterfield, James S. Harmon, Richard S. Howe, Nicholas J. Nigro, Gary G. Paulson, B. Jean Preston, Bill J. Shields.

Professors Fred Donald Bloss, Charles J. Brasefield, John W. Hamblen, M. Keith Humble, Carl E. Langenhop, Alfred Lit, James W. Neckers, E. J. Simon, William C. Westberg. *Associate Professor* Leslie E. Gates. *Assistant Professors* Richard L. Linster, Wilbur N. Moulton, Milton Shute. *Instructors* Willard C. Hart, W. A. Howe.

PROGRAMS OF INSTRUCTION

The Bachelor of Science degree may be earned with concentration of study in applied science, engineering, engineering technology, industrial education, and industrial technology.

Graduate study may lead to either the Master of Science degree or the Doctor of Philosophy degree. Details of the graduate programs appear in the Graduate School issue of the *Southern Illinois University Bulletin.*

STUDENT ORGANIZATIONS AND ACTIVITIES

The Engineering Club sponsors social hours, lectures, demonstrations, and discussions and provides leadership in the co-ordination of its interests with those of engineering societies. Participation in the club's activities provides the student contact with fellow students, practicing engineers, and faculty members. It is a source of valuable engineering and scientific information as well.

The Industrial Education Club is concerned with products, procedures, industrial organization, management, industrial education, and training within industry. Group projects are undertaken involving campus life and the disciplines appropriate to the various undergraduate programs.

Iota Lambda Sigma is a professional fraternity for men in the field of industrial education. Its ideals are based on service. It embraces interest in industry, learning (skills as well as knowledge), and the role of the teacher or supervisor of industrial subjects. Membership is by invitation and is open to those with potential leadership qualities. Scholarship is also a criterion for determining eligibility for membership.

The Amateur Radio Club uses a ham shack and other radio equipment of the engineering laboratories. Membership is open to all interested students, whether enrolled in the School of Technology or not.

ADMISSION TO THE SCHOOL

Inquiries concerning admission to the University should be directed to the Admissions Office, Southern Illinois University, Carbondale, Illinois 62903. Application for admission should be initiated at least thirty days in advance of the desired entrance date. High school seniors should start the admission process during the first semester of their senior year, but their formal admission will not be considered until after receipt of the high school record showing completion of the seventh semester of high school.

Freshmen are admitted to General Studies. Students in General Studies are eligible to petition for admission to the School of Technology when they have completed 75 hours of work. Transfer students need 90 or more hours to be eligible for admission to the school.

High school students preparing for study in the School of Technology should have four units of English, two and one-half units of mathematics (algebra, geometry, trigonometry), two to three units of social studies, and two to three units of science (biology, chemistry, physics); physics is especially recommended. They should apply to the School of Technology at the beginning of the last semester in high school.

COMPLETE DETAILS concerning admission, tuition, fees, housing, degree requirements, and student employment are given in the General Information bulletin. For a free copy write to Central Publications, Southern Illinois University, Carbondale, Illinois 62903.

TUITION AND FEES

At the present time legal residents of Illinois registered for more than eight hours pay a total of $61.50 per quarter. This includes $42.00 tuition,

a $5.00 book rental fee, a $5.00 student union building fund fee, and a $9.50 student activity fee. Out-of-state students pay an additional $50.00 tuition, or a total of $111.50. Students registered for eight hours or fewer pay one-half tuition, one-half book rental fee, and full student union building fund fee; they have the option of paying the student activity fee.

ADVISEMENT

Academic advisement for students during the first two years is under the general direction of the executive officers of General Studies. Academic advisement for upperclassmen (those enrolled in the various colleges, schools, divisions, and departments) is under the general direction of the officers of the academic units in which they are enrolled.

In addition to the General Studies advisers, each student desiring to concentrate his studies in the School of Technology may seek secondary advice from an adviser in that school concerning courses as well as other academic and professional matters.

REQUIREMENTS FOR THE BACHELOR'S DEGREE

Every bachelor's degree candidate is expected to meet the University's general requirements and to follow the recommendations of the academic unit in which he intends to do his major work. The general requirements have been undergoing intensive study which has resulted in the new General Studies program, outlined below. Details of the program appear in the current General Studies bulletin.

Each candidate for the degree must complete a minimum of 192 hours of credit in approved courses. At least 64 must be in senior college courses, of which 48 must be earned at Southern, 16 of which may be earned in extension from Southern. Each student must have a *C* average, and grades not lower than *C* in subjects aggregating at least three-fourths of the work. A *C* average is required in the major subject. These averages are required for the credit made at Southern as well as for the total record.

The *quarter hour* is the unit of credit used at Southern and throughout this bulletin. One quarter hour is two-thirds of a semester hour.

OUTLINE OF GENERAL STUDIES REQUIREMENTS

Area A: Man's Physical Environment and Biological Inheritance....24 hours

A first-level basic sequence 9 hours

A second-level continuation sequence 9 hours
Third-level advanced courses 6 hours

Area B: Man's Social Inheritance and Social Responsibilities ..... *24 hours*
A first-level basic sequence 9 hours
A second-level continuation sequence 9 hours
Third-level advanced courses 6 hours

Area C: Man's Insights and Appreciations ..... *24 hours*
A first-level basic sequence 9 hours
A second-level continuation sequence 9 hours
Third-level advanced courses 6 hours

Area D: Organization and Communication of Ideas ..... *18 hours*
Required college composition and speech 9 hours
Either a foreign language or a basic mathematics sequence 9 hours

Area E: Health and Physical Development ..... *6 hours*
First-level required physical education 3 hours
Second-level required health education 3 hours

WAIVERS

Each student is entitled to waive (i.e. omit entirely) the first-level sequence i[illegible]egin his work in [illegible]er, for some maj[illegible]e possible: *Area* [illegible]al education, in[illegible]ic advisers are [illegible] privilege. A student who has not chosen a field of concentration cannot waive a first-level sequence.

FOR INFORMATION ON WAIVERS CONSULT YOUR GENERAL STUDIES ADVISER

SCHOOL OF TECHNOLOGY REQUIREMENTS

All curricula in the School of Technology include General Studies Area D 114–9 (or 114, 115, 116) by credit, waiver, advanced standing, or proficiency examination and Technology 300–9 by credit, proficiency examination, or advanced standing.

Areas of Concentration

APPLIED SCIENCE

Science is concerned with discovering and describing the structure and processes of the natural world. Applied science may be thought of as science in the process of becoming technology; it is particularly concerned with the application of new science.

The applied scientist finds that the conventional theoretical formulations often do not completely explain the phenomena with which he must deal, and that pure science has tended to pass on into new fields of study so quickly that many important fields are abandoned before they are adequately investigated. He must therefore be prepared to make himself responsible for original and fundamental investigations in the physical and mathematical principles that underlie his own work, while he still holds his place as the pre-eminent intellectual agent of progress in the practical world. The applied science program at Southern is directed toward the application of science in the fields of materials science, information processing science, and nuclear science.

