YALE COLLEGE PROGRAMS
OF STUDY
FALL AND SPRING TERMS
1964–1965
(no winter term
suggests semesters)

Yale College
Yale University
1 April 1964
Number 7
### Yale College Programs of Study 1964-65

#### INTENSIVE DEPARTMENTAL MAJOR†

<table>
<thead>
<tr>
<th>Freshman year</th>
<th>Sophomore year</th>
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<th>Senior year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engl. 15*</td>
<td>C.C., Philos., or Rel.* Major</td>
<td>Major</td>
<td>Major</td>
</tr>
<tr>
<td>Foreign Lang.*</td>
<td>Major Seminar</td>
<td>Elective</td>
<td>Major Essay</td>
</tr>
<tr>
<td>Hist., Hist. of Art or Music, Hist. of Sci. and Med.*</td>
<td>Natural Sci., Math. 20a, b, or Foreign Lit.*</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Social Sci.*</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Natural Sci.*</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
</tbody>
</table>

*Distributional Requirements, pp. 5-6. For Distributional Credits see pp. 6-8. In history and in certain Divisional and Special Majors, five courses each in Junior and Senior year are required.

Although Mathematics 10a and 15a are not included in the Distributional Requirements, the opportunity for such a course is called to the attention of the attention of the B.A. candidate.

For information about ROTC, see pp. 225-230.

#### CHARTS FOR SCIENTIFIC AND ENGINEERING PROGRAMS

The charts on the following pages present graphically the normal four-year program in each of the scientific fields. The student is cautioned to read these charts with the stated requirements of distribution (see pp. 5-6) clearly in mind.

### BIOCHEMISTRY

<table>
<thead>
<tr>
<th>Freshman year</th>
<th>Sophomore year</th>
<th>Junior year</th>
<th>Senior year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 12 or 14†</td>
<td>Chem. 29 and 20L</td>
<td>Chem. 34 and 34L</td>
<td>Biochem. 101a</td>
</tr>
<tr>
<td>Biol. 11†</td>
<td>Math. 20a and 25b</td>
<td>Biol. 31a</td>
<td>Biochem. 102a</td>
</tr>
<tr>
<td>or 14††</td>
<td>Phys. 22</td>
<td>Biol. 51a</td>
<td>Biochem. 104b</td>
</tr>
<tr>
<td>Engl. 15†</td>
<td>Social Sci.††</td>
<td>C.C., Philos., or Rel.*</td>
<td>Elective or Honors</td>
</tr>
<tr>
<td>Foreign Lang.‖†</td>
<td>Hist. of Art or Music, Hist. of Sci. and Med.‖†</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td></td>
<td>Elective</td>
<td>Elective (1 term)</td>
<td>Elective</td>
</tr>
</tbody>
</table>

*Distributional Requirements, pp. 5-6. For Distributional Credits see pp. 6-8. Distributional Credits may be anticipated by excellent work in secondary school. See pp. 6-8. In some cases, foreign language may require an additional two terms of study.

†If Biology 20 was taken in the Freshman year, an elective may be taken here.

‡One or two term courses in other fields may be taken in place of biology upon approval of the Director of Undergraduate Studies.

### BIOLOGY

<table>
<thead>
<tr>
<th>Freshman year</th>
<th>Sophomore year</th>
<th>Junior year</th>
<th>Senior year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biol. 11††</td>
<td>Biol. 20†</td>
<td>Biol. 30</td>
<td>Biol.</td>
</tr>
<tr>
<td>(Biol. 20)</td>
<td></td>
<td>Biol. 31a</td>
<td>Biol. 3†</td>
</tr>
<tr>
<td>Chem. 12†</td>
<td>Hist. Hist. of Art or Music, Hist. of Sci. and Med.††</td>
<td>C.C., Philos., or Rel.*</td>
<td>Elective</td>
</tr>
<tr>
<td>Math. 10††</td>
<td>Elective</td>
<td>Elective (1 term)</td>
<td>Elective</td>
</tr>
<tr>
<td>and 15b†</td>
<td>Elective</td>
<td>Elective (1 term)</td>
<td>Elective</td>
</tr>
<tr>
<td>Engl. 15††</td>
<td>Social Sci.††</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Foreign Lang.‖†</td>
<td>Chem. 33 and 33L</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>or 12 or 22†</td>
<td>Physics 12</td>
<td>Elective</td>
<td>Elective</td>
</tr>
</tbody>
</table>

