

MEMORANDUM

S.79-15

To.....H.M. Evans, Secretary.....

From...N. Heath, Assistant to the.....

.....Senate.....

...Dean of Science.....

Subject....Report on Special Topic Courses.....

Date...1978-12-19.....

Details of the selected topics courses offered in the Faculty of Science in the semesters 77-3, 78-1, 78-2 and 78-3 are attached for the information of Senate. The courses included are:

77-3 Biological Sciences

471 Experimental Aquatic Biology

472 Advanced Developmental Biology

473 The Echinoderms

Mathematics

495 Non Parametric Statistics

Physics

198 Introductory Astronomy

78-1 Biochemistry

420 Contemporary Biochemistry

Biological Sciences

471 Introduction to Mammalogy

472 Anatomy, Biology and Taxonomy of the Araneae of Canada

473 Physical and Chemical Aspects of the Terrestrial Environment

Mathematics

291 Mathematical Model Building

292 Principles of Mathematics for Teachers II

496 Experimental Design

78-2 Biological Sciences

471 Limnology

78-3 Biological Sciences

471 Ornithology

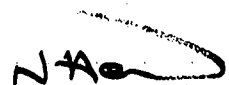
471 Biology of fishes

472 Toxicology

472 Environmental Physiology

473 Experimental Ecology of Benthic Marine Algae

78-3	Chemistry	472	Theoretical Chemistry
	Mathematics	292	Introduction to Actuarial Mathematics
	Physics	493	Nonlinear Problems in the Physical World



N. Heath

NH:km
Attach.

Department of Biological Sciences

Course Outline

Fall 1977 (at Kelowna)

BiSc. 471-3

(2 - 0 - 4)

Dr. L.D. Druehl

Special Topics in Biology: Experimental Aquatic Biology

Prerequisites: BiSc. 204 (or Okanagan Coll., BiSc. 222).
Recommended BiSc. 326 be taken concurrently.

Theories and techniques for the evaluation of aquatic biological processes will be explored. Emphasis will be on local waters. One field trip to the Bamfield Marine Station is planned. Each student will conduct a research project.

Enrollment: 4

Department of Biological Sciences

Course Outline

Fall 1977

BiSc. 472-3

(2 - 2 - 0)

Drs. Baillie & Smith

Special Topics in Biology: ADVANCED DEVELOPMENTAL BIOLOGY

Prerequisites: BiSc. 201, 202 and 203. BiSc. 301 recommended.

This course is designed to bring the advanced undergraduate student up to date in modern studies of developmental biology. The lectures are concerned with major topic areas such as cytoplasmic localization phenomena, maternal versus embryonic transcriptional events, nuclear totipotency, etc. The lectures cover the classical experiments in these areas followed by an in depth examination of recent experiments at the molecular and biochemical level. The student is expected to be well grounded in basic embryology, biochemistry, and cell biology in preparation for this course.

Course texts: Molecular Biology of Eucaryotic Cells by Hood, Wilson & Wood.

Enrollment: 4

Department of Biological Sciences

Course Outline

Fall 1977

BiSc. 473-3

(0 - 0 - 9)

Dr. P.V. Fankboner

Special Topics in Biology: The Echinoderms

Prerequisites: BiSc. 306

Objective of the course: Further study and training by advanced students of invertebrate zoology on the microanatomy, ecology and taxonomy of echinoderms living in coastal waters of British Columbia.

Course Text: Starfishes and their relations by Clark.

Enrollment: 14

NON PARAMETRIC STATISTICS

1. PROBABILITY THEORY

- 1.1 Preliminary Remarks
- 1.2 Counting
- 1.3 Probability
- 1.4 Random Variables
- 1.5 Some Properties of Random Variables
- 1.6 Continuous Random Variables

2. STATISTICAL INFERENCE

- 2.1 Populations, Samples, and Statistics
- 2.2 Estimation
- 2.3 Hypothesis Testing
- 2.4 Some Properties of Hypothesis Tests
- 2.5 Nonparametric Statistics

3. SOME TESTS BASED ON THE BINOMIAL DISTRIBUTION

- 3.1 The Binomial Test
- 3.2 The Quantile Test
- 3.3 Tolerance Limits
- 3.4 The Sign Test and Some Variations

4. CONTINGENCY TABLES

- 4.1 The 2 x 2 Contingency Table
- 4.2 The r x c Contingency Table
- 4.3 The Median Test
- 4.4 Measures of Dependence
- 4.5 A goodness of Fit Test
- 4.6 Cochran's Test for Related Observations

