SAULT COLLEGE
of Applied Arts and Technology
Sault Ste. Marie

COURSE OUTLINE

MATHEMATICS

MTH 551-4
MTH 554-4

r'""'\;ic;''^.H June 1981 by J. Real

MATHEMATICS

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TEXTS:

Washington; "Technical Calculus with Analytic Geometry"
(Addison Wesley)

Blakely: "Calculus for Engineering Technology"
(Wiley)

Person: "Calculus with Analytic Geometry"
(Holt, Rinehart, Winston)
(for Aviation Technology only)

REFERENCES:

Rice & Knight: "Technical Mathematics with Calculus"
(McGraw-Hill)

Klaf: "Calculus Refresher for Technical Men"
(Dover Publications)

Middlemiss: "Calculus",
(McGraw-Hill)

Peterson: "Calculus,
(McGraw-Hill)

Goodman: "Analytic Geometry & Calculus"
. (Harper & Row)

Washington: "Basic Technical Mathematics with Calculus"
(Addison Wesley)

Ayres: "Calculus",
(Schaum Publishing Co-)

Turner: "Examples in Practical Mathematics for Technical Students
(Prentice-Hall)

Adler; "Thinking Machines"
(Signet)

Richmond: "Calculus for Electronics"
(McGraw-Hill)

Malvino & Leach: "Digital Principles and Applications"
(McGraw-Hill)

Aircraft Flight Manuals for:
a}Cessna 150M, 172M, ISO, 182
b)Piper - PA-39 (Twin Comanche)
c}DeHaviland - Otter

MATHEMATICS

MTH 551-4 - Electrical & Electronic Technology, 3rd semester
MTH 554-4 - Mechanical Technology^ Aviation Technology

1. Tlt'lE OBJECTIVES:

(a) The student is expected to complete each non-optional topic in this course in the time period indicated, during the semester (normally 14-1.6 weeks) ^ plus a specified make-up period of approx. 2 weeks, prior to the beginning of the next semester in which the student v^ishes to take the requisite mathematics course of his particular technology program.

(b) The student will be given instruction on each topic in the classroom or its equivalent as per the number of scheduled class periods specified by column two of the last tv7o pages of this course outline. Normally, a topic test v;ill be administered .after such time. Variations in the • number of periods utilised for a topic is at the discretion of the instructor and should not exceed 2 periods, at most, in any given topic. Such variations should be as few and as small as possible.

Notes

1. Students beginning this course should have completed satisfactorily the algebra, trigonometry and analytic geometry which constitutes what is frequently called pre-calculus mathematics.. The course assumes a good knowledge of various curves and their characteristics skill in algebraic manipulation; the definition of tangent to any curve as the limiting position of a secant through PI and P2 as P2-^P1.

2. Sufficient time is allowed for a good treatment of differentiation using the delta method. Formulas should be introduced only after thorough understanding through practice in the process of differentiation with much reference to its limiting aspect.

3. Formulas should be proved (some as exercises by the'students) and then through use become part of each student's mathematical make-up. Formulas for differentiation (24} -and for integration (18) of common types should be memorized,

4. Instructors should look upon this course as an opportunity to build a solid foundation through understanding and skill development for more advanced courses in the calculus. Practical applications from major subject fields should be used whenever possible.

5. The topics number systems and Boolean Algebra have applications in digital computers (electronics) and computer programming. They should be presented at the beginning of the sem.ester.

6. For the Electrical/Electronics students, use should be made of the student's book "Digital Principles and Applications" for the number systems and Boolean Algebra topic exercises, etc.

7. For the Aviation Technology students special emphasis is to be given to more complex interpolation techniques in tabulated data, and to the use of layout of graphical performance charts. Emphasize the mathematics of these areas and limit the aviation centered uses to a few practical problems.

8. The instructor should take note that there is insufficient time in this semester to cover all the topics indicated for the Electrical/ Electronic and Aviation classes. Therefore:

   a) Mechanicals, taking MTH 554, should cover the whole,course
   b) Electrical/Electronic, taking MTH 551-4, should cover.all indicated topics to the end of topic II.
   c) Aviation, taking MTH 554, should cover all indicated.topics to the middle of topic 10.