SUGGESTED COURSES

Physics 211, 212, 213, 313	19	
Elective area, such as materials science, information processing science, or nuclear science	30	
Prerequisites to the Above Courses		29
Total		245

ENGINEERING

The engineering courses are designed to produce a graduate who understands the basic sciences and knows how to apply them to a broad field of engineering and scientific activity. This area of concentration includes research, development, creative design, and analytical engineering. The program leads to graduate work in many areas of science and engineering. The graduate may avail himself of the facts of basic science and engineering in the solution of problems, or he may pursue graduate study in many areas of science and technology.

The engineering courses permit a student to plan a broad program, leading to the Bachelor of Science degree, for those students who become well grounded in the basic sciences and mathematics.

Engineering entrance requirements are (1) character, attitude, and interest suitable to the responsibilities of the engineering profession, (2) intellectual ability and achievement indicated by satisfactory scholastic work prior to entering engineering school, and (3) completion of at least two years in an approved college or university with minimum of 9 hours in English and speech, 18 in mathematics (analytical geometry, calculus), 15 in physics (mechanics, heat, light, sound, electricity, and magnetism), and 15 in chemistry (general, inorganic).

Students pursuing the course in engineering should have a well-rounded general education in addition to the specific requirements indicated above; thus the committee on admissions suggests that applicants obtain as much exposure to courses in other fields of knowledge as possible. Students who have majored in nonscientific fields are considered as acceptable as science majors as long as they have acquainted themselves well with the contents of pre-engineering courses.

The rest of the college work should be chosen with the object of developing the intellectual talents of the individual, rather than as required preprofessional preparation. The college work should include courses in language and literature, history, and the social studies, or other subjects which may afford the foundation for cultural development. Unless that foundation is laid early, there is the danger that later demands of technical and professional training may lead to its neglect.

SUGGESTED COURSES

General Studies Requirements (See page 4. Waive GSA-1.)		87
School of Technology Requirements (See page 5.)		9
Air Science Requirement (See the General Information bulletin.)		3
Pre-Engineering (See the engineering entrance requirements, above.)		(76)
Entrance requirements and prerequisites to the Requirements for the Concentration in Engineering may total as many as 76 hours in addition to the General Studies Requirements. The student should make every effort to satisfy these requirements through advanced standing, proficiency examinations, and waivers. In some cases a department chairman may waive the prerequisites to certain advanced courses for students who plan to enter engineering.		
Requirements for a Concentration in Engineering		146
Chemistry 461, 462	8	
Engineering 222, 260, 300, 311, 313, 331, 335a, 344a, 361, 370, 412, 517	79	
Mathematics 305, 306	6	
Physics 313, 413	8	
Psychology 320	4	
Technology 599	3	
Elective area selected from: systems design and analysis, energy conversion, materials, and information theory. Approval of and guidance in the selection may be obtained from the academic adviser.	38	
Total		245

ENGINEERING TECHNOLOGY

A concentration of courses in engineering technology may fulfill the educational requirement for professional work in many fields of technology, such as civil, electrical, and mechanical engineering.

All engineering technology students will complete the General Studies program, the engineering technology core courses, and all requirements in the field of specialization, as well as several hours of technical electives.

SUGGESTED COURSES

General Studies Requirements (See page 4. Waive GSC-1.)	87
Air Science Requirement (See the General Information bulletin.)	3
School of Technology Requirements (See page 5.)	9

Requirements for a Concentration in Engineering Technology		105
Engineering Technology 101–9, 204–9, 260–9, 300–6, 311–9, 318–6, 361–4	52	
Mathematics 150, 251, 252	15	
Elective area such as civil engineering, electrical engineering, or mechanical engineering. Arrangements and guidance for selection may be made with the student's School of Technology adviser.	38	
Total		204

INDUSTRIAL EDUCATION

Our rapidly expanding technology in recent years has brought about a tremendous need for specialists who are prepared to work with people. These individuals serve as teachers, supervisors, directors, and consultants in the many areas representative of industry and technology.

Nearly every facet of our lives depends on the skillful use of knowledge in the research, development, manufacture, and maintenance of the industrial materials and machines which sustain us. Professionals in the area of industry are charged with the responsibilities of interpreting our technological society through insights, appreciation, and an understanding of the materials, processes, products, working conditions, and new developments in industrial production.

Educational specialists are prepared to work with all levels of school youth and adult programs relating to industry. Those who gain experience and continue graduate work receive special instruction at college and university levels to prepare them to educate others to serve in these professions.

This curriculum provides a number of professional specializations leading to the Bachelor of Science degree. Graduate programs in this area are described in the Graduate School bulletin.

SUGGESTED COURSES

General Studies Requirements (See page 4. Waive GSC-1.)		87
Air Science Requirement (See the General Information bulletin.)		3
School of Technology Requirements (See page 5.)		9
Requirements for a Concentration in Industrial Education		104
Guidance 305, 422	6	
Industrial Education 100–2, 235–6, 309–4, 312–3, 322–3, 327–3, 343–3, 491–3	27	

Industrial Technology 305–3, 306–3, 332–4	10
Instructional Materials 417–4	4
Secondary Education 310–4, 352–12, 440–3	19
Elective area. A student has the opportunity to specialize for employment in manual arts therapy, industrial arts, trade and industries, or technical teaching in the public schools, private trade schools, or in technical institutes, colleges, and universities. Other specializations lead to employment as training directors within industry, as directors or administrators of technical schools, or in supervisory positions in industry, foreign service, civil service, and research. The advanced positions require graduate degrees.	38
Total	203

INDUSTRIAL TECHNOLOGY

The technologist can be defined as a worker who is interested and engaged in the actual application of an organized body of knowledge to various situations. In practice this definition is broadened to include many hundreds of industrial workers. We are living today in an age of technology.

Industry depends on many types of technologists to produce its products. Not all technologists actually work on a product directly. Some work with the problems of production, such as plant lay-out, materials, scheduling, time and motion analysis, and safety. Others are engaged in management, supervisor training, liaison, and personnel tasks. The technologist is not a professional engineer, nor is he a technician working on the bench. He is the much-sought-after "middleman" in industry who must work with all of the processes of industry. He may be required to function as a businessman, technician, supervisor, instructor, trouble-shooter, manager, and diplomat. His position is not an easy one to fill but is very important to a product, an organization, and an industry. His preparation for such a position must necessarily be technically broad to cope with a wide range of techniques and processes and must include a sound educational foundation in the physical sciences in order that he may understand the product and its production. He must also have a knowledge of human relations and human behavior as a basis for understanding the fundamentals of management. His educational program should provide for the development of a high degree of maturity and social awareness. There is a great employment demand for the industrial technologist who will assume responsibility for the efficient functioning of modern industrial establishments.

Industrial technology is a four-year concentration of courses leading to the Bachelor of Science degree and designed to prepare an individual for employment as a technologist in a variety of technological areas.

