BULLETIN OF YALE UNIVERSITY

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BULLETIN OF
Yale UNIVERSITY
Number 8 1 August 1984

best (binding)

Yale College Programs of Study

and Spring Terms

1984 – 1985

No mention of winter term suggests terms are semesters.

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gram must be approved by his dean and adviser, and every reasonable program will be approved. A student whose program departs marked from the Guidelines will be obliged to persuade the Residential College Dean and faculty program adviser that it will still achieve for the student in its own way the goals of a liberal education.

MAJOR PROGRAMS

Students seeking the B.S. or the B.A. degree with a major in science are expected to elect their majors at the beginning of Sophomore year, although a major in science may still be elected later if the student has completed the courses required to enter it. Sophomores interested in majoring in science should have their schedules approved by the Director of Undergraduate Studies or adviser designated by the department in which they wish to major. Students seeking the B.A. degree with a major in a field other than science are expected to elect their major at the beginning of Junior year. The schedules for Sophomore year of these students must be signed by a Sophomore adviser, chosen by the student, with whom the program has been discussed.

All candidates for a bachelor's degree in Yale College must elect one of the major programs listed on page 28. The requirements for a major are described in general terms in the sections below, and in more detail at the beginning of the course descriptions of each department or program in CHAPTER III. In every case students plan their schedule of courses in these major subjects or fields in consultation with a representative of the department or program concerned, and must secure the consultant's written approval. Students should acquaint themselves fully with all the requirements of the major they plan to enter, considering not only the immediate choice of courses but also the plan of their entire work in the last two or three years in college.

SELECTION OF A MAJOR

In designing a program of study, the student ought to plan for depth of concentration as well as breadth of scope. To study a subject in depth can be one of the most rewarding and liberating experiences a person can secure and can form the basis of the interests and occupations of a lifetime. Although no one should specialize to the neglect of distribution, knowledge advances by specialization, and one can gain some of the excitement of discovery by pressing toward the outer limits of human knowledge in a particular field. Intense study of a seemingly narrow area of investigation will often disclose ramifications and connections that alter perspectives on every other subject. Such study also sharpens a person's judgment and acquaints him with processes by which new truths can be found.

In order to expose themselves to this kind of experience, students must choose a field of study that will be their major field, that is, the subject in which they will work more intensively than they do in any other. A list of possible majors in Yale College from which such a choice is to be made is given below on page 28. Specific requirements for each major are established by the department or program concerned and are explained in CHAPTER III.

Some students will have made a tentative choice of a major before entering college. Others will have settled on a general area—for example

sciences or the humanities—without being certain of the particular department or program they intend to major in. Still others will be undecided. Past experience shows that students who arrive with minds made up often change them after a year or two. Even students who are certain of their choices should keep open the possibility of a change by selecting courses during the first two years, students should have in mind not only the application of the Guidelines described above, but the need for a preliminary exploration of the subjects to which they are drawn, in order to become aware of their own tastes, talents, and

As in the case of the Guidelines, the student should make the final choices in selecting a program, but once again, a few general principles may help in selecting courses.

In most of the humanities and social sciences, there is some progression from elementary to advanced courses. It is possible to begin a major in, for example, English, psychology, or history at the end of the Sophomore year, since there are few prerequisites, and students may satisfy them in either Freshman or Sophomore year, or even, in some cases, on the basis of work done in secondary school.

In some other fields of study, such as the natural sciences and such languages as foreign languages and literatures, a sequence of courses must be taken in chronological order from the Freshman to the Senior year. In order to major in one of these fields, the student must lay the groundwork in the Freshman year. If the initial courses are missed in the Freshman year, it may be impossible to begin a major in these subjects in the Sophomore year. The Freshman courses are prerequisites for the Sophomore courses, and so on.

In order, therefore, to attain the maximum range and freedom of choice for the upperclass years, each student should think seriously about the possible choices of a major before arriving at college. A student who has a remote interest in majoring in a science should be sure to include in the work of the Freshman year a course in mathematics and probably two courses in the natural sciences, one of these preferably in chemistry.

No matter what major a student selects, the knowledge of a foreign language required in the Distributional Requirements for the Bachelor's degree is found to be useful in his studies. Students who cannot comfortably take a foreign language would be well advised to take during Freshman year or more year courses that will enable them to do so. Anyone who contemplates postgraduate study should keep in mind that the requirements for the doctoral degree usually include a reading knowledge of two foreign languages, commonly French, German, or Russian.

Many of the courses open to Freshmen will continue work they began in secondary school. Students will probably want to choose some of their Freshman courses in areas in which they have already acquired some familiarity and interest, but for the sake of intellectual stimulation and to avoid being unduly limited in their range of future choices, they should also elect some courses in fields that are wholly new to them.

THE MAJOR (B.A. OR B.S.)

The major consists of a number of courses in the same area. A major usually includes twelve term courses taken for the most part in Junior and Senior years. Majors are offered by departments or by interdepartmental or interdisciplinary programs. In many departments and pro-

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★*Comparative Literature* 316a/★*English* 184a (26416), RENAISSANCE LYRIC POETRY. Thomas Greene.
MW 2.30-3.45 Not CR/F I(0)
Readings in Petrarch, Ronsard, Du Bellay, Wyatt, Shakespeare (S… and Donne, with special attention to the relationship between langua… and selfhood, as well as the relationship between inherited traditions and … ity. *Prerequisite: reading knowledge of French.*

★*Comparative Literature* 355b/★*English* 302b (26453), JOYCE AND MANN. James Snead.
MW 1.30-2.45 Not CR/F I(0)
A comparison of the major works of Joyce and Mann in light of … implications for the development of the twentieth-century novel, with par… emphasis on *Ulysses* and *The Magic Mountain*. Alternate reading of works … two writers with focus on the transformation of mythic and philos… sources; medievalism; typical rhetorical figures and modes; anti-tradition… critical reception. *Reading knowledge of German required for Comparative Li… ture majors*, recommended for others. Texts available in translation.

★*Comparative Literature* 366b (26466), EIGHTEENTH- AND NINETEENTH-CENTURY NARRATIVE FICTION. Claudia Brodsky.
TTh 1.30-2.45 Not CR/F I(0)
Close readings of English, German, French, and American narrative … Analysis of the relation between the discursive and representational dim… of fiction in forms ranging from early epistolary and journal novels, sha… first-person narratives, to authorial narrations and narrative realism. Inc… works by Richardson, Diderot, Goethe, Goldsmith, Laclos, Kleist, B… Austen, Melville, Balzac, and Dickens. *Reading knowledge of French requ… Comparative Literature majors,* recommended for others.

★*Comparative Literature* 368b (26468), SHORT PROSE OF THE TWENTIETH CENTURY. Howard Stern.
MW 3.30-4.45 I(0)
An investigation of an area delimited by several genres, including the … poem, feuilleton, philosophical aphorism, and essay, with emphasis on th… ical issues of poetics, interpretation, and translation. Works by Kafka, B… Ponge, Calvino, and others. *Reading knowledge of French, German, or I… required for Comparative Literature majors,* recommended for others.