*Distributional Requirements, pp. 5-6. For Distributional Credits see pp. 6-8. Distributional Credits may be anticipated by excellent work in secondary school. See pp. 6-8. In some cases, foreign language may require an additional two terms of study.

†If Biology 20 was taken in the Freshman year, an elective may be taken here.

‡One or two term courses in other fields may be taken in place of biology upon approval of the Director of Undergraduate Studies.
### CHEMISTRY

<table>
<thead>
<tr>
<th>Freshman year</th>
<th>Sophomore year</th>
<th>Junior year</th>
<th>Senior year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 12 or 14†</td>
<td>Chem. 29 and 29L</td>
<td>Chem. 34 and 34L</td>
<td>Major</td>
</tr>
<tr>
<td>Math. 10a† and 15b†</td>
<td>Math.</td>
<td>Major</td>
<td>Major</td>
</tr>
<tr>
<td>Phys. 14a and 15b†</td>
<td>Phys. 255† (or Phys. 22)</td>
<td>C.C., Philos., or Rel.*</td>
<td>Elective</td>
</tr>
<tr>
<td>Foreign Lang.††</td>
<td>Hist., Hist. of Art or Music; Hist. of Sci. and Med.††</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Engl. 15†† or Literature</td>
<td>Social Sci.††</td>
<td>Elective</td>
<td>Elective</td>
</tr>
</tbody>
</table>

### ENGINEERING AND APPLIED SCIENCE

<table>
<thead>
<tr>
<th>Freshman year</th>
<th>Sophomore year</th>
<th>Junior year</th>
<th>Senior year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 11, 12, or 14†</td>
<td>E.&amp;A.S. 20</td>
<td>Major</td>
<td>Major</td>
</tr>
<tr>
<td>Math. 15a† and 20b</td>
<td>Phys. 24</td>
<td>Major</td>
<td>Major</td>
</tr>
<tr>
<td>Elective &quot;a&quot;†† and Phys. 15b</td>
<td>Social Sci.††</td>
<td>Major</td>
<td>Major</td>
</tr>
<tr>
<td>Engl. 15††</td>
<td>Hist., Hist. of Art or Music, Hist. of Sci. and Med.††</td>
<td>C.C., Philos., or Rel.*</td>
<td>Elective</td>
</tr>
<tr>
<td>Foreign Lang.††</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
</tbody>
</table>

*Distributional Requirements, pp. 5-6. For Distributional Credits see pp. 6-8.
†May be anticipated by excellent work in secondary school. See pp. 6-8.
‡In some cases, foreign language may require an additional two terms of study.
§The two-year sequence of Physics 14a, 15b and 25 is preferred, but Physics 22 will be accepted. For those electing Physics 22 a suitable curriculum will be arranged.
††May be taken in Freshman year if Mathematics 20a is taken concurrently.
*For the B.S. degree, two advanced term courses in science or mathematics are required.
**Students specializing in civil engineering are required to take the three-week summer course, C.E. 256, Surveying and Field Engineering, during the month of June following their Freshman year.
†††Students not adequately prepared must take Math. 10a, 15b, and 20a.
†‡E.&A.S. 10a is appropriate for this elective.
§†Students specializing in chemical engineering are required to take the four-week summer laboratory course, Ch.E. 403, during the month of June following the Junior year.