5. THE USE OF RANKS

- 5.1 The One-Sample or Match Pairs Case
- 5.2 A Confidence Interval for the Median
- 5.3 Two Independent Samples
- 5.4 A Confidence Interval for the Difference Between Two Means
- 5.5 Measures of Rank Correlation
- 5.6 Several Independent Samples
- 5.7 Several Related Samples
- 5.8 The Balanced Incomplete Block Design
- 5.9 Tests with Efficiency of One or More

6. STATISTICS OF THE KOLMOGOROV-SMIRNOV TYPE

- 6.1 Tests of Goodness of Fit

6. STATISTICS OF THE KOLMOGOROV-SMIRNOV TYPE (cont'd)

- 6.2 Tests for Two Independent Samples
- 6.3 Tests for Several Independent Samples

7. SOME MISCELLANEOUS TESTS

- 7.1 Some Quick Tests
- 7.2 A Slippage Test for Several Independent Samples
- 7.3 Tests Based on Runs
- 7.4 Fisher's Method of Randomization

Recommended Text:

Practical Nonparametric Statistics by W.J. Conover,
John Wiley & Sons Inc., New York, London, Sydney,
Toronto

Periphysical Topics III

PHYSICS 198-3

TITLE: I N T R O D U C T O R Y A S T R O N O M Y

FALL SEMESTER 1977

INSTRUCTOR: *Leigh Hunt Palmer*

TEXTBOOK: *Exploration of the Universe, Third Edition,
by George O. Abell*

TIME & PLACE: *7:30 - 9:30 p.m. Monday and Wednesday,
Room 9002*

Introductory Astronomy will be a quantitative survey of the subject with mathematical treatment at the level of simple algebra. Lectures will be supplemented with planetarium sessions and optical observation sessions. Relevant physics from the areas of optics, mechanics, relativity and nuclear physics will be included. The astronomical topics will be selected from among those in the textbook and will include the motions of the earth, moon, sun, planets, and stars, methods and instruments of observational astronomy, stellar and galactic evolution, and cosmogony.

Questions regarding the course should be directed to Leigh Palmer at 291-4844.

Vector: 3-1-0

Prerequisites: B.C. High School Physics 11 and Math 12 or equivalent

Enrolment: 46

SIMON FRASER UNIVERSITY

MEMORANDUM

To..... N. Heath
Administrative Assistant

From..... A.M. Unrau

Subject..... BIOCHEMISTRY 420-3
1978 - Spring Semester

Date..... 18 December, 1978

"Selected Topics in Contemporary Biochemistry"

Topic

Physical and Biochemical Properties of Model and Cell Membranes

1. Historical and modern concepts of membrane structure. Electron microscopic examination of membrane structure. Chemical composition of biomembranes;
2. Comparison of synthetic model monolayer and bilayer vesicles with biomembranes;
3. Studies of physical properties of membranes; i.e., fluidity of structure:
(a) E.S.R. - mobility of polar head-groups and mobility along hydrocarbon chain of fatty acid;
(b) N.M.R. - Deuterium label, relaxation phenomena, etc.
4. Transport properties, theories of active transport;
5. Macrolide antibiotic effect on membrane structure;
6. Correlation of antibiotic resistance with sterol biosynthesis pathways.

AMU

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Instructor : A.M. Unrau

Vector: 3-0-0

Enrolment: 4

Prerequisite: Permission of the Biochemistry Curriculum Committee.
Upper levels standing (with at least 60 semester hours)
in the Biochemistry Program will usually be required.

Department of Biological Sciences

Course Outline

Spring 1978 (at Kelowna)

BiSc. 471-3

Dr. R.M. Sadleir

Special Topics in Biology: Introduction to Mammalogy

Prerequisites: Permission of the Department.

A review of the biology of mammals with special emphasis on the larger game species of British Columbia and on marine mammals.

Course Texts: Mammalogy by Vaughan
Mammalogy by Gunderson
Mammalian Odours & Pheromones by Stoddart
The Mammals of B.C. by Cowan & Guiget

Enrollment: 6

Department of Biological Sciences

Course Outline

Spring 1978 (at Kelowna)

BiSc. 472-3

(2-0-3)

Dr. Turnbull

Special Topics in Biology: Anatomy, Biology and Taxonomy of the Araneae of Canada

Pre-requisites: Permission of the Department.

Canadian Spiders (Araneae): A review of the biology, anatomy, and taxonomy of spiders with emphasis on the common spiders of Canada.

Enrollments: 6

Department of Biological Sciences

Course Outline

Spring 1978

BiSc. 473-3

(2 - 0 - 4)

Drs. Brooke/Lister

Special Topics in Biology: Physical and Chemical Aspects of the
Terrestrial Environment

Prerequisites: 75 semester hours credit in the biological
sciences program.

Students who have credit for BISC 300 may
not take this for further credit.