   Topics not covered should be included at the beginning cf the next semester course. (MTH 577-4, MTH 578-4)

TOPICAL OBJECTIVES:

MTH 551-4 Number Systems: (to be accomplished in approx. 2 periods)

The student is to be introduced to and become familiar with the binary, octal and binary coded decimal number systems and their relationship to our norm,al base ten system. The student is to be able to change -a nuKiber .pf one system, into its equivalent in any other system.

The student will be able to carry out the mathematical operations of adding, subtracting, multiplying and dividing in the binary system.

The student is to be able to understand and use addition and multiplication tables in the .binary system.

MTH 554-4

Empirica^l Equations (Aviation only)

The student will fee expected to .take experimental data involving two variables, organize it and m.ake a graph of it and use various techniques to arrive at an empirical equation for the resulting curve. These curves may,yield :a linear equation, parabolic, polynomial relation or a povjer function^

MTH 551-4

Boolean .Algebra: (to be accomplished in approx. 8 periods)

The student will be able to:

a) define 2 elements and 2 operators
b) understand'and use truth tables
c) derive simple identities
d) use negation - the not operator
e) apply the above to elementary logic and switching circuits

a) The student will be expected to understand the mechanics of basic interpolation and recognize the trend of the parameters in a given table., i.e, (as one parameter increases, the other parameter may increase or decrease thus affecting the interpolation procedure).

b) Use of^th^:aviation CR-3 or (4) computer to evaluate interpolation proportions;is to be included as a interpolation aid.

c) The student will then be required to enter a more complex table, organize;a multi-interpolation problem, where altitude, temperature, and power settings required are not directly listed, and determine such parameters as; R.P.M. and/or manifold pressure settings, expecte airspeed, fuel consximption rate and aircraft range.

d) various- practical problems on any facet of flight planning are then to be assigned.

(e) the student will be expected tO' apply the above" knowledge and procedures to solving practical hypothetical problems from charts "that he has not been previously exposed to".

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Graphical Performance Charts (Aviation only)

The student will be expected to:

(a) read various aviation performance graphs, paying attention to multiple line/axis situations and interpolate between lines when necessary.

(b) read into take off and landing charts from various directions to determine missing parameters/^"interpolating when'-necessary.

(c) apply procedures and knowledge learned in the above to solve practical flight planning problems using graphs that he has not previously been exposed to>

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Graph Preparation (Aviation only)

(a) the student will be given several graph assignrnents, of increasing complexity. He will be given a tabular performance chart and required to translate the total data into a graphical presentation-

(b) The student will be expected to plot winds aloft reports on a CR-3 type computer and interpolate for any desired -result.

(c) The student will be expected to learn several ways to plot; label and arrange numerical data into a graph and"to determine which arrangement to employ when several options eould be considered

(d) The student will be expected to read direct and ..interpolate results from his/her own various graphs. ."

Introduction to Differential Calculus:

(all groups)'

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The student is expected to learn the meaning of a functibn^^J.^functional^ notation, the limit of a function, the delta process' of differentiation and its application to various common functions.-

Differentiation by Rule: (all groups)

The student^will be required to derive'and use differentiation formulae such as :

(a) the Power Rule (power of a variable)
(b) the Chain Rule (power of a polynomial in one variable)
(c) the Product Rule
(d) the Quotient Rule

The student will be required to find'^ derivatives of:

(a) a function by inversion
(b) an implicit function

Practical'Appricatíons of Differentiation: (all groups)

The student will be required to use the various ways of finding derivatives in-order to further -find:

(a) gradients or slopes of curves. ;a:t ^specified points
(b) equations of tangents to any curve at a specified point
(c) maximum and minimum points on a curve whose equation iS known, using, the slope test, 2nd derivative test and/or the ordinate test to confirm the type of point
(d) a maximum or minimum quality using the technique of part "C" above is specified
(e) the solutions to related subject area problems by utilizing any of the above methods.