SUGGESTED COURSES

General Studies Requirements (See page 4. Waive GSC-1.)		87
Air Science Requirement (See the General Information bulletin.)		3
School of Technology Requirements (See page 5.)		9
Requirements for a Concentration in Industrial Technology		102
Economics 215	3	
Engineering Technology 361	4	
Industrial Technology 227–6, 235–6, 300–4, 305–3, 306–3, 309–4, 312–3, 318–6, 322–3, 327–3, 341–3, 343–6	50	
Management 380–4, 382–3	7	
Psychology 320	4	
Elective areas in industrial technology include preparation for technical, supervisory, and training positions in industrial manufacturing and processing. The student may elect to specialize in areas such as architecture, construction, design, drafting, electronics, graphic arts, metal, plastics, power, plant operations, safety, transportation, wood, and others. Basic preparation for trades and industries may be provided through proper selection of industrial technology courses.	34	
Total		201

Course Descriptions

APPLIED SCIENCE

222–3 DIGITAL COMPUTER PROGRAMMING FOR ENGINEERS. (See Engineering 222.)

415–9 (3,3,3) WATER SUPPLY AND WASTE WATER DISPOSAL. *(a)* A study of the principles involved in the collection, storage, treatment, and distribution of water for municipal, industrial, and irrigation use. *(b)* The removal of storm waters, municipal sewage, and excess irrigation waters; water rights and stream administration; water quality criteria; the economic aspects of projects. *(c)* Theory of unit operations as applied to the treatment of water and waste water; and the design of works for the collection, treatment, and disposal of water and liquid wastes. Laboratory. Must be taken in a,b,c sequence. Prerequisite: consent of instructor.

420–3 DIGITAL COMPUTERS IN RESEARCH. Basic foundations used in operations research. An intensive study in the use of digital computers as related to topics such as probability and statistics, matrices, game theory, Monte Carlo techniques, distribution and scheduling problems, and simulation. Prerequisite: 222.

421–3 PROGRAMMING LANGUAGES. A study of development and the use of automatic programming languages for stored program electronic computers. Included are symbolic languages, interpretive systems, algebraic-oriented and business-oriented data processing languages, macro assemblers and list processors. (ALGOL, FORTRAN, COBOL, COMIT, IPL, etc.) A comparison of the languages will be made, and each student will prepare programs using the languages studied. Prerequisite: 222.

422–3 PROGRAMMING SYSTEMS. The use and methods of electronic data processing systems. Topics are searching, ordering, codifying, information retrieval, process control, executive routines, and heuristic programming. The student will apply system techniques for solution of problems using the computer equipment of Data Processing and Computing Center. Prerequisite: 222.

Courses on the 500 level are for graduate students only and are described in the Graduate School bulletin.

501–9 MATERIALS SCIENCE.

502–6 MATERIALS STRUCTURE ANALYSIS.

516–4 WATER RESOURCES DEVELOPMENT.
521–6 DESIGN OF AUTOMATIC PROGRAMMING LANGUAGE PROCESSORS.
522–6 PROGRAMMING SYSTEMS DESIGN.

ENGINEERING

222–3 DIGITAL COMPUTER PROGRAMMING FOR ENGINEERS. (Same as Applied Science 222.) Programming of digital computers in a problem-oriented language (FORTRAN). Problems solved will illustrate some of the elementary methods of numerical analysis. Prepares the student to use digital computers in later courses. Includes programming of a computational problem from inception to completion: formulation and analysis, flow charting, coding, check-out, documentation. Prerequisite: Mathematics 251.

260–9 (3,3,3) ANALYTICAL MECHANICS (Same as Engineering Technology 260.) *(a)* Resultants of force systems, algebraic and graphical conditions of equilibrium of force systems; analysis of forces acting on members of trusses, forces due to friction; centroids. *(b)* Displacement, velocity, and acceleration of a particle; translation, rotation; plane motion. *(c)* Solutions using the principles of force, mass and accelerations, work and energy, and impulse and momentum. Must be taken in a,b,c sequence. Prerequisite: Mathematics 150 concurrently.

300–9 (3,3,3) THERMODYNAMICS. (Same as Engineering Technology 300.) *(a)* The study of fundamental energy concepts and the laws of thermodynamics, availability of energy, properties of gases, vapors and gas-vapor mixtures, flow and non-flow processes. *(b)* Engine cycles and applications to internal combustion engines, gas turbines, steam turbines, jet devices, air compressors, and air engines. Combustion refrigeration and air conditioning. Heat transfer principles. *(c)* Axiomatic thermodynamics, criteria for equilibrium; absolute temperature; Maxwell's relations; open systems; the phase rule; systems of one and two components; idealized systems; equations of state; systems involving chemical and electrochemical equilibrium. Must be taken in a,b,c sequence. Prerequisite: Mathematics 251.

302–6 (3,3) HEAT AND MASS TRANSFER. *(a)* Dimensional analysis and its application to the theory of heat transfer. Mathematical and graphical methods of analyzing problems in conduction, convection, and radiation. Particular attention to the applications of heat transfer principles used in various processes. *(b)* A study of the theory related to all types of heat power equipment. The design calculations for various components of heat power machines such as steam and gas turbines, air compressors, pumps, refrigeration, and air conditioning equipment. Must be taken in a,b,c sequence. Prerequisite: 300.

305–12 (3,3,3,3) ARCHITECTURAL ENGINEERING DESIGN. *(a)* An introduction to the profession of architecture; work illustrating basic architectural forms and their organization. *(b)* A study of architectural planning, composition, and sketching. *(c)* A study of the fundamentals of architectural design. *(d)* A study of architectural planning of contemporary architectural problems. Must be taken in a,b,c,d sequence. Prerequisite: 260.

311–9 (3,3,3) ENGINEERING MATERIALS. (Same as Engineering Technology 311.) *(a)* Stress and strain in the elastic as well as the plastic states. Failure theories. Elastic and plastic torsion. Thick cylinders and rotating discs. Energy methods. Beams on elastic foundations. Introduction to plates and shells. Limit design. *(b)* Mechanics of continua for elastic, plastic, viscoelastic, and creeping materials, limit analysis, applications to brittle, ductile, and transitional modes of fracture, to creep, fatigue, friction, and wear. Laboratory emphasizing student-planned projects. *(c)* Physical and chemical properties of all types of materials; influence of these properties on behavior of materials under various structural, magnetic, dielectric, heat, and other environmental conditions. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 260.

313–6 (3,3) FLUID MECHANICS. *(a)* A broad introduction to concepts, principles, and methods of fluid dynamics. Model and properties of the continuum. Continuity, momentum, and energy equations for the system and the control volume. Kinematics of fluid motion. Equations of motion of nonviscous fluid, and their integration. Potential flows. Navier-Stokes equations for viscous fluids, and applications. Boundary layers, turbulence, and drag. Lift, dimensional reasoning, and similitude. *(b)* Introduction to theoretical fluid mechanics. Forces on floating and submerged bodies, equations of motion, dynamic similarity, laminar and turbulent flow, skin friction, flow resistance in conduits, cavitation and propulsion, drag, circulation and principles of turbomachinery. Must be taken in a,b sequence. Prerequisite: 260.

321–6 (3,3) PHYSICAL METALLURGY. *(a)* The elementary physics of metals, constitutional diagrams, equilibrium and non-equilibrium conditions. The properties of metals and alloys as related to structure. *(b)* A study of the internal structure, treatment, and properties of iron, plain carbon steel, and cast iron. Laboratory. Must be taken in a,b sequence. Prerequisite: 311.