★*Comparative Literature* 488a *or* b (26488), DIRECTED READING AND/OR INDIVIDUAL RESEARCH. David Marshall and staff.
Hours to be arranged with adviser Not CR/F I(0)
Special projects set up by the student in an area of his own particular … with the help of a faculty adviser and the Director of Undergraduate St… intended to enable the student to cover material not otherwise offered … department. The project must terminate with at least a term paper or its equ… lent, and must have the approval of the Director of Undergraduate St… *Enrollment limited to Comparative Literature majors.*

★*Comparative Literature* 489a (26489), THE SENIOR COLLOQUIUM. Jennifer Wicke and staff.
T 8-10 P.M.; *disc.* Th 1 HTBA Not CR/F I(0)
For description see Literature 489a. *For Senior Comparative Literature … only.*

…rative Literature 491a *or* b (26491), SENIOR ESSAY.
Not CR/F I(0)
An independent writing and research project required of all Comparative …ature majors. A prospectus signed by the student's adviser must be submit… to the office of the Director of Undergraduate Studies by the end of the … week of the term in which the essay is to be written. A rough draft must … submitted to the adviser and to the Director of Undergraduate Studies … roximately one month before the final draft is due. Essays are normally 25 to … ages long.

HENRY LUCE COURSE, 1984–85

…y Luce Seminar 184a/★*History* 390a (65202), THE ORIGINS OF THE WITCHES' SABBAT. Carlo Ginzburg.
Th 1.30-3.20 II(0)
Examination of the emergence of the notion of witches' sabbat in late … eval Europe. Focus on learned stereotypes (lay and clerical) as well as on … ic culture (myths and rituals). Readings from demonological treatises … ler, Sprenger and Institor, de Lancre, and others), Inquisitorial trials; … enth- and twentieth-century literature on folklore, history of religions. … Knowledge of Latin, French, German, or Italian recommended but not … ired.
For further information about the Henry Luce Course, see CHAPTER I.
Enrollment limited to 30. Students wishing to enroll must register for the … ar in Room 112, Whitney Humanities Center, 53 Wall Street, on September … 6.

MATHEMATICS

(*See also* APPLIED MATHEMATICS)

…tor of Undergraduate Studies: Walter Feit, 210 LOM.

…ULTY OF THE DEPARTMENT OF MATHEMATICS

…ESSORS
…per Aaboe
…hard Beals (*Chairman*)
…ald Coifman
…ter Feit
…ard Garland
…ert Howe
…ge Lang
…nie Lee
…us Macintyre
…iam Massey
…ent Moncrief
George Mostow
Ilya Piatetski-Shapiro
David Pollard
George Seligman
Robert Szczarba
Tsuneo Tamagawa
Gregg Zuckerman

ASSISTANT PROFESSORS
Nathan Habegger
Neil Immerman
Rudolf Schmid

J. W. GIBBS INSTRUCTORS
Guy David
Douglas Pickrell
Philip Scowcroft
Allen Shepard
Alexander Suciu
Simon Thomas
Paul Vojta

LECTURER
Frank Ryan

…th course offerings and the major in Mathematics reflect the many roles … athematics itself: as the language and tool of the sciences, as a cultural … omenon with a rich historical tradition, and as a model of abstract … oning. The Mathematics major provides a broad education in various … s of mathematics in a program flexible enough to accommodate many … s of interest.
…A. and B.S. degree programs. The B.A. degree program normally consists … ten term courses in Mathematics numbered 222a or b or higher. Each … dent is expected to take either Mathematics 230 or its equivalent: Math-

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ematics 222a or b and 250a. He is also expected to take at least two
courses in each of three of the following categories: analysis (250a,
courses between 300 and 349); statistics and applied mathematics (co
between 241 and 260, except 250a); algebra and number theory (222a
courses between 350 and 399); geometry and topology (courses bet
400 and 449); logic and foundations (courses between 450 and 469
270a). All Mathematics majors are urged to take at least one of
Computer Science 221a or b or 440a, which may be counted as a term co
in applied mathematics. In some instances permission may be grante
take additional required term courses in other departments (e.g., Com
Science, Engineering and Applied Science, History of Science, Histo
Medicine, Philosophy, Physics, Statistics).

A candidate for the B.S. degree must take, in addition to the ter
courses required for the major in Mathematics, at least two advanced
courses in the physical sciences, to be chosen with the approval o
Director of Undergraduate Studies.

Any student interested in mathematical research as a career is urge
take Mathematics 230, 301a, 305b, 310a, 350a, and 370b. A sample progra
mathematics for such a student might consist of these courses plus
from Mathematics 430b, 435b, 270a, and 450b. Students with more int
in teaching mathematics or in applications of mathematics should se
consider Mathematics 222a or b and 250a. A program for such a stu
might consist of Mathematics 222a or b, 241a, 242b, 246a or b, 250a,
310a, 350a, and 270a or 450b.

The intensive major. Candidates for a degree with an intensive ma
Mathematics are expected to include at least two terms of graduate co
work, or of equivalent independent study, in their programs. Famili
with the material of the following courses should be considered prere
to graduate courses in the respective categories: *Algebra:* two courses in
range 350–399. *Analysis:* Mathematics 230, 246a or b, 301a, 305b, 310a,
ometry and Topology: Mathematics 250a, 350a. *Logic and Foundations:* M
ematics 270a, 450b, 456b.

Senior requirement. A student majoring in Mathematics is required d
the Senior year to give an oral presentation on some topic selected
members of the faculty. In 1984–85, the department expects to provide
an experimental basis, two or three mini-seminars which will cover to
not available in regular courses. Seniors may opt to take such a semin
their Senior requirement instead of giving an oral presentation. For de
students should consult the Director of Undergraduate Studies at the
of fall term.

The following members of the department may be consulted by stu
through their Residential College affiliation:

BK, R. Schmid	MC, G. Seligman
BR, R. Lee	PC, G. Mostow
CC, N. Immerman	SY, R. Szczarba
DC, R. Howe	SM, R. Beals
TD, R. Coifman	ES, W. Feit
JE, T. Tamagawa	TC, W. Feit

THE MASTER'S DEGREE PROGRAM

Students who, by the end of their Senior year, complete the requirem
of the department for the M.A. in Mathematics will be eligible to re
this degree at their Senior Commencement. Required are: (1) eight

numbered 500 or higher, most of which must be completed with
of High Pass or better; (2) a reading knowledge of mathematical
re in a foreign language of importance for mathematical research
lly French, German, or Russian); (3) satisfactory performance on a
oral examination.
master's program is in no sense a substitute for the B.A. or B.S. program;
it is designed to accommodate a very few exceptional students who,
ans of accelerated or independent study, can satisfy the department as
command of the content of the normal undergraduate program.
dates must submit to the Director of Undergraduate Studies, during
term of Sophomore year, a proposal which foresees this level of
ment by the end of Junior year. Their status and progress will be
ed before they are permitted to continue in the program in Senior

least two terms of graduate work are to be taken in the Junior year
lly courses in algebra or analysis will be the first graduate courses
The general oral examination covers a list of topics available from
ector of Graduate Studies, and will be accepted in lieu of the usual
oral presentation. Details concerning the requirements for the mas-
gree may be obtained from the Director of Graduate Studies.