### GEOF CLUB

<table>
<thead>
<tr>
<th>Freshman year</th>
<th>Sophomore year</th>
<th>Junior year</th>
<th>Senior year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Ila or IIG or Geol. 20a</td>
<td>Geol. 23a and 24b</td>
<td>Geol. 38a, 39b</td>
<td>Geol. 40</td>
</tr>
<tr>
<td>Chem. 12†</td>
<td>Phys. 12† or 22</td>
<td>Phys. Chem., or Adv. Zool.</td>
<td>Geol. 35a and Geol. &quot;b&quot; elective</td>
</tr>
<tr>
<td>Math. 10a† and 15b†</td>
<td>Adv. Math. or Elem. Biol.</td>
<td>C.C., Philos., or Rel.*</td>
<td>Elective</td>
</tr>
<tr>
<td>Social Sci.††</td>
<td>Hist., Hist. of Art or Music, Hist. of Sci. and Med.††</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Engl. 15††</td>
<td>Foreign Lang.††</td>
<td>Elective</td>
<td>Elective</td>
</tr>
</tbody>
</table>

### INDUSTRIAL ADMINISTRATION

<table>
<thead>
<tr>
<th>Freshman year</th>
<th>Sophomore year</th>
<th>Junior year</th>
<th>Senior year</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 15††</td>
<td>I.A. 20a and 35b</td>
<td>I.A. 32a and 33b</td>
<td>Major</td>
</tr>
<tr>
<td>Math. 10a† and 15b†</td>
<td>Psych. 10a and 10b</td>
<td>Econ. 23a, 24b and 24Lb</td>
<td>Major</td>
</tr>
<tr>
<td>Foreign Lang.††</td>
<td>Econ. 10*</td>
<td>C.C., Philos., or Rel.*</td>
<td>Elective</td>
</tr>
<tr>
<td>Natural Sci.††</td>
<td>Natural Sci., Hist., Hist. of Art or Music, Hist. of Sci. and Med.††</td>
<td>Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
<td>Elective</td>
</tr>
</tbody>
</table>

*Distributional Requirements, pp. 5-6. For Distributional Credits see pp. 6-8.
†May be anticipated by excellent work in secondary school. See pp. 6-8.
‡In some cases, foreign language may require an additional two terms of study.
§Unless excused by special permission, students are expected to take a summer full course in geology, such a course counting as a half-year advanced elective course in geology required for the major.
†§Students specializing in chemical engineering are required to take the four-week summer laboratory course, Ch.E. 403, during the month of June following the Junior year.

5 year courses per year (or 10 term courses) seems to be standard load.
### Mathematics

**Freshman Year**
- Math. 10†, 10a†, and 15b†, 15af and 20b, or 27
- Natural Sci.††
- Eng. 15††
- Foreign Lang.††
- Social Sci.††

**Sophomore Year**
- Math. 20a† and 22b†, or 37
- Hist., Hist. of Art or Music, Hist. of Sci. and Med.††
- Elective
- Elective

**Junior Year**
- Math.
- Math.
- Science
- C.C., Philos., or Rel.†
- Elective
- Elective

**Senior Year**
- Math.
- Math.
- Math. (or Science)
- Elective
- Elective

### Physics

**Freshman Year**
- Phys. 14at and 15b†
- Math. 10a† and 15b†
- Chem. 11† or 12†
- Eng. 15††
- Foreign Lang.††

**Sophomore Year**
- Math. 20a and 25b
- Math. 20a and 25b
- Hist., Hist. of Art or Music, Hist. of Sci. and Med.††
- Elective
- Elective

**Junior Year**
- Phys. 31a† and 31b
- Elective
- Elective

**Senior Year**
- Phys. 32at and 32bt or 44†
- At least 1 course each term selected from 36a, 37b, 41a, 41b, 42b, 47b, 50
- Social Science††
- Elective
- Elective