331–12 (4,4,4) CIRCUIT AND FIELD THEORY. *(a)* Introduction to the theory of circuits. Study of network theorems, sources of electrical energy, basic electric measurements, magnetic circuits. *(b)* Solution of electric and magnetic fields of simple geometry. Study of Coulomb's Law, Gauss' Theorem, Maxwell's equations for static fields by vector methods. *(c)* Vector analysis, electrostatics, space charge flow, steady magnetic fields, Maxwell's equation, uniform plane waves, circuits concepts, transmission lines, dipole radiation, field theory of rotating machinery and transformers. Laboratory. Must be taken in a,b,c sequence. Prerequisite: Mathematics 253.

333–9 (3,3,3) ELECTRICAL ENERGY CONVERSION. *(a)* The principles and physical aspects of electromechanical energy conversion and the basic concepts of machine performance; analysis and performance of D.C. machines. *(b)* Basic theory of transformers, analysis of performance of synchronous and induction machines. *(c)* Analysis of performance of fractional-horsepower motors, control-type generators and self-synchronous machines, dynamics of electromechanically-coupled systems, magnetohydrodynamics, and other energy conversion methods. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 331.

334–9 (3,3,3) MICROWAVE AND ANTENNA THEORY. An advanced study of electromagnetic fields, a study of the modes of propagation of electromagnetic energy of short wave length through guided ducts and the radi-

ation of this energy into space. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 331.

335–9 (3,3,3) ELECTRONICS. *(a)* An introduction to electronics for all students of engineering. A foundation for more advanced studies in electronics. *(b,c)* Electron tube theory, amplifiers, modulation, vacuum tube and transistor circuits. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 331.

341–3 MECHANICAL VIBRATIONS. Equations of motion applied to systems with free and forced vibrations, damping, multiple-degrees of freedom. Applications to engines and rotating machinery. Prerequisite: 260, Mathematics 253.

343–9 (3,3,3) ENGINEERING DESIGN. Projects of a research design or development nature. The student will select a problem, develop the theory for a solution, check the theory experimentally, analyze the data, and compare the results. The project can be from one to three quarters in length. Laboratory. Must be taken in a,b,c sequence. Prerequisites: 300, 311, 331.

344–9 (3,3,3) STRUCTURES. *(a)* Analysis of statically determinate structures under stationary and moving loads. Application of the theory of statically determinate structures to stress and deflection computations. *(b)* Fundamental theory of statically indeterminate structures to the evaluation of deformations, reactions and moments in continuous structures. *(c)* Introduction to design. Must be taken in a,b,c sequence. Prerequisite: 260.

346–6 (3,3) CONCEPTS OF ENERGY RELEASE. *(a)* A study of exotic type energy conversion principles. The theory and application of energy release to conventional devices. *(b)* Thermodynamic analysis of low temperature phenomena. Solar energy and the concepts of thermonuclear power. Must be taken in a,b sequence. Prerequisite: 300.

350–6 (3,3) ANALOG AND DIGITAL COMPUTER DESIGN. An introduction to the design of analog and digital computers. Subjects include: operational amplifiers, multiplying circuits, regulated power supplies, Boolean algebra, switching circuits, memory devices. Not a course in programming. Must be taken in a,b sequence. Prerequisites: 335, Mathematics 253.

351–6 (3,3) ELECTROMECHANICAL DESIGN. Develops and makes use of the mechanical and electrical knowledge of the student in the synthesis of complete control systems, to train students for careers in creative automation. Must be taken in a,b sequence. Prerequisite: 335.

352–6 (3,3) ELECTRONIC DEVICE DESIGN. *(a)* Helps students use the latest electronic devices in designing circuits and equipment. *(b)* The use of tunnel diodes, lasers, masers, traveling wave tubes in the design of equipment. Emphasis will be on total design concept. Laboratory. Must be taken in a,b sequence. Prerequisite: 335.

361–4 ENGINEERING ECONOMICS. (Same as Engineering Technology 361.) A study of factors and methods involved in selecting the most economical and feasible plan in industrial and engineering ventures considering both the business and technical aspects involved. Prerequisite: junior standing.

370–4 THEORY OF STOCHASTIC PROCESSES. Concept of a stochastic process. Renewal theory. Markov processes with application to reliability of systems, queues, and other problems of engineering interest. Related statistical problems. Prerequisite: 300.

406–3 STATISTICAL MECHANICS. Introductory subject for graduate engineering students. Classical mechanics of systems of particles and motion

in phase space. Quantum mechanical concepts and energy of microscopic systems. Most probable distribution. Determination of thermodynamic properties of gases, crystals, black body radiation field. Fluctuation theory. Application to plasmas, thermionics, masers, cryogenics. Prerequisites: 461, Mathematics 306.

412–9 (3,3,3) ENGINEERING PRACTICE. *(a)* Written communication encountered in engineering organizations: correspondence, memoranda, technical papers, specifications, and reports. Lectures, conferences, and frequent written assignments are adapted to the individual needs of each student. *(b)* The law of contracts with enough emphasis on legal procedure to enable students to understand decided cases. If possible, the study of the legal material will be followed by practice in applying some of the principles. *(c)* Research methods. Must be taken in a,b,c sequence. Prerequisite: 361.

439–3 TRANSIENT ANALYSIS. A study of electrical and mechanical networks by means of the Laplace Transform. Theoretical vibration problems in the real and complex time domain, as they apply to engineering will be discussed. Prerequisite: 335, Mathematics 306.

445–9 (3,3,3) STRUCTURAL DESIGN. *(a)* General principles of structural design. Probabilities of failure or unserviceability. Factor of safety. Ultimate versus elastic design. Stress control and erection of indeterminate structures. Economics and preliminary planning of structures. Approximate analysis of beams, trusses, frames, and slabs. Preliminary design of indeterminate structures. *(b)* Consideration of behavior and modes of failure of typical metal structures, structural components, and connections as affected by design features, service conditions, and material properties. Comprehensive review of methods of plastic analysis and design of steel structures. Correlation of buckling behavior of structures and structural members with buckling criteria and requirements. *(c)* An introduction to the design of reinforced concrete structures, behavior of beams, columns and frames, proportioning of members. Laboratory. Must be taken in a,b,c sequence. Prerequisites: 311, 344.

461–6 (3,3) ADVANCED MECHANICS. *(a)* Stress and strain at a point in three dimensions. Introduction to the theory of elasticity with examples of solutions in two dimensions. Consideration of bending of flat plates; energy methods in elasticity; elastic stability problems. *(b)* The foundation of dynamics leading to Lagrange's equations and Hamilton's principle. Gyroscopic effects in mechanical systems. Analysis of the stability of steady motions. Self-excited vibrations and non-linear vibrations. Must be taken in a,b sequence. Prerequisite: 260.

462–6 (3,3) THEORY OF ELASTICITY. *(a)* The linear theory of homogeneous, isotropic, elastic media. Analysis of stress and strain. *(b)* The solution of differential equations of elasticity by numerical inverse, energy, and complex variable methods. Must be taken in a,b sequence. Prerequisite: 461.