MENT IN COURSES

lified Freshmen and Sophomores may, *with the permission of the in-*
take any of the courses numbered 222a or b or above.
shmen taking calculus are normally placed in Mathematics 111a, 112a,
16a, or 120a, according to their backgrounds and, in particular, to their
in C.E.E.B. Achievement or Advanced Placement Tests. It is expected
or absolutely required) that any Freshman applying for placement in
anced course (i.e., 115a or higher) will have taken the Advanced
ment Test. All placement is subject to appeal and review during the

re are three basic calculus sequences, namely 111a–114b, 112a–115b, and
17b. Each sequence consists of a semester of differential calculus
ed by a semester of integral calculus. The main differences are in
sis. Mathematics 111a–114b is intended for students with weaker
ation, and the presentation will be paced to allow consolidation of
sic techniques from algebra, analytic geometry, and trigonometry.
matics 112a–115b will presuppose these techniques, and will be most
priate for well-prepared students who need calculus for applications.
matics 116a–117b is intended for students with a strong preparation
rong interest in mathematics, including the theoretical basis of the
s; theory, understanding, and problem solving will be stressed.
m Mathematics 114b or 115b a student would naturally continue to
b or 222a or b. Mathematics 116a–117b will prepare a student for 230,
222a or b and 250a.
material covered in Mathematics 230 is approximately that covered
or b, 222a or b, and 250a. However, Mathematics 230 emphasizes
matical rigor, while students taking Mathematics 120a or b combined
22a or b and Mathematics 250a will spend more time on applications.
nts who take Mathematics 230 should have a strong interest in abstract
matics.

REQUIREMENTS OF THE MAJOR

Prerequisite: None
Number of Courses: *B.A. Degree*—10 term courses; *B.S. Degree*—12 term
Distribution of Courses: *B.A. Degree*—2 courses in 3 categories chos
among (a) analysis, (b) statistics and applied math, (c) algebra and numbe
(d) geometry and topology, (e) logic and foundations, with course rang
above; *B.S. Degree*—same, and 2 advanced-level courses in the physical
with approval of DUS
Specific Courses Required: Math 230 or the combination of Math 222a
250a
Substitution Permitted: CompSci 221a or b or 440a; or courses in other
depts, with permission of DUS
Senior Requirement: Oral presentation on topic selected by the faculty,
seminar
Intensive Major: 2 courses on graduate level counted among the required

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**Mathematics E.C.* (65500), MATHEMATICAL ANALYSIS. Nathan Habeg
3 HTBA TC Not CR/F IV(50)
An introduction of some of the fundamental ideas of modern math
for a small group of Freshmen interested in the serious study of math
The seminar is built around Mathematics 230, Vector Calculus and
Algebra, *which must be taken concurrently*. The Early Concentration
expand the topics covered in Mathematics 230—the algebra of finite dimen
vector spaces and the usual notions of calculus extended to functions be
these spaces—and apply them in other areas of mathematics. Possible ad
areas include metric spaces, topological spaces, Hilbert spaces, Fourier
and differential equations. Candidates for enrollment should have a
preparation in mathematics, particularly in calculus, as shown by a score
the BC Advanced Placement Test in Mathematics or by other
indications. *Counts toward the major.*

INTRODUCTORY COURSES

These courses do not count toward the requirements of a
Mathematics.

Mathematics 111a *or* b, CALCULUS I. Robert Szczarba [F], Asger Aabo
and staff.
3 HTBA For sections see the Fall or Winter Supplement IV(
Fundamentals of calculus of functions of one variable, with discus
elementary functions and analytic geometry as needed. No prior acqua
with calculus is assumed. This course is suitable for students with mo
calculus background. *Not open to students who have completed Mathematics*

Mathematics 112a, CALCULUS OF FUNCTIONS OF ONE VARIABLE I.
Serge Lang and staff.
3 HTBA For sections see the Fall Supplement IV(69)
Limits, continuity. Differentiation of elementary and transcendental
tions, and applications. No prior acquaintance with calculus is assum
open to students who have completed Mathematics 110.*

*Last offered in 1983–84.

matics 114b, CALCULUS II. Robert Szczarba and staff.
3 HTBA For sections see the Winter Supplement IV(69)
ntinuation of Mathematics 111a. Change of variable in integrals, integra-
parts, polar coordinates, computation of areas and volumes. Rudiments
ions of several variables, with applications. *After Mathematics* 111a *or* 112a.

matics 115a *or* b, CALCULUS OF FUNCTIONS OF ONE VARIABLE II.
ard Garland [F], Serge Lang [Sp], and staff.
3 HTBA For sections see the Fall or Winter Supplement IV(69)
ntinuation of Mathematics 112a. The definite integral and the fundamen-
rem of calculus. Techniques of integration. Polar coordinates. Taylor
Physical and geometrical applications. *After Mathematics* 110* *or* 112a, *or*
alent; *open to Freshmen with some preparation in calculus.* One section that
reater emphasis to applications is taught by a member of the Engineering

matics 116a (65555), CALCULUS I: THEORY AND APPLICATIONS.
olf Schmid.
MWF 10.30-11.20 IV(33)
content and prerequisites of 116a are similar to those of 112a, but the
tion is geared to students with a strong interest in abstract mathematics.
n to students who have completed 111a *or* b, *or* 112a.

matics 117b (65556), CALCULUS II: THEORY AND APPLICATIONS.
olf Schmid.
MWF 10.30-11.20 IV(33)
ntinuation of Mathematics 116a. The content is similar to that of Math-
s 115b differing only in terms of presentation, which emphasizes abstrac-
well as applications. *After Mathematics* 111a, 112a, *or* 116a. *Not open to*
who have completed Mathematics 114b *or* 115b.

matics 120a *or* b, CALCULUS OF FUNCTIONS OF SEVERAL VARIABLES.
mie Lee [F], Ronald Coifman [Sp], and staff.
3 HTBA For sections see the Fall or Winter Supplement IV(69)
lytic geometry in three dimensions, using vectors. Real-valued functions
nd three variables, gradient and directional derivative, level curves and
, maxima and minima. Parametrized curves in space, motion in space,
egrals; applications. Multiple integrals, with applications. *After Mathe-*
115a *or* b *or by permission.* Two sections that give greater emphasis to
ions are taught by members of the Engineering faculty in the fall term,
he spring.

MEDIATE AND ADVANCED COURSES

e courses count toward the requirements of a major in Mathematics.

matics 222a, LINEAR ALGEBRA AND MATRIX THEORY.
Lect A (65678) MWF 10.30-11.20 Douglas Pickrell IV(68)
Disc. 1 HTBA
Lect B (65679) TTh 9-10.15 George Mostow IV(68)
Disc. 1 HTBA
ntroduction to the applications of vector spaces in algebra, analysis, and
ry. Matrix algebra, determinants, eigenvalues, quadratic forms, principal
d linear programming.

offered in 1983–84.