### Molecular Biology and Biophysics

**Freshman Year**
- Math. 20a and 25b
- Phys. 22 or 25||
- Biol. 11†
- Hist., Hist. of Art or Music, Hist. of Sci. and Med.††

**Sophomore Year**
- Physics 33a
- 2 courses the first term and 3 courses the second term chosen from Biology, Chemistry, or Physics
- C.C., Philos., or Rel.†

**Junior Year**
- Molecular Biol. and Biophys. 45 and 45L
- 2 courses each term chosen from Biology, Chemistry, or Physics

**Senior Year**
- Elective

*Distributional Requirements, pp. 5–6. For Distributional Credits see pp. 6–8.
†May be anticipated by excellent work in secondary school. See pp. 6–8.
§Minimal requirements.
||Physics 15 may be elected if extra preparation is required.
††May be taken in Freshman year if Mathematics 20a is taken concurrently.
countries that are commonly grouped under the term "Latin America," and an understanding of what they have and what they do not have in common. The Latin American Studies major is built upon a stem of language and literature, with depth and perspective provided by study of history and the social sciences.

PREREQUISITES FOR THE MAJOR

Students entering the major must have completed satisfactory two years of college Spanish, or the equivalent. Courses in the summer program of the Language Institute may, in some cases, assist students in meeting this requirement.

Students interested in the major are strongly urged to take Economics 10 and History 10 in their Freshman or Sophomore year.

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Students interested in the major are strongly urged to take Economics 10 and History 10 in their Freshman or Sophomore year.
Major in mathematics will be expected to include at least two terms of graduate course work in their programs. Eligibility for admission to such courses will be determined by consideration of previous work in advanced courses, in particular in Mathematics 31a and 32b, or an equivalent course. Mathematics 37.

The master's degree program. Students who complete, by the end of their Senior year, the requirements of the department for the M.A. in mathematics will be eligible to receive this degree at their Senior commencement. Required are: (1) eight term courses numbered 100 or higher, some of which must be completed with grades of 85 (High Pass) or better; (2) a reading knowledge of mathematical literature in a foreign language of importance for mathematical research (normally French, German, or Russian); (3) satisfactory performance on a general oral examination.

The master's program is in no sense a substitute for the B.A. or B.S. program; rather, it is designed to accommodate a very few exceptional students who, by means of accelerated or independent study, can satisfy the department as to their command of the content of the normal undergraduate program. Candidates must submit to the Director of Undergraduate Studies, at the time of registration for the Junior year, a proposal which foresees this level of achievement by the end of Junior year. Their status and progress will be reviewed before they are permitted to continue in the program in Senior year.

At least two terms of graduate work are to be taken in the Junior year (normally Mathematics 100 and/or Mathematics 122a and 122b will be the first graduate courses taken). The general oral examination will be given before classes begin in the fall. The same criteria will be used to determine eligibility for Distributional Credit. One or two divisions of Mathematics 100 and 15b will be designated as special divisions, to be made up of students with strong interests and abilities. Entering freshmen wishing to be placed in such divisions should indicate their preference when planning their schedules.

Students planning to take courses in mathematics and who have had no previous training in trigonometry, and those who have had less than three years of mathematics in secondary school, are urged to apply for the Basic Mathematics Review Course (p. 258); this course should then be taken concurrently with Mathematics 100.

Note: Credit may not be claimed for both of: Mathematics 22 and 24; 22 and 25; 22 and 29; 22 and 56; 22 and 37; 30 and 24; 30 and 25; 30 and 37, nor for Mathematics 27 and any of Mathematics 10, 15, 26, except by permission of the Director of Undergraduate Studies.

Mathematics 10a, Introductory Analytic Geometry and Calculus, Consult Mr. Hsien Hsiang, 122A LOM.

Students majoring in mathematics may, with the permission of the department, write a Senior essay. They must submit with their request a statement in writing from the member of the department who is to supervise the work.