Courses on the 500 level are for graduate students only and are described in the Graduate School bulletin.

510–3 ELECTROMAGNETIC FIELDS.
511–3 QUANTUM ELECTRONICS.
517–8 (4,4) ANALYSIS AND DESIGN OF ENGINEERING SYSTEMS.

ENGINEERING TECHNOLOGY

101–9 (3,3,3) GRAPHICS. *(a)* Basic principles of graphic communications. Orthographic projection, sections and conventions, dimensioning, auxiliary views, freehand lettering, and sketching. *(b)* Graphical solution of problems involving the understanding of the space relationships of points, lines, and planes; intersections and developments. *(c)* Auxiliary views, threads and fasteners, dimensioning. Laboratory. Must be taken in a,b,c sequence. No prerequisite.

204–9 (3,3,3) ELECTRICAL CIRCUITS. The principles of electrical science as applied to modern industry. A study of magnetic circuits. Principles of D.C. and A.C. circuits. The fundamental laws of current flow. Laboratory. Must be taken in a,b,c sequence. Prerequisite: Mathematics 252.

260–9 (3,3,3) ANALYTICAL MECHANICS. (See Engineering 260.)

263–12 (4,4,4) SURVEYING. *(a)* The use and care of surveying instruments. Fundamental principles of surveying, computations, land surveying, topographic surveying data processing. *(b)* Field astronomy, route surveying, introduction to photogrammetry, hydrographic surveying, and subsurface surveys. *(c)* Precise surveying, geodesy, altimetry analysis of errors and error propagation, conditioned and adjusted by method measurements of least squares and other methods. Laboratory. Must be taken in a,b,c sequence. Prerequisites: 101 and GSD 114c.

300–9 (3,3,3) THERMODYNAMICS. (See Engineering 300.)

301–9 (3,3,3) REFRIGERATION AND AIR CONDITIONING. *(a)* Discussion of refrigerating cycles. Refrigeration at more than one level. Operation and ratings of various types of compressors, evaporators, condensers, and automatic controls used in commercial refrigerating systems. Heat flow problems in condensers, evaporators, and cooling towers. *(b)* Control of temperature and humidity in buildings, or other large areas. Air handling equipment, duct systems, and air distribution within the space. Fundamental principles and techniques for cooling and dehumidification for comfort. Equipment and control systems. *(c)* Physiological aspects of air conditioning. Air and water vapor mixtures, load estimates for heating, boilers, radiators, and heating systems. Complete and part air conditioning systems, including air handling equipment. Must be taken in a,b,c sequence. Prerequisite: 300a.

303–9 (3,3,3) ELECTRONICS TECHNOLOGY. A study of the application of electrical and electronic controls to the generation and regulation of power conversion. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 204.

308–9 (3,3,3) MACHINE DESIGN. *(a)* Applications of the principles of mechanics to problems of design and development, mechanisms for specific functions, dynamic effects and friction in mechanisms. *(b)* Strength and safety considerations in design of machine parts. Fatigue and stress concentrations; power transmissions, bearings, brakes, clutches, and springs. *(c)* Combined stresses; helical, bevel, and worm gearing; curved beams, thick cylinder and flat plates; high-speed cams. The student puts previous studies into practice by design of a complete machine. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 260.

310–9 (3,3,3) CONSTRUCTION MECHANICS. *(a)* A study of construction

methods, the forces involved in the management of machinery and manpower. *(b,c)* The dynamics of estimating, scheduling and controlling procedures. Must be taken in a,b,c sequence. Prerequisite: 260.

311–9 (3,3,3) ENGINEERING MATERIALS. (See Engineering 311.)

314–9 (3,3,3) SOIL MECHANICS. *(a)* Mechanics of soil masses; soils as engineering materials. Soil identification and testing. *(b)* Shearing resistance and consolidation of soils, deformations with an analytical review of the theoretical concepts, results of laboratory materials, including cement, foundation, and surfacing materials. Use of X-ray diffraction and Debye-Scherrer camera equipment. Influence of mineral constituents on soil behavior and design. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 311.

318–9 (3,3,3) HYDRAULICS. *(a)* The fundamentals of fluid statics, open channel flow and flow measuring equipment. *(b)* The design of fluid machinery. Analysis of hydraulic and pneumatic systems for response characteristics. Response studies on pumps, motors, and valves. Laboratory. Must be taken in a,b,c sequence. Prerequisites: 260, 300b.

320–9 (3,3,3) MECHANICAL ENGINEERING LABORATORY. *(a)* A study of various types of measuring instruments. *(b)* Fuels and lubricants testing and exhaust gas analysis. *(c)* A study of the characteristics of internal combustion engines, steam turbines, compressors, pumps, fans, and refrigeration systems. Report writing. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 300a.

322–6 (3,3) INTERNAL COMBUSTION ENGINES. *(a)* The design and principles of operation of internal combustion engines. The Otto, Diesel, and Brayton cycles and the fundamental thermodynamic laws involved. *(b)* Theories of combustion and detonation, combustion charts, fuels, and air tables. Effects of chemical equilibrium and variable specific heats. Cetane and octane numbers; carburetion and injection. Must be taken in a,b sequence. Prerequisite: 300b.

326–9 (3,3,3) ADVANCED DESCRIPTIVE GEOMETRY AND PHOTOGRAMMETRY. *(a)* Single-curved surfaces; warped surfaces; double-curved surfaces; intersection of surfaces; development of surfaces. Elements of descriptive-projective geometry. *(b)* Principles and practice of terrestial and aerial photogrammetric mapping, including planning flights, control surveys, uncontrolled mosaics, radial-line control, simple stereoplotting instruments, parallel distortions, graphical till determination, trimetrogen charting and economics. *(c)* 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 economic relation of these instruments to density of field control, office methods, and personnel. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 263.

332–9 (3,3,3) ELECTRICAL MACHINERY. *(a)* Introduction to direct and alternating current machinery. Theory and operating characteristics. *(b)* Advanced studies on polyphase alternators, motors, machinery, and power generation. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 204.

336–9 (3,3,3) ELECTRICAL MEASUREMENTS. *(a)* Theory and use of D.C. and A.C. instruments; analysis of sensitivity, accuracy, precision, and error. *(b)* A study of ammeters, voltmeters, and wattmeters. Energy measurements, watt-hour and demand meters. *(c)* Theory and application of

impulse testing; oscillography; standards and tests. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 204.

337–9 (3,3,3) INDUSTRIAL ELECTRONICS AND COMMUNICATIONS. *(a)* A study of electronic instrumentation; controlled rectifiers; magnetic amplifiers; induction and dielectric heating. *(b)* Theory of transmitter, receiver and television operating procedures. *(c)* Continuation of *a* and *b*. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 204.

338–12 (4,4,4) ELECTRICAL INSTRUMENTATION. *(a)* A discussion of the basic operating principles of control instruments and their applications to industrial processes. *(b)* The application of commercially available instruments to research problems. Dynamic and static calibration of instruments. *(c)* Control elements and techniques for devices and processes, dynamics of open and closed cycle control systems. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 204, 318.