Mathematics 222b, LINEAR ALGEBRA AND MATRIX THEORY.
Lect A (65681) MWF 8.30-9.20 Peter Schultheiss IV(68)
Disc. 1 HTBA
Lect B (65682) MWF 9.30-10.20 Staff IV(68)
Disc. 1 HTBA
Lect C (65683) TTh 9-10.15 George Veronis IV(68)
Disc. 1 HTBA
(Students must enroll in a discussion section assigned to their lecture.
The content of this course is identical to that of Mathematics 222a. It
A emphasizes applications and is taught by a member of the Engineering

**Mathematics* 230 (65693), VECTOR CALCULUS AND LINEAR ALGEBRA.
Walter Feit.
Lect MWF 11.30-12.20 IV(34)
Rec. 1 HTBA
A careful study of the calculus of functions of several variables, co
with linear algebra.

Mathematics 241a/*Statistics* 241a (97241), PROBABILITY THEORY.
John Hartigan.
MWF 9.30-10.20 IV(32)
For description see under Statistics.

Mathematics 242b/*Statistics* 242b (97242), THEORY OF STATISTICS.
I. Richard Savage.
MWF 9.30-10.20 IV(32)
For description see under Statistics.

Mathematics 246a *or* b (65712), ORDINARY DIFFERENTIAL EQUATIONS.
Roger Howe [F], Frank Ryan [Sp].
TTh 9-10.15 IV(21)
Numerical solution methods. Geometric and algebraic properties of
ential equations. First-order equations, second-order equations, linear
with constant coefficients. *After Mathematics* 120a *or* b *or the equivalent.*

Mathematics 250a (65716), VECTOR ANALYSIS. William Massey.
MWF 11.30-12.20 IV(34)
Calculus of functions of several variables, using vector and matrix no
Implicit and inverse mappings. Transformation of coordinates. Theore
Green, Gauss, and Stokes. Potential theory, with physical and geom
applications. *After Mathematics* 120a, 222b, *or the equivalents.*

Mathematics 260b (65726), ANALYTICAL METHODS. Ronnie Lee.
MWF 10.30-11.20 IV(33)
A unified treatment of several advanced methods of applied mathe
the calculus of variations, partial differential equations, and Sturm-L
eigenvalue problems. *After Mathematics* 120a, 222b, 246a, *or the equivalent*

Mathematics 270a (65736), SET THEORY. Simon Thomas.
MWF 10.30-11.20 IV(33)
Algebra of sets; finite, countable, and uncountable sets. Cardinal
and cardinal arithmetic. Order types and ordinal numbers. The axiom of
and the well-ordering theorem. *After Mathematics* 120a *or* b *or the equival*

**Mathematics* 301a (65767), INTRODUCTION TO ANALYSIS. Richard Beal
TTh 1-2.15 Not CR/F IV(26)

An introduction to the theory of functions of real variables, including
nts of set theory, metric spaces, and point set topology. *After Mathematics*
or the equivalent.

hematics 305b (65771), REAL ANALYSIS. Richard Beals.
TTh 1-2.15 Not CR/F IV(26)
Topics from the theory of functions of real variables, with emphasis on
y of integration and applications to Fourier analysis. *After Mathematics*
or by permission.

hematics 310a (65776), INTRODUCTION TO COMPLEX ANALYSIS.
Gregg Zuckerman.
MWF 10.30-11.20 IV(33)
An introduction to the theory and applications of functions of a complex
able. Differentiability of complex functions. Complex integration and
chy's theorem. Series expansions. Calculus of residues. Conformal
ping. *After Mathematics* 230 *or* 250a *or the equivalent.*

hematics 315b/515b (65781), INTERMEDIATE COMPLEX ANALYSIS.
Gregg Zuckerman.
MWF 10.30-11.20 IV(33)
Continuation of Mathematics 310a. Topics include argument principle,
ché's theorem, Hurwitz theorem, Runge's theorem, analytic continuation,
warz reflection principle, Jensen's formula, infinite products, Weierstrass
rem. Functions of finite order, Hadamard's theorem, meromorphic func-
Mittag-Leffler's theorem, subharmonic functions. *After Mathematics* 310a.

hematics 320a/520a (65786), MEASURE THEORY AND INTEGRATION.
Stephen Semmes.
TTh 1-2.15 IV(26)
Construction and limit theorems for measures and integrals on general
ces; product measures; L^p spaces; integral representation of linear function-
analytic sets. *After Mathematics* 301a *or the equivalent.*

hematics 325b/525b (65791), INTRODUCTION TO FUNCTIONAL ANALYSIS.
Guy David.
TTh 11.30-12.45 IV(24)
Hilbert, normed, and Banach spaces; geometry of Hilbert space, Riesz-
her theorem; dual space; Hahn-Banach theorem; Riesz representation theo-
s linear operators; Baire category theorem; uniform boundedness, open
ping, and closed graph theorems. *After Mathematics* 320a.

hematics 350a (65816), AN INTRODUCTION TO ABSTRACT ALGEBRA.
Tsuneo Tamagawa.
MWF 1.30-2.20 IV(36)
Group theory. Rings, with emphasis on integral domains and polynomial
s; modules over Euclidean domains; applications to linear algebra. *After*
hematics 222a *or* b *or the equivalent.*

hematics 353b/653b (65819), REPRESENTATIONS OF FINITE GROUPS.
Ilya Piatetski-Shapiro.
MWF 1.30-2.20 IV(36)
Basic theory of representations and characters of finite groups: orthogonality
ions, induced representations, exceptional characters, Brauer's theorem.
lications to the structure of finite groups. Theorems of Burnside and Fro-
ius. *After Mathematics* 350a.

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[*Mathematics* 354b, NUMBER THEORY. 1985–86]

**Mathematics* 370b (65836), FIELDS AND GALOIS THEORY. Paul Vojta.
MWF 1.30-2.20 IV(36)
The theory of fields and Galois theory, including finite fields, solvab... equations by radicals, and the fundamental theorem of algebra. *After M... matics* 350a.

**Mathematics* 400a (65866), INTRODUCTION TO MATHEMATICAL MECHANICS. Vincent Moncrief.
TTh 1-2.15 IV(26)
Newton's equations and the Galilean group; the Euler-Lagrange equa... and Noether's theorem; the Kepler problem and rigid body motion; symp... manifolds and Hamiltonian mechanics.

[*Mathematics* 430b, AN INTRODUCTION TO ALGEBRAIC TOPOLOGY. 198...

**Mathematics* 435b (65901), DIFFERENTIAL GEOMETRY. George Mostow.
TTh 9-10.15 IV(21)
Applications of calculus to the study of the geometry of curves and su... in Euclidean space, intrinsic differential geometric properties of manifold... connections with non-Euclidean geometries and topology. *After Mathe... 230 or 250a or the equivalent.*

Mathematics 450b (65916), INTRODUCTION TO MATHEMATICAL LOGIC. Simon Thomas.
TTh 9-10.15 IV(21)
The propositional calculus, deduction, and semantic interpretation ... lower predicate calculus, completeness, axiomatic set theory, problems ... foundations of mathematics.

[*Mathematics* 456b/955b, RECURSIVE FUNCTION THEORY. 1985–86]

**Mathematics* 460a (65926), PHILOSOPHICAL FOUNDATIONS OF MATHEMATICS. Philip Scowcroft.
2 HTBA Not CR/F IV(0)
Various philosophical positions with respect to the foundations of ma... matics, including realism, constructivism, and finitism.