Qualified Freshmen and Sophomores may, with the permission of the instructor, take any of the following courses numbered 36 or above. In their choice of courses for the Sophomore year, Freshmen with outstanding records in Mathematics 10a, 15b; Mathematics 15-20b; Mathematics 1; or Mathematics 27, are urged to consider the intensive course, Mathematics 37, which covers the material of Mathematics 22, Mathematics 30, and part of that of Mathematics 31a.

Freshmen taking calculus will normally be placed in Mathematics 10a, 15a, or 20a according to their backgrounds and their performance on the Advanced Placement Test and a departmental placement test to be given before classes begin in the fall. The same criteria will be used to determine eligibility for Distributional Credit.

One or two divisions of Mathematics 100 and 15b will be designated as special divisions, to be made up of students with strong interests and abilities. Entering freshmen wishing to be placed in such divisions should indicate their preference when planning their schedules.

Students planning to take courses in mathematics and who have had no previous training in trigonometry, and those who have had less than three years of mathematics in secondary school, are urged to apply for the Basic Mathematics Review Course (p. 258); this course should then be taken concurrently with Mathematics 100.

Note: Credit may not be claimed for both of: Mathematics 22 and 24; 22 and 25; 22 and 29; 22 and 56; 22 and 37; 30 and 24; 30 and 25; 30 and 37, nor for Mathematics 27 and any of Mathematics 10, 15, 26, except by permission of the Director of Undergraduate Studies.

Mathematics 10a, Introductory Analytic Geometry and Calculus, Consult Mr. Hsien Hsiang, 122A LOM.

2. T, Th, 8.
4. T, Th, 9.10.
5. M, W, F, 10.10.
6. T, Th, 10.10.
8. T, Th, 11.10.

An introduction to plane analytic geometry and the fundamental ideas of differential and integral calculus. Functions and their limits; techniques, theory, and some applications of differentiation.

Mathematics 10b, Introductory Analytic Geometry and Calculus, Consult Mr. Szechara, 122A LOM.

2. T, Th, 9.10.
3. T, Th, 9.10.
4. T, Th, 9.10.

A course intended for Freshmen with preparation in calculus and analytic geometry. The trigonometric, exponential, and logarithmic functions; theory, techniques, and some applications of (Riemann) integrals. Proofs of basic properties of continuous and differentiable functions.
Mathematics 15b, Analytic Geometry and Calculus. Consult Mr. Hsiang.


The content of this course is identical with that of Mathematics 13b or the equivalent.


4. T, Th, S, 8.

Vector geometry in space, infinite series, and calculus of functions of two and three variables. After Mathematics 15 or the equivalent.

Mathematics 20b, Intermediate Analytic Geometry and Calculus. Consult Mr. Szczarba.

2. M, W, F, 10.10. 4. T, Th, S, 10.10.

The content and prerequisites of this course are identical with those of Mathematics 20a.

Mathematics 22a, Linear Algebra and Analytic Geometry. Consult Mr. Mostow.


Vectors and analytic geometry in the plane and space; extensions of the basic notions to real and complex n-space and to abstract vector spaces. Linear equations and determinants, with geometrical interpretations. Algebra of matrices and linear transformations, especially orthogonal and symmetric transformations; quadratic forms and characteristic roots and vectors.

Mathematics 22b, Linear Algebra and Analytic Geometry. Consult Mr. Seligman.

1. M, W, F, 10.10. 3. T, Th, S, 10.10.
2. T, Th, S, 9.10.

The content of this course is identical with that of Mathematics 22a.

[Mathematics 25a or b, Functions of Several Variables. Omitted 1964-65.]


Mathematics 30b, Advanced Calculus. Consult Mr. Mostow.


Calculus of vector-valued functions of variable vectors. After Mathematics 20 and 22, or the equivalent.

Mathematics 31a, Introduction to Analysis. Consult Mr. Hahn.

M, W, F, 10.10.