340–4 MECHANISMS. The movement of bodies in space, basic mechanisms including analytical and graphical analysis. Linkages, cams, gears and their manufacture. Vibration, critical speeds, and gyroscopic applications. Laboratory. Prerequisite: 260c.

342–9 (3,3,3) ENGINEERING TECHNOLOGY DESIGN. An elective project on any engineering subject selected by the student with advice from the instructor. Stimulates original thought and creativity. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 204, 300, 311.

347–9 (3,3,3) FOUNDATION ENGINEERING. *(a)* Subsurface investigation, theory of consolidation and settlement, strength theory and conditions of failure due to stresses imposed by engineering structures on foundation materials. *(b)* Study of the principal problems involved in the analysis, design, and construction of foundations for buildings, highways and other engineering structures. *(c)* Science of soil stabilization, utilization of stabilization agents, stabilization of foundation materials. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 314.

349–9 (3,3,3) AGRICULTURAL DESIGN. *(a)* Analysis of factors affecting farm buildings, functional planning and structural design of various farm buildings. *(b)* Analytical study of operating characteristics of selected farm equipment and machinery. *(c)* Analysis of distribution, lighting, motors, and controls as applied to agriculturally related operations. Laboratory. Must be taken in a,b,c sequence. Prerequisites: 204, 300b, 311.

361–4 ENGINEERING ECONOMICS. (See Engineering 361.)

364–6 (3,3) SURVEYING AND HIGHWAY DESIGN. *(a)* Applications of route surveying and photogrammetry to highway location and design. Highway administration, planning, economics and finance; geometric design; traffic engineering; drainage; subgrade; base courses; design and construction of flexible and rigid pavement. *(b)* Advanced highway surveying; applications of interpretation of aerial photographs; geometric highway design, traffic engineering, bituminous materials and airport design and engineering. Laboratory. Must be taken in a,b sequence. Prerequisite: 263, 314 (concurrently).

INDUSTRIAL EDUCATION

100–2 ORIENTATION IN INDUSTRIAL EDUCATION. Introduction to the various phases of industrial education to enable the student to develop

an understanding of the role of industrial education in industry and in education, and to help guide his thinking in relation to occupational goals. No prerequisite.

217–4 GENERAL TYPOGRAPHY. (Same as Printing and Photography 217B.) After brief introductory work in screen and block typography, major portion of course is devoted to study of foundry type, type classifications use of job cases, hand typesetting, layout, use of illustrations, and proof-pulling. Laboratory. No prerequisite.

235–9 (3,3,3) TECHNICAL DRAFTING. (Same as Industrial Technology 235.) *(a)* Basic fundamentals and principles of drafting. Emphasis on orientation, techniques, reading and understanding the language of industry. *(b)* Emphasis on drafting problems and an understanding of complete working drawings, pattern development, and reproduction techniques. *(c)* Machine drafting, including detail and assembly drawings of machines and machine parts. Laboratory. Must be taken in a,b,c sequence. No prerequisite.

259–3 to 60 SHOP AND DRAFTING SUBJECTS. This is a designation for shop or drawing credit earned, or for trade proficiency, when credit is to be established for work above the high school level. It may be used toward degree requirements in the trade and industries specialization. Credit in this course will be established by departmental evaluation. Prerequisite: junior standing.

300–12 (4,4,4) PLASTIC MATERIALS AND PROCESSES. (Same as Industrial Technology 300.) *(a)* An introduction to the general field of plastics. History, development, commercial materials, and processing will be explored. *(b)* Thermoplastics, including a study of the materials, equipment, design, tooling, and techniques of forming. *(c)* Thermo-setting plastics and specialized processing and converting, including advanced techniques and experimental development with all types of plastics. Laboratory. May be taken in any sequence. Prerequisite: 312a or one year high school woodworking.

302–4 CONSTRUCTION METHODS FOR PRIMARY TEACHERS. Various media such as wood, metal, and paper. Acquainting the primary teacher with the materials, tools, and processes which students at the primary level can manipulate and use in the classroom. Laboratory. No prerequisite.

303–4 DIVERSIFIED CRAFTS FOR TEACHERS AND RECREATIONAL LEADERS. Experience in constructional activities involving the use of wood, metals, leathers, plastics, reed, raffia, clay, and other materials adaptable to the needs and interests of camp counselors and elementary school leaders. Laboratory. No prerequisite.

309–12 (4,4,4) GRAPHIC ARTS. (Same as Industrial Technology 309.) *(a)* An introduction to the basic fundamentals of graphic arts such as layout, type composition, presswork, bookbinding, silk screen, linoleum block, and photography. *(b)* Continuation of fundamentals with special emphasis on typography, press operation, and offset lithography. *(c)* Advanced techniques of typographic design, further experiences in letterpress, lithography, copy preparation, and plate making. Laboratory. Must be taken in a,b,c sequence. Prerequisite: one course in drafting.

312–9 (3,3,3) WOOD PRODUCTS AND PROCESSES. (Same as Industrial Technology 312.) *(a)* Introduction to processing of wood materials and use of the basic industrial tools and machines. *(b)* Industrial jigs and fix-

tures of the wood industry and their use in production techniques. *(c)* Custom design and fabrication with wood materials and research on industrial technology in processing. Laboratory. Must be taken in a,b,c sequence. Prerequisite: one course in drafting.

319–24 (3 per quarter) INDUSTRIAL INTERNSHIP. Industrial experience includes job skills, manufacturing processes, technical information, and labor-management relationships with supervised instruction, conferences and examinations. Prerequisite: consent of chairman.

320–12 (4,4,4) INDUSTRIAL CRAFTS. (Same as Industrial Technology 320.) *(a)* Basic designing, decorating, and fabricating of a variety of craft materials such as reed, textiles, plastics, leather, ceramics, wood, and metal. *(b)* Continuation of basic fundamentals with special emphasis on art metal techniques and processing. *(c)* Emphasis upon creative design and new techniques with all craft media, but special emphasis on leather and industrial fabrics. Laboratory. Must be taken in a,b,c sequence. Prerequisite: one course in drafting.

322–9 (3,3,3) MACHINING OF METALS. (Same as Industrial Technology 322.) *(a)* Introduction to machine shop theory and practice: provides skill and information in using the basic machine tools. *(b)* Provides skill and information in using basic and specialized machine tools. *(c)* Provides additional skill and information in the use of specialized machine tools with emphasis on production problems. Laboratory. Must be taken in a,b,c sequence. Prerequisite: one course in drafting.

327–9 (3,3,3) MATERIALS, PROCESSES, AND FABRICATION OF METALS. (Same as Industrial Technology 327.) *(a)* Study of the basic tools, materials and manipulative processes used in a number of metalworking areas. *(b)* Designing, planning and fabrication of metal products; industrial processes and mass production applications; properties of metals. *(c)* Basic processes, materials, and equipment in forming, fabrication, and decorating of metal products with special emphasis on the non-ferrous metals and alloys. Laboratory. May be taken in any sequence. Prerequisite: one course in drafting.