Mathematics 470a *or* b (65936), INDIVIDUAL STUDIES. Consult the Direct... of Undergraduate Studies.
Meets RP IV(0)
Individual investigation of an area of mathematics outside of those co... in regular courses, involving directed reading, discussion, and either pape... an examination. A written plan of study approved by the student's advise... the Director of Undergraduate Studies is required. The course may norma... elected for only one term.

COURSES IN OTHER DEPARTMENTS THAT ARE PARTICULARLY RELEVANT TO THE MAJOR

The following courses may, with the permission of the Direct... Undergraduate Studies, be counted with Mathematics courses toward... requirements of the major.

...ter Science 221a *or* b (27347), INTRODUCTION TO COMPUTER SCIENCE. ... Perlis.
...rth 1-2.15 Not CR/F IV(26)
... description see under Computer Science.

...ment Sciences 235a (65235), LINEAR PROGRAMMING AND EXTENSIONS. ... Denardo.
...Th 2.30-3.45 Not CR/F IV(27)
... description see Management Sciences under Organization and Manage-

...ter Science 440a/540a (27566), NUMERICAL COMPUTATION I. ...ny Chan.
... MWF 1.30-2.20 Not CR/F IV(36)
... description see under Computer Science.

...ter Science 441b/541b (27567), NUMERICAL COMPUTATION II. ...illiam Gropp.
... MWF 1.30-2.20 Not CR/F IV(36)
... description see under Computer Science.

...DUATE COURSES OF INTEREST

...ch year the departments of Mathematics and Statistics offer a large ...er of graduate courses, some of which are accessible to advanced ...graduates. Further information may be obtained from the respective ...tors of Undergraduate Studies whose permission, together with that ... relevant Director of Graduate Studies, is required for admission. ...ng the most basic graduate courses are:

...matics 501a, MODERN ALGEBRA.

...matics 544a, ALGEBRAIC TOPOLOGY.

...ics 600a, ADVANCED PROBABILITY.

MATHEMATICS AND PHILOSOPHY

...major allows students to explore those areas where philosophy and ...matics meet, in particular, mathematical and philosophical logic and ...hilosophy of mathematics.

...e prerequisites for the major are Mathematics 120a or b and Philosophy ... A total of twelve term courses in mathematics and philosophy is ...red. At least five of these should be in mathematics and at least five in ...sophy. Required courses include Set Theory (Mathematics 270a), and ...duction to Mathematical Logic (Mathematics 450b), both of which ... be taken before the end of the Junior year, although they should ...ably be taken before that year. They also include:
...either of the following:
...a) Logical Theory II (Philosophy 440b),
...b) Recursive Function Theory (Mathematics 456b);
...an advanced philosophy course (other than Philosophy 204a or 440b) ...with a substantive logical component;

Yale '84-'85

(3) one of the seminars designated as fulfilling the Senior requirement (see below).

Requirements (1), (2), and (3) must be satisfied separately; however, a student may satisfy (2) and (3) by taking two designated seminars, provided at least one of them is in Philosophy.

Senior requirement. Each year certain seminars offered by the Mathematics and Philosophy departments are designated as fulfilling the Senior requirement of this major. Subjects covered in these seminars vary from year to year. A student who selects one of them to satisfy requirement (3) above will be expected to give a presentation within the seminar on a topic selected in consultation with the instructor. These seminars may be taken at any time after a student has completed Mathematics 270a and Philosophy 204a.

The seminars fulfilling the Senior requirement for 1984–85 are Philosophy 449a, Probability, Induction, and Decision Theory; Philosophy 452b, Symmetry and Physical Law; and Mathematics 460a, Philosophical Foundations of Mathematics.

A typical program satisfying the major might consist of:

Mathematics 120a or b, 222a or b, 270a, 350a, 450b, and designated seminar;

Philosophy 110a, 204a, 222a, 440b, and designated seminars with presentation.

Majors should consult Walter Feit and Ruth Marcus or R. I. G. Hughes.

REQUIREMENTS OF THE MAJOR

Prerequisites: Math 120a or b, Phil 204a
Number of Courses: 12 term courses (within which total the prerequisites and Senior seminar are included)
Distribution of Courses: At least 5 in each subject
Specific Courses Required: Math 270a, 450b, and Math 456b or Phil 440b, and advanced Phil course with substantive logical component
Senior Requirement: Senior seminar

MATHEMATICS AND PHYSICS

A minimum of fourteen term courses in mathematics and physics above the Sophomore level is required, with at least six in each of the two subjects. A Senior essay on a topic appropriate for the combined major and acceptable to both the Physics and the Mathematics departments is also required. The student must present an oral report on this essay to the Mathematics department. Majors should consult Walter Feit and Edward Hinds.

REQUIREMENTS OF THE MAJOR

Prerequisites: Math 120a or b; Phys 150a, 151b, or 180a, 181b, or 200a, 201b, or 250a, 251b; and Phys 165La, 166Lb, or 205La, 206Lb
Number of Courses: 14 term courses above Sophomore level (within which total the prerequisites and Senior essay are not included)
Distribution of Courses: At least 6 in each subject, Math at level 222 or above, Phys at level 300 or above
Specific Courses Required: None
Senior Requirement: Senior essay on topic acceptable to Physics and Mathematics depts; oral report on essay to Mathematics dept

MECHANICAL ENGINEERING

...of Undergraduate Studies: Aris Phillips, 201 BECTON.

...OF THE DEPARTMENT OF MECHANICAL ENGINEERING

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Associate Professors	Assistant Professors
Mahadevan Krishnan	Juan Fernandez de la Mora
Akhilesh Maewal	Marshall Long
Katepalli Sreenivasan	Mitchell Smooke

...nical engineering is among the most diversified of the traditional ...ering disciplines. The mechanical engineer builds machines to extend ...physical and mental capabilities and to convert traditional and novel ...sources into useful forms for man and his works.

...e mechanical engineer should bring to this enterprise a clear under-...g of the fundamentals of mechanics and the thermal energy sciences. ...ying these principles, the modern mechanical engineer must also be ...ed to choose the best materials for a given application, be comfort-...a computer terminal making calculations and performing interactive ... tasks, and be sufficiently familiar with the chemical and electrical ...es, which are often relevant to the total design and realization of a ... These systems typically include thermal, wind, and hydroelectric ... plants; internal and external combustion engines; aircraft, hover-... and satellites; heating, air-conditioning, and refrigeration systems; ...draulic, magneto-hydrodynamical, and electromechanical equipment ...ding robots). The mechanical engineer has also played an increasingly ...tant role in the design of instrumentation, prosthetic devices, and bio-...ials for medical applications.

...ll these tasks, the utmost consideration of the modern mechanical ...er is the improvement of the quality of human life. He must be ...ply aware both of the finiteness of the earth's resources and of the ...n that his works place on the earth and its ecosystem.