Further Differentiation:

The student v/ill be required to:

(a) find 2nd, •3rd and higher order derivatives using the rules of topic 1^"'
(b) use dxrferentiation to solve problems in linear velocity and acceleration, and problems in angular velocity.
(c) define instantaneous velocity and acceleration
(d) define a differential "dx" and "dy" .and solve practical probleras using differentials-

Introduction to Integration:

The student will be required to know:

(a) that integration is anti-differentiation, and how to use the integration power rules.
'1" -. f^^ -%t^^ meaning of an indefinite integral and how to find it:
"'¥Xx^"> and-"-a particular integral and how to find it: P(x)
(c) how to apply integration techniques to acceleration, velocity and distance problems
(d) how to use integration to solve electronic problems (El students only)

c. Number	Periods	Topic Description	Refere:
1		'Number Systems (Electrical .^:-.Electronic only)	
		Binary, Octal, binary coded 7:decimal systeims	Major su text or Malvirlo"
		Change of base	Leach
		Addition S Multiplication tables	Ch. 2,3
		Alaebra of elements	
		goelean Algebra (Electrical 5'Electronic only)	
		Definitions of 2 elements & ..2operations	
		Truth tables	
		Derivation of simple identities	See text
		Negation - the not operator	bboklisi
		Application to logic & sv/itches	Ref. #1: Ch- 5
		Empirical Equations (Aviation Only),	Rice anc Knight
		Xihear--empirical equations	2nd Edit Ch. 6
		Non-^l.inear empirical equations	P.. 1311 Ch. 14 P.. 354^
		Interpolation (Aviation only)	Any 4 Di
		(tabulated performance charts)	log ^
		Review basic interpolation trends in tabulated data (4 place logarithm S natural trig tables)	table
		Use of Aviation CR-3 type computers in interpolation (proportions)	
		Multiple interpolation procedures--	Cessna 1
		Practical Problems in assorted performance tables	Cessna 1 Cessna 1
		"" take-off landing, clin-b cruise performance char	
		Graphical (Performance Charts) (Aviation only)	Cessna 1
		Reading graphical charts	
		Normal critical path through . multiple graph charts	
		Reverse path through multi- . graph charts given conditions	
		Practical problems	

~'c Numoer	Periods	Topic Description	Referenc
		Graph'"PreDaration (Aviation Only)	
		Procednres for making engineering graphs	Cessna]
		Selection of axis, names, labelling techniques	
		Multiline graphs from tabulated performance charts	Piper Tx Comanche
		Interpolation in multiline graphs	
		Windsliioft graph on CH-3 computer	
		Practical assignments	
		Graphical Methods of Calculus	Rice s
		Gradients of curves, rate of - change	Knight Ch. 24
		Slci^es -of graphs 'of linear & jipn-^linear functions	
		Average & instantaneous rates of change	
		Int^luction to Differential Calculus	
		•Fiaitttlonal notation	Washinc p. 45-6
		Liiiiiting value of a function	Blakely Ch,3
		Differentiation-delta method	p. 31-5
		Practical applications-rectiline motion	Person 8,9,10,
	12	Differentiation by Rule	Washinc p.64-84
		Differentiation formulas	Blakeli' Ch, 5 S
		Compos i te function & the chain rule	p. 80-]
		Implicit differentiation	Person Ch. 13,
		Electrical Applications	15,
		Successive differentiation	
10	10	Practical Application of Differentiation	Washinc D. 85-:
		Gradients	Blakely Ch-. 4
		Tangents to curves	p. 54-'
		Maxima and minima	Person Ch. 16
		(Aviation should finish the -semester here)	18
		Related' rate problems	

ToDic Number	Sueeested Periods	toDic Descrio zon	Reference
11		^ Differential and Integ-ral,. (for Mechanical, give more "application time) '-differential formulas -^^applications of diff^ren-tial -integration as anti-dif.ferent-iation -applications of indefinite integration -algebraic .substit'cxt'ion. -Electrical/Electronic sjnduld finish •ti'ie, Semester he^e •	-Wash. p.113-12 Blakely Ch-. 7 p.ii:-i2 •Person 2 23
12		Definite Integration -areas tinder a curve -fundamental theorem of integral calculus -compntations with definite integrals -application to areas,"-vol-ume,. motion electrical prob.le:ms --Mechanicals should finish the semester here	Wash. p. 128-15, Blakely^ P' 121-^ Person CJ 25,26