343–9 (3,3,3) ELECTRICITY-ELECTRONICS. *(a)* An introduction to electricity and electronics. *(b)* Introduction to vacuum tubes and associated circuitry. *(c)* Advanced application of electronic theory with emphasis on electronic control circuits. Laboratory. Must be taken in a,b,c sequence. No prerequisite.

380–12 (1 per quarter) SPECIAL SKILLS IN TEACHING TECHNOLOGICAL SUBJECTS. Develops new and special industrial skills for teaching industrial and technological subjects. For advanced students and teachers to develop new but basic manipulative skills and understandings in selected areas. Prerequisite: 12 hours in industrial education.

408–3 TEACHING AIDS IN TECHNOLOGICAL EDUCATION. Selection, development, analysis, cataloging, and use of commercial and self-made instructional aids and devices. Prerequisite: consent of instructor.

430–8 (2,2,2,2) SPECIAL PROBLEMS IN INDUSTRY AND TECHNOLOGY. Special opportunity for students to obtain assistance and guidance in the investigation and solution of selected technical problems. Prerequisite: consent of instructor.

435–12 (6,6) MANUAL ARTS INTERNSHIP. Supervised hospital experience featuring various applications of manual arts therapeutical treatments. Prerequisite: consent of department.

450–12 (1 to 4 per quarter) ADVANCED TECHNIQUES IN TECHNICAL SUBJECTS. Modern industrial practices and techniques in various selected technical fields. For experienced persons seeking an opportunity to develop advanced techniques and to increase understanding in specialized industrial fields. Emphasis on modern industrial processes, methods, materials, and techniques used in school shops, drafting rooms, and industrial organizations. Prerequisite: basic training in area selected for study. Limited to certified teachers.

465–9 (3,3,3) INDUSTRIAL SAFETY. (Same as Industrial Technology 465.) *(a)* Basic fundamental principles and practices used in industrial accident prevention; accident statistics; industrial hazards; mechanical safeguards. *(b)* Safety management, supervision, and organization of effective accident prevention programs; safety psychology; safety training and education. *(c)* Industrial hygiene and health safeguards; occupational diseases; toxic substances; chemical hazards; radiological safety; industrial fire prevention and control. Must be taken in a,b,c sequence. Prerequisite: 12 hours in technical subjects.

480–3 PROBLEMS OF JUNIOR HIGH SCHOOL INDUSTRIAL ARTS. Ways and means of correlating industrial arts with other curriculum areas, selecting content, and solving problems pertinent to industrial arts at the junior high school level. Prerequisite: 12 hours in technical subjects.

485–3 PRINCIPLES AND PHILOSOPHY OF INDUSTRIAL, VOCATIONAL, AND TECHNICAL EDUCATION. An understanding of the nature and purpose of practical arts, vocational and technical education, their relationships and differences, and the place of each in preparing people for the world of work. No prerequisite.

487–3 LAYOUT AND PLANNING OF TECHNICAL FACILITIES. Principles and practices underlying the planning and designing of shops and laboratories in vocational, industrial, and technical education. Prerequisite: 12 hours in technical subjects.

491–6 (3,3) PRINCIPLES OF INDUSTRIAL TEACHING. *(a)* Problems and special methods in teaching industrial arts. *(b)* Emphasis on methods of teaching trade subjects. May be taken in either sequence. Prerequisite: one half of major must be completed.

494–3 ORGANIZATION AND ADMINISTRATION OF INDUSTRIAL EDUCATION. Principles and policies governing the administration of industrial education programs in elementary, junior, senior high schools; relation of federal and state supervision of industrial education to local administration. Prerequisite: 12 hours in technical subjects.

495–3 OCCUPATIONAL ANALYSIS. Involves the fundamental steps for analyzing trades and other occupations with some thought toward establishing appropriate units of instruction for the apprentice or student. Jobs, operations, and essential related information are analyzed. Prerequisite: 12 hours in technical subjects.

496–3 SELECTION AND ORGANIZATION OF SUBJECT MATTER. Selection and arrangement of teaching content; preparation of assignment, operation, information, and job sheets; preparation of tests. Prerequisite: 12 hours in industrial education.

497–3 TEACHING OF READING IN TECHNOLOGICAL EDUCATION. An understanding of the literature available, one's obligation for keeping abreast of new developments and emphasis on reading and scanning for

new ideas in student's specialized field. Prerequisite: 12 hours in industrial education.

498–3 PLANNING MULTIPLE ACTIVITY PROGRAMS. Philosophy, techniques and administration of laboratories and shops featuring multiple offerings. Prerequisite: consent of instructor.

Courses on the 500 level are for graduate students only and are described in the Graduate School bulletin.

502–6 MEASUREMENTS AND EVALUATIONS OF PRODUCTS AND PROCEDURES.

504–4 HISTORY OF INDUSTRIAL AND VOCATIONAL EDUCATION.

505–4 ADMINISTRATION AND SUPERVISION OF INDUSTRIAL EDUCATION.

506–4 CO-OPERATIVE PROGRAMS.

540–2 to 6 RESEARCH IN TECHNOLOGICAL EDUCATION.

541–4 OCCUPATIONAL INFORMATION AND GUIDANCE.

550–4 COLLEGE TEACHING OF INDUSTRIAL AND TECHNICAL SUBJECTS.

560–12 (1 per quarter) NEW DEVELOPMENTS IN TECHNOLOGICAL EDUCATION.

570–2 to 6 SPECIAL INVESTIGATIONS IN INDUSTRIAL EDUCATION.

580–3 to 9 SEMINAR IN TECHNOLOGICAL EDUCATION.

599–3 to 9 THESIS.

INDUSTRIAL TECHNOLOGY

212–9 (3,3,3) WOOD SCIENCE AND TECHNOLOGY. *(a)* Wood science; a study of the structure and properties of wood. *(b)* New wood products and their industrial uses. *(c)* Modern industrial processes in wood technology including plant layout and production management. Laboratory. Must be taken in a,b,c sequence. No prerequisite.

216–9 (3,3,3) MATERIALS AND PROCESSES OF INDUSTRIAL COVERINGS. *(a)* Basic materials and processes used in surface coverage and decoration of forms, frames and bodies. *(b)* Fabric and plastic material and processes used on firm and cushioned surfaces. *(c)* Techniques and processes in flat surface coverings such as plastics, ceramics, metal, etc. Laboratory. May be taken in any sequence. No prerequisite.

227–9 (3,3,3) MANUFACTURING PROCESSES. *(a)* Analysis of tools and the basic processes of machining, forming and shaping materials used in modern manufacturing. *(b)* A study of the principles and procedures involved in casting, forming, and joining of industrial materials. *(c)* A study of fabrication, assembly, and methods of manufacture with emphasis on machine tools, automatic machines, and correlation of design with materials and processes. Laboratory. Must be taken in a,b,c sequence. No prerequisite.

235–9 (3,3,3) TECHNICAL DRAFTING. (See Industrial Education 235.)