...e program in mechanical engineering is designed to provide a broad ...tion in the foundations of the disciplines mentioned above, and to ... students both for graduate studies in these areas and for entry into ...priate positions in research laboratories, industry, or government, ...ossibilities for careers in engineering, medicine, law, or business. At ...hree types of programs leading to a B.S. or B.A. degree may be taken: ... degree program with a major in Engineering Mechanics, or a B.S. ... program with a major in Engineering Sciences (Mechanical), or a ...degree program with a major in Engineering Sciences (Mechanical). ...ective B.S. majors in both programs are advised to complete introduc-...hysics and mathematics through calculus (Mathematics 115a or b) by ...d of their first year.

...icular note should be made of the optional course, Mechanical Engi-...g 185b, which provides an opportunity for Freshmen to learn about ...echanical Engineering program through case studies and a term ... project. A student's undergraduate engineering program usually ...nates with one or more Special Project courses (Mechanical Engineer-...a, 472b) in which the student pursues a particular interest through ...-oriented projects and experimental investigations. Projects may be ...d by the student himself, may be performed in a team, or may be

1985-86

Ezra Stiles, and Trumbull. At the head of each college is a resident master. In each college a dean advises students on both academic and non-academic matters. Associated with the master and the dean as fellows are about fifty members of the faculty drawn from different departments and schools of the University, a few of whom reside in the college and others of whom have offices there.

Upon entrance, each Freshman is assigned to one of the twelve residential colleges. During their first year, all Freshmen are required to live on campus. Except for those Freshmen affiliated with Timothy Dwight or Silliman Colleges, Freshmen live in a quadrangle at the center of the University known as the Old Campus; those living on Old Campus may take a limited number of meals in their college, and they participate fully in its life. After Freshman year most students live on campus in their colleges, with about ten percent of upperclassmen choosing to live off campus. Whether they live on campus or off, undergraduates normally continue as members of the same college throughout their undergraduate careers.

THE UNDERGRADUATE CURRICULUM

One of the distinguishing features of a liberal education is that is has no single definition. Yale consequently does not prescribe any specific course to be taken by a student, but instead urges each undergraduate to design a program of study suited to his own particular needs and interests from the multitude of courses available to college students in a university.

It is also true of a liberal education that it is neither too narrowly focused nor too diffuse. As a matter of educational policy, Yale College has always stood behind the principle of distribution in studies as strongly as it has supported the principle of concentration. Thus Yale requires that each student choose in the later years of college an area of concentration in one of the major programs or departments, while also expecting that the student's course of study be characterized, particularly in the earlier years, by a reasonable diversity of subject matter and approach. The faculty of Yale College has therefore formally declared its support of the principles embodied in the Distributional Guidelines (see GUIDELINES FOR THE DISTRIBUTION OF STUDIES below). In addition, all undergraduates must fulfill the Distributional Requirements, which constitute the only specific rules limiting the selection of courses outside a student's major program.

DISTRIBUTIONAL REQUIREMENTS

Distributional Requirements for the Freshman Year and for the First Two Years. One of the chief objectives of these Distributional Requirements is to assure that in the first two years of their undergraduate education students elect courses from a variety of departments and in this way become exposed to different ideas and various ways of thinking. Many students come to Yale with advanced preparation in one or more fields. Early in their college careers, such qualified students ought to take advantage of any head start they may have in a subject to pursue it at a higher level than would otherwise be possible; a college course in a familiar subject at a more advanced level often discloses unfamiliar aspects of the subject. In addition, in disciplines like mathematics and languages, where the maintenance and improvement

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2. Distributional Requireme

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Distributional Requirements
Requirements for the Bachel
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GRADUATE CURRICULUM

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JTIONAL REQUIREMENTS

nts for the Freshman Year and for the First Two ectives of these Distributional Requirements is years of their undergraduate education students of departments and in this way become exposed is ways of thinking. Many students come to Yale r in one or more fields. Early in their college lents ought to take advantage of any head start o pursue it at a higher level than would otherwise se in a familiar subject at a more advanced level ispects of the subject. In addition, in disciplines ıages, where the maintenance and improvement

of skills greatly depend on continuity of application, students ought not lightly to consider interrupting the progress of their studies during their first years of college. During these years, nevertheless, they should also explore some subjects that they have never studied before. At the beginning of Sophomore year students are expected to make at least a tentative choice of the department or program in which they will major; science majors *must* do so. In choosing Freshman and Sophomore courses, therefore, students should give attention to the prerequisites for any major in which they anticipate having a particular interest. But they should not close their minds to other possibilities. They should use the first year to explore, and then not hesitate to change their plans during the second year. Students who have selected courses wisely will have the groundwork to enter most majors when the time comes to do so.

For these reasons, there are two sets of Distributional Requirements that students are expected to fulfill before the end of their Sophomore year: one for the Freshman year and one for the first two years.

1. Distributional Requirements for the Freshman Year.

   Freshmen may take no more than four course credits in a single department, and no more than six course credits in a single Distributional Group (except that a student taking a course in a foreign language may take as many as seven course credits in Group I, and a student taking a laboratory course may take as many as seven course credits in Group IV). They must take at least two course credits in Group I or II and two course credits in Group III or IV.

2. Distributional Requirement for the First Two Years.

   In meeting the Distributional Requirements for the Bachelor's Degree, the student must take at least two course credits in each of the four Distributional Groups by the end of the student's first four terms of enrollment.

Distributional Requirements for the Bachelor's Degree. The Distributional Requirements for the Bachelor's Degree are intended to assure that by graduation all students can confidently assert that they possess a competence in a foreign language at the intermediate level and that their work, including their studies in their major programs, has been grounded in a sound acquaintance with a variety of fields of inquiry and approaches to knowledge. Yale does not require prescribed courses in specific subjects, but instead encourages undergraduates to design programs that best reflect their own intellectual interests, that open the maximum range of intellectual opportunities through which those interests can be expanded, and that direct their studies always to that most elusive of goals, a liberal education. Thus the third Distributional Requirement relates to the student's entire academic career.

3. Distributional Requirements for the Bachelor's Degree.

   To qualify for the bachelor's degree, a student must earn at least twelve course credits drawn from outside the Distributional Group that includes the major. At least two course credits must be drawn from each one of the four Groups. A student must also demonstrate competence in a foreign language at the intermediate level, either by passing the appropriate

courses or by examination. No more than six course credits in a single Group may be employed to meet the Distributional Requirements for the Bachelor's Degree, except that a student who takes more than four course credits in order to attain the required level of competence in a foreign language may offer as many as eight course credits in Distributional Group I.*

For the purpose of distribution in Yale College, courses are classified into four Groups according to the following general scheme:†

Group I: language and literature, English and foreign, ancient or modern.

Group II: architecture; art; classical civilization; film; history; history of art; history of science, history of medicine; humanities; music; philosophy; religious studies.

Group III: anthropology; archeology; economics; linguistics; management sciences; organizational behavior; political science; psychology; sociology.

Group IV: astronomy; biology; chemistry; computer science; engineering; forestry and environmental studies; geology and geophysics; mathematics; molecular biophysics and biochemistry; physics; statistics.