An introduction to the theory of functions of real variables, including set theory and point set topology. After Mathematics 20 and 22 or 25, or by permission.

Mathematics 32b, Real Analysis. Consult Mr. Hahn.

M, W, F, 10.10.

Topics from the theory of functions of real variables, with emphasis on theory of integration. After Mathematics 31a or 37, or by permission.


See Mathematics 122a.]

Mathematics 37, Intensive Mathematics II. Consult Mr. Mostow.

Rec., One hour to be arranged.

Linear algebra and analytic geometry of spaces of dimensions three and higher. Topics from advanced calculus, especially in functions of several variables, with an emphasis on challenging problems. After Mathematics 27, or by permission.

Mathematics 41a (Statistics 41a), Introduction to Statistics. Consult Mr. Anscombe.

M, W, F, 9.10.

Basic concepts and methods of statistics; frequency and probability distributions, normal curve, moments, sampling theory, testing goodness of fit, and other. The laboratory in statistics (Mathematics 42b) must be taken concurrently. Open to Juniors and Seniors after Mathematics 15 or the equivalent; open to others by permission.

Mathematics 42b (Statistics 42b), Mathematical Statistics. Consult Mr. Anscombe.

M, W, F, 9.10.

Mathematical theory underlying the topics of Mathematics 41a, as well as correlation, estimation, testing of hypotheses. Mathematics 45 must be taken concurrently or have been taken previously. After Mathematics 41a, or 22 or 25, or by permission.


Mathematics 45 (Statistics 45), Laboratory in Statistics. Consult Mr. Anscombe.

2. W, 1:45-3:35.

The principles of statistics are illustrated by numerical analysis of data, carried out by the students on electric desk calculators. Mathematics 25a must be taken concurrently with the first term of Mathematics 45.
Mathematics 46a, Elements of the Theory of Differential Equations. Consult Mr. Berg.

2. T, Th, S, 9.10.

A study of ordinary differential equations, concerned with formal methods of solution, series solutions, approximate solutions, existence and uniqueness theorems, and systems of linear differential equations. After Mathematics 22 and 23, or the equivalent, except that Mathematics 22a may be taken concurrently.


T, Th, S, 11.10.
The content and prerequisites are identical with those of Mathematics 46a.

Mathematics 48b, Topics in Advanced Calculus. Consult Mr. Berg. (10)

2. T, Th, S, 9.10.

Special functions, Fourier series, and boundary value problems, introductions to the calculus of variations and to integral equations. After Mathematics 20 and 22 or 25, or the equivalent; preferably after Mathematics 46.

Mathematics 52a, Theory of Numbers. Consult Mr. Ore.

M, W, F, 10.10.

An introductory course in the theory of numbers. After Mathematics 20 or the equivalent.

Mathematics 54b, Probability. Mr. Ore.

M, W, F, 10.10.
The basic laws of probability, with various applications; the law of large numbers, normal and other laws of probability. After Mathematics 20 or the equivalent.


Mathematics 58a, An Introduction to Modern Algebra. Consult Mr. Taniwaga.

M, W, F, 1.45.

Abstract groups and permutation groups. Abstract fields and polynomials. Splitting fields and Galois groups for polynomials, with applications to solvability of equations by radicals and the classical construction problems. Separation and approximation of roots of polynomials with real and complex coefficients. After Mathematics 20 and 22 or 25, or the equivalent.


Mathematics 62b, Advanced Analytic Geometry. Consult Mr. Veldkamp.

M, W, F, 1.45.

Analytic models for affine and projective geometries; their geometrical properties and geometrical transformations. After Mathematics 58a, or the equivalent.

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MECHANICAL ENGINEERING

(See under Engineering and Applied Science.)

METALLURGY AND SOLID STATE SCIENCE

(See under Engineering and Applied Science.)

MILITARY SCIENCE

(See under Reserve Officers Training Corps.)