271–12 (4,4,4) GRAPHIC ARTS TECHNOLOGY. *(a)* Machine composition, including keyboard operation, nomenclature, use, care, and operation of linecasting machines. *(b)* Offset lithography, including camera work,

plate making, and press work. *(c)* Printing design, including type design, commercial layouts, color, papers, cover design folders, booklets, bookbinding, presswork, printing economics, advanced lithography, advanced machine composition, and advanced printing mechanics. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 309a.

300–12 (4,4,4) PLASTIC MATERIALS AND PROCESSES. (See Industrial Education 300.)

304–9 (3,3,3) ARCHITECTURAL DRAFTING AND DESIGN. *(a)* Basic room planning, analysis of family needs, utilization of building sites, and developing preliminary plans. *(b)* Preparation of house plans, including elevations, details, plot plan, and service plans. *(c)* Advanced residential planning and designing; standards, codes, specifications, and research. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 235a or one course in high school drafting.

305–9 (3,3,3) TECHNICAL ILLUSTRATION. *(a)* Basic pictorial illustration, sketching angular perspective and parallel perspective. *(b)* Tone values and rendering various industrial materials in illustrations, technical and pictorial sketching. *(c)* Idea computation, detail, assembly, oblique, diagrammatic and axonometric sketching, manufacturing, maintenance, and assembly illustration. Integrated system schematics. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 235a.

306–9 (3,3,3) INDUSTRIAL DESIGN. *(a)* Basic design with industrial materials. *(b)* Advanced design problems with opportunity for concentration in one or two areas of industry. *(c)* Applied industrial design through cooperative arrangements with industry. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 235b.

309–12 (4,4,4) GRAPHIC ARTS. (See Industrial Education 309.)

312–9 (3,3,3) WOOD PRODUCTS AND PROCESSES. (See Industrial Education 312.)

318–9 (3,3,3) WELDING AND FOUNDRY PROCESSES. *(a)* Basic tools, materials and industrial processes used in making patterns and molds in the casting of ferrous and non-ferrous metals and alloys. *(b)* Fundamentals in the techniques, care, and use of oxy-acetylene and electric arc welding and flame cutting equipment on the common metals. *(c)* Advanced instruction in the use of oxy-acetylene, electric arc, tungsten arc, and automatic equipment in the welding of all kinds of metals; metallurgical aspects of metals and welds, testing procedures, and standards. Laboratory. Prerequisite: *(a,b)* 327a; *(c)* 318b.

320–12 (4,4,4) INDUSTRIAL CRAFTS. (See Industrial Education 320.)

322–9 (3,3,3) MACHINING OF METALS. (See Industrial Education 322.)

325–9 (3,3,3) PRECISION FORMING AND SHAPING OF METALS. *(a)* Advanced machine-tool techniques related to the production of precision-made metal parts. *(b)* Specialized machine-tool techniques for the development of devices used in the transmission of machine power. *(c)* Methods and procedures in the set up and scheduling of automatically controlled machine tools. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 322c.

327–9 (3,3,3) MATERIALS, PROCESSES, AND FABRICATION OF METALS. (See Industrial Education 327.)

332–12 (4,4,4) POWER MECHANICS. *(a)* An introduction to the fundamentals of power development, generation, and transmission, including such areas as heat engines, hydraulics, wind, electrical levers, and gears. *(b)*

Continuation of fundamentals of power with special emphasis on fuel type engines, their design, construction, operating principles, and major operating systems. *(c)* Automotive internal combustion engines, chassis and power transmission. Emphasis on construction, operation and care. Laboratory. Must be taken in a,b,c sequence. No prerequisite.

341–9 (3,3,3) INDUSTRIAL MAINTENANCE. *(a)* Care, repair, sharpening and maintenance of cutting tools, hand tools, portable power tools, and machine tools. *(b)* Installation procedures, equipment layout, replacement of parts, and upkeep of plant services, facilities and shop equipment; preventive maintenance procedures, inspection and inventory. *(c)* Characteristics, properties, and maintenance problems of mechanical equipment, hydraulic systems, and electrical motors and controls; lubrication, bearings, belts, drive components. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 312a, 327a.

342–9 (3,3,3) PROTECTIVE AND DECORATIVE COATINGS. *(a)* Methods, tools, and equipment used in finishing the common industrial materials; surface preparations; application procedures, types of finishes; and restoring and refinishing techniques. *(b)* Industrial materials, processes and equipment used in applying protective and decorative coatings; spraying techniques and testing procedures used on industrial finishes. *(c)* Composition, properties, and performance of industrial finishes, metallic and organic coatings; management and theory of colors; and new industrial finishing processes. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 312a, 327a.

343–9 (3,3,3) ELECTRICITY-ELECTRONICS. (See Industrial Education 343.)

345–9 (3,3,3) INDUSTRIAL ELECTRONICS. *(a)* Study of basic principles, concepts, and techniques in industrial application of electronics. *(b)* Analysis of complex circuits for fundamental principles and concepts which facilitate trouble shooting of industrial equipment. *(c)* Principles and concepts involved in multivibrators, oscillators, pulse generators and computer circuits. Laboratory. Must be taken in a,b,c sequence. Prerequisite: 343b.

351–9 (3,3,3) INDUSTRIAL TOOL DESIGN. *(a)* Theory and practice in the design of basic jigs and fixtures used in the metalworking industry. *(b)* A continuation, with emphasis on special tooling for continuous production equipment. *(c)* Design and development of gauges and measuring devices for controlled production equipment. Laboratory. Must be taken in a,b,c sequence. Prerequisites: 322c, Technology 300b.

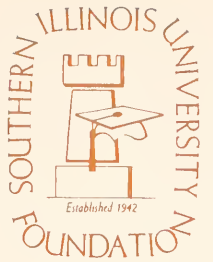
465–9 (3,3,3) INDUSTRIAL SAFETY. (See Industrial Education 465.)

TECHNOLOGY

Course 300 is required of all School of Technology students.

300–9 (3,3,3) APPLICATION OF FUNDAMENTAL PHYSICAL PRINCIPLES. A general coverage of applied science and the physical principles which control man's exploitation of scientific discovery. *(a)* Applied mechanics and the properties of materials. *(b)* Electricity, electronics, circuits, and devices. *(c)* Wave phenomena, heat, power, and exchange principles.

599–3 to 9 THESIS.



Southern Illinois University Foundation

The Southern Illinois University Foundation is a nonprofit corporation chartered by the state and authorized by the Board of Trustees to receive gifts for the benefit of the University, to buy and sell property, and otherwise to serve the University.

It respectfully asks alumni and other citizens of Southern Illinois to consider making gifts and bequests to benefit the University. Such gifts should be conveyed to the Foundation, with proper stipulation as to their uses. The Foundation, through its officers and members, will be glad to confer with intending donors regarding suitable clauses to insert in wills and suitable forms of gifts and memorials, including bequests by means of life insurance. Large or small gifts to the library will be appreciated; likewise, gifts for special equipment, buildings, endowment of professorships in particular subjects, gifts to student loan funds and scholarship funds, gifts for the use of foreign students, and endowments for particular sorts of research. Any gifts or bequests can be given suitable memorial names.

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