Beginning with students entering in 1983, a student is required to demonstrate competence at the intermediate level in a foreign language either upon entrance or before graduation, preferably by the end of Junior year. This requirement may be met by presenting an appropriate Advanced Placement Test score, or by passing an examination at Yale, or by passing an intermediate-level course in a foreign language at Yale. The languages offered at Yale in which a student may attain the required competence are: Arabic, Chinese, Czech, French, German, classical Greek, Hausa, Hebrew, Italian, Japanese, Latin, Polish, Portuguese, Russian, Serbo-Croatian, Spanish, Swahili, and Yoruba. Information about appropriate Advanced Placement Test scores, relevant courses, and the nature of the examinations in these languages is contained in Chapter III in the introductory statements of the departments offering courses in foreign languages.

Students who possess competence in a language other than those listed here, either because it is their native language, or because they learned it abroad or by study at another university, or by some other means, should consult the appropriate Director of Undergraduate Studies or their Residential College Dean to arrange for an examination. Students who, for physiological reasons, are not able to complete the language requirement may petition the Committee on Honors and Academic Standing for a waiver of the requirement. The Committee may, in individual cases and on petition of the student's major program, partially or fully waive the requirement for sound and weighty academic reasons.

*Students who entered Yale College at any time before 1983–84 are not required, in order to qualify for graduation, to demonstrate competence in a foreign language at the intermediate level.

†Some courses may fall into another Distributional Group in addition to the one indicated in this classification. The Group number of a course is the Roman numeral in the data line of the course listed in CHAPTER III.

GUIDELINES FOR TH

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120a or b, 121b, 125, 129) offer frequ
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glish and foreign, ancient or modern.
civilization; film; history; history of
cine; humanities; music; philosophy;

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emistry; computer science; engineer-
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APTER III.

GUIDELINES FOR THE DISTRIBUTION OF STUDIES

Although educated men and women may never agree about everything that a liberal education should include, nearly all do agree on the propositions below, which are intended to serve the student as guides in his choice of studies. The specific courses by which the student achieves his educational goals must depend on individual interests and needs, but all students should select courses according to a reasoned plan that embodies each of the following Guidelines.

1. It is axiomatic that educated men and women should be able to express themselves effectively in their own language, both in speech and in writing. To suppose that anyone can think clearly even though he cannot write clearly is an illusion: words are the most basic tools of thought. A person who cannot use them skillfully will be handicapped not only in communicating ideas to someone else, but also in defining, developing, and understanding them himself. Students should therefore choose at least one course, and preferably several, in which they write papers that are evaluated closely for clarity of expression. The most obvious department in which to find such courses is English; its introductory courses (English 110a, 112a, 115, 116b, 120a or b, 121b, 125, 129) offer frequent opportunities for writing. In addition, many courses in various departments, in the sciences and social sciences as well as in the humanities, provide special attention to prose composition. Among these are courses which have been especially designed to emphasize writing; they are designated "Writing Intensive" (WI) in CHAPTER III.

A student should also do formal course work in English literature. Using language effectively depends to a large extent upon the scope and quality of one's reading. A person can fully grasp the possibilities of the English language, and experience the thought and feeling it opens up, only by a study of the uses made of it by its greatest masters. By joining the study of writing with the study of literature, a student will inevitably improve his own writing while deriving from his reading an increased pleasure made possible by his augmented skill. The study of literature leads to an expansion of one's experience and personal horizons, and is a continuing source of instruction and pleasure for the duration of one's life. Above all, reading widely and deeply enlarges the power of the imagination, which in one way or another underlies almost all intellectual endeavor.

2. Students should be able to understand, speak, read, and write a language other than their own, and should be acquainted with the literature of that language. Such abilities increase subtlety of mind and sharpen sensitivity to the use of one's own language. Students should know at least one foreign language well enough to speak it fluently, if it is a modern language, and to read it freely and with enjoyment. Such a skill, if preserved through use, will be an intellectual and personal asset throughout a person's entire lifetime. Professionally it can be equally important. Most careers today are potentially international in their range. Businessmen, lawyers, teachers, physicians, writers, and artists—anyone in any profession has superior advantages and opportunities if he knows at least one foreign language, and preferably several. It is for these reasons that Yale College augments this Guideline with the requirement that each student demonstrate competence in a foreign language at the intermediate level, preferably by the end of Junior year.

Using his skills in language, a student should also enter into the literature of a foreign language, because only through such study can a person

experience another culture fully enough to broaden his range of feeling and judgment. The question of which literature or literatures to study will depend on a student's preparation and future goals. Graduate schools, for example, commonly require a reading knowledge of at least two modern foreign languages (usually French, German, or Russian); for some fields of graduate work, a knowledge of Latin or Greek is required as well. But a student should also consult personal interests and tastes: a student who likes English Romantic poetry, for example, might study French or German Romantic poetry in the original; one who is interested in Spenser or Milton might want to read Virgil in Latin.

In starting a new language in college, students should plan to take at least two years of study or an intensive course covering that amount of material in one year, in order to acquire fluency in speech and writing. They may then proceed to a literature course in that language. Entering Freshmen who have already acquired a high degree of proficiency in one foreign language should seriously consider taking a literature course in that language during their Freshman year, because both skill and confidence in languages can easily wane with a year's disuse.

3. Just as the study of a foreign language and its literature helps to overcome geographical provincialism, so does the study of other times help to correct temporal provincialism. An educated person needs a historical perspective on his own times, and that can come only from studying other civilizations and cultures, either those from which his own culture has developed, or those different from his own. Certainly no student ought to leave college without having studied the history, art, music, philosophy, religion, or literature of the ancient world or the Middle Ages. Ideally, one ought to study the arts, artifacts, and ideas of both the modern and the ancient worlds, but if one must choose between the two, it would be wise to begin with the ancient. As for any student who may not have had a good general course in American history in secondary school, he should obviously take one in college.

4. Mathematics is the basic language of the natural and the social sciences, and has become a useful tool in many of the humanities. So pervasive are mathematical techniques that contemporary men and women may not consider themselves truly educated until they have an understanding of the fundamentals of mathematics. At a minimum students should have a proficiency in mathematics at the level of calculus. Students without this foundation should probably acquire it in Mathematics 111a–114b or 112a–115b before proceeding further. Those wishing to open opportunities for advanced study in a variety of fields other than mathematics may need to take appropriate advanced courses in mathematics. Since not every subject requires the same kind of mathematical knowledge, the most immediately useful course for a student's purpose may not be found in the Mathematics department itself but rather in one or more of the following departments or programs: Computer Science, Economics, Engineering and Applied Science, Molecular Biophysics and Biochemistry, Political Science, Psychology, Sociology, or Statistics. These departments offer courses in the mathematical or statistical methods used in their disciplines. Whatever course a student chooses in order to broaden his mathematical knowledge, however, skill in mathematics should be maintained, because, like language, it is likely to dissipate if it is not used.

5. Acquiring a detailed familiarity with several natural and applied sciences is a practical necessity for some students. For all students, however, being educated means developing a b
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What a student ultimately derives fro
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n his own. Certainly no student ought to
lied the history, art, music, philosophy,
nt world or the Middle Ages. Ideally, one
, and ideas of both the modern and the
hoose between the two, it would be wise
ny student who may not have had a good
in secondary school, he should obviously

uage of the natural and the social sciences,
many of the humanities. So pervasive are
ontemporary men and women may not
d until they have an understanding of the
a minimum students should have a profi-
l of calculus. Students without this foun-
it in Mathematics 111a–114b or 112a–115b
e wishing to open opportunities for ad-
other than mathematics may need to take
mathematics. Since not every subject re-
natical knowledge, the most immediately
ose may not be found in the Mathematics
e or more of the following departments or
Economics, Engineering and Applied Sci-
Biochemistry, Political Science, Psychology,
partments offer courses in the mathemati-
their disciplines. Whatever course a student
mathematical knowledge, however, skill in
ned, because, like language, it is likely to

arity with several natural and applied sci-
some students. For all students, however,

being educated means developing a broad view of what science is, what it has achieved, and what it might continue to achieve. One can be aware that in the last three hundred years science has come to be synonymous with rational inquiry and knowledge without realizing what a scientist means by "knowing" or how some scientific facts are more prone to change than others. Only by studying a science can one develop the critical faculties that educated citizens need: an ability to evaluate the opinions of "experts," to distinguish quackery from responsible science, and to realize which things are known and which unknown, which are knowable and which unknowable, to science. Studying a science reveals new patterns of thought. One can learn to appreciate both the close analysis and deductive reasoning of theoreticians and the careful observations and manipulative skill of experimentalists. Only by studying a science can one share the excitement, delight, puzzlement, and beauty that scientists find in their work. To know science is to appreciate a thousand intricate coherences in nature, which are hidden from casual observation but which, once known, lend richness to everyday life.

Students with little previous preparation will find introductory science courses without prerequisites in all of the science departments and among the Residential College Seminars. Introductory courses on other levels are available for students with more background and for prospective science majors. It is impossible to overemphasize the advantages of beginning the study of science early in college, especially for those students with any inclination toward scientific careers.

6. Finally, to understand the duties and problems facing everyone as a human being among other human beings, students should become familiar with at least one of the social sciences. Like the natural sciences, the social sciences often rely heavily on mathematics, but their emphasis is on people rather than on things. At a time when the population of the world and its problems are increasing, the future of mankind's achievements may depend significantly on the insights achieved through the social sciences. An educated person should have some understanding of what men have learned and are learning about living together. Modern Americans especially ought to have a knowledge of the cultures of Eastern Europe, Asia, Africa, Latin America, as well as of those of Western Europe and their own country. The Yale curriculum contains a wide variety of courses on these areas, dealing with social systems, governments, economies, histories, and cultures.

What a student ultimately derives from four years of study at Yale obviously depends in large measure upon his careful planning of a program of study. In fulfilling these Guidelines, as in pursuing their other educational goals, students should seek broadly for informed advice, from their faculty advisers and Residential College Deans, and from Directors of Undergraduate Studies or other faculty members in the various departments and programs. No adviser will prescribe a particular set of courses, and the responsibility of shaping a program is the student's, but each student should make use of all the advice available in order to plan the most effective program. It would be impossible, and surely imprudent, for a student to attempt to map out at the beginning of his studies a firm schedule of courses for the next eight terms. Yet it is important for the student to think ahead, and always to plan with these principles in mind.

Although these Guidelines are not actual requirements (except that a student must display proficiency in a foreign language), Yale College expects that a student's program will reflect these principles. Every student's pro-

gram must be approved by his dean and adviser, and every reasonable program will be approved. A student whose program departs markedly from the Guidelines will be obliged to persuade the Residential College Dean and faculty program adviser that it will still achieve for the student in its own way the goals of a liberal education.

MAJOR PROGRAMS

Students seeking the B.S. or the B.A. degree with a major in science are expected to elect their majors at the beginning of Sophomore year, although a major in science may still be elected later if the student has completed the courses required to enter it. Sophomores interested in majoring in science should have their schedules approved by the Director of Undergraduate Studies or adviser designated by the department in which they wish to major. Students seeking the B.A. degree with a major in a field other than a science are expected to elect their major at the beginning of Junior year. The schedules for Sophomore year of these students must be signed by a Sophomore adviser, chosen by the student, with whom the program has been discussed.

All candidates for a bachelor's degree in Yale College must elect one of the major programs listed on page 28. The requirements for a major are described in general terms in the sections below, and in more detail at the beginning of the course descriptions of each department or program in CHAPTER III. In every case students plan their schedule of courses in their major subjects or fields in consultation with a representative of the department or program concerned, and must secure the consultant's written approval. Students should acquaint themselves fully with all the requirements of the major they plan to enter, considering not only the immediate choice of courses but also the plan of their entire work in the last two or three years in college.

SELECTION OF A MAJOR

In designing a program of study, the student ought to plan for depth of concentration as well as breadth of scope. To study a subject in depth can be one of the most rewarding and liberating experiences a person can secure and can form the basis of the interests and occupations of a lifetime. Although no one should specialize to the neglect of distribution, knowledge advances by specialization, and one can gain some of the excitement of discovery by pressing toward the outer limits of human knowledge in a particular field. Intense study of a seemingly narrow area of investigation will often disclose ramifications and connections that alter perspectives on every other subject. Such study also sharpens a person's judgment and acquaints him with processes by which new truths can be found.

In order to expose themselves to this kind of experience, students must choose a field of study that will be their major field, that is, the subject in which they will work more intensively than they do in any other. A list of possible majors in Yale College from which such a choice is to be made is given below on page 28. Specific requirements for each major are established by the department or program concerned and are explained in CHAPTER III.

Some students will have made a tentative choice of a major before entering college. Others will have settled on a general area—for example,

the natural sciences or the humanities
ular department or program they in
completely undecided. Past experienc
their minds made up often change th
who feel certain of their choices sh
change. In selecting courses during th
in mind not only the application of th
the need for a preliminary exploration
drawn, in order to become aware of t

As in the case of the Guidelines, the
in designing a program, but once ag
in selecting courses.

1. In most of the humanities and soc
from elementary to advanced courses.
example, English, psychology, or hist
because there are few prerequisites, a
the Freshman or Sophomore year, o
work done in secondary school.

2. In some other fields of study, s
subjects as foreign languages and liter
taken in chronological order from the
to major in one of these fields, the stu
Freshman year. If the initial courses a
be too late to begin a major in these
Freshman courses are prerequisites fo

3. In order, therefore, to attain t
options for the upperclass years, each
his probable choices of a major befo
has even a remote interest in majoring
in the work of the Freshman year a co
courses in the natural sciences, one of

4. No matter what major a studen
language required in the Distributio
Degree is bound to be useful in his st
ably use a foreign language would be
or Sophomore year courses that will
intends postgraduate study should kn
Ph.D. degree usually include a reading
commonly French, German, or Russi

5. Many of the courses open to Fres
in secondary school. Students will pr
Freshman courses in areas in which t
iarity and interest, but for the sake of
being unduly limited in their range of
some courses in fields that are wholly

THE MAJOR

The major consists of a number c
program usually includes twelve ter
Junior and Senior years. Majors are c
partmental or interdisciplinary progr
grams, a limited number of courses