The physical and chemical aspects of terrestrial environment
as related to biological systems; large and small-scale
environmental processes, energy balances and fluxes;
measurement and evaluation.

Enrollments: 17

Selected Topics in Mathematics

TITLE: MATHEMATICAL MODEL BUILDING

EVENING COURSE

291-2

SPRING 78

INSTRUCTOR: Dr. M. Singh

VECTOR: 2-1-0

ENROLMENT: 11

An introductory course in applications of the calculus in business, commerce, and engineering problems. The course includes: approximation techniques and mathematical modelling applied to problems in ecology, population dynamics, business management, and related areas; Mathematics of finance: finite difference methods and their applications in actuarial science.

The emphasis will be to inquire into practical and realistic problems. Making appropriate approximations, mathematical models will be constructed, and then the subsequent comparison of theoretical results with available data shall be made.

PREREQUISITE: MATH 152-3 or 155-3

8/77

Selected Topics in Mathematics

MATH 292-3

78-1 Title: PRINCIPLES OF MATHEMATICS FOR TEACHERS II

Instructor: Dr. H. Gerber

Enrolment: 28

Vector: 3-1-0

1. Integers, Rationals and Reals

- a. Integers and rationals
- b. Multiplication and division of integers and rationals
- c. Using integers as exponents
- d. Irrationals and reals
- e. Approximations and rational exponents

2. Logic and set theory

- a. Venn Diagrams, complements and intersection
- b. Logical connectives

3. Informal Geometry and Measurement

- a. Points, lines and planes
- b. Angles and separation
- c. Simple closed curves
- d. Motion Geometry - flips or reflections
- e. Translations, rotations and congruence of triangles
- f. Measurement - Metric system
- g. Perimeters, areas and volumes
- h. Functions, relations and graphs
- i. The straight line and the circle

4. Computing

- a. Hand calculators
- b. Flow charts

PREREQUISITE: MATH 190-3

11/77

Selected Topics in Mathematics

MATH 496-4

Title: EXPERIMENTAL DESIGN

Spring 78

Instructor: Dr. P. De Jong

Vector: 4-1-0

Enrolment: 10

1. Brief review of:

- (a) Distribution of random variables, expected values.
- (b) Sampling from $N(\mu, \sigma^2)$ with the generation of chi-squares, F and t distribution.
- (c) Two parameter tests with explanation of $H_0: \mu_1 = \mu_2$ test by t or F, and generalization to one-way ANOVA.
- (d) Review of Power and required sample size.

2. Analysis of variance

- (a) One-way analysis (one factor)
- (b) Two or more factors
- (c) Fixed, random and nested models
- (d) Tuckey's and Scheffé's tests

3. Analysis of covariance

4. Multiple regression

5. Factorial Experiments

- (a) 2^n models
- (b) Latin squares and Greco-Latin squares
- (c) Conformity
- (d) Fractional designs
- (e) Incomplete block designs
- (f) Response surfaces

PREREQUISITES: Math 302 or Math 371. Permission will be given to students from other departments with suitable backgrounds.

RECOMMENDED TEXT: Fundamental Concepts in the Design of Experiments by Hicks

REFERENCE TEXT: Introduction to Linear Models and the Design and Analysis of Experiments by William Mendenhall

Department of Biological Sciences

Course Outline

Intersession - BISC 471-3

Summer 1978

Dr. G.H. Geen

Special Topics in Biology: Limnology

Prerequisites: One of BISC 300, 306 or 424 recommended.

This course will involve a consideration of fresh waters with particular reference to those in British Columbia. The origin of lakes and streams and the physical and chemical parameters of particular importance to plant and animal life will be considered. Much of the emphasis in the lectures, laboratories and field work will focus on the biology of fresh water organisms.

Recommended Text: Limnology by R.G. Wetzel

Enrollment: 5

Department of Biological Sciences

Course Outline

Fall 1978

BiSc. 471 (Group 01)

(2 - 0 - 4)

Dr. N. Verbeek

Special Topics in Biology: Ornithology

Prerequisite: BiSc. 304 or BiSc. 316.

To provide advanced undergraduate students with an understanding of the biology of birds. This will be achieved through a series of lectures on a wide range of topics. Laboratories will emphasize classification, identification, and morphology of North American birds, behaviour, and ecology. Field trips will provide practical experience in field identification, behaviour studies and ecology of birds.

Course texts: Families of Birds by O.L. Austin
The Life of Birds by J.C. Welty
Birds of North America by Robbins et al

Enrollment: 14

Department of Biological Sciences

Course Outline

Fall 1978 (At Bamfield) The Biology of Fishes

BiSc. 471

(3 - 0 - 4)

Dr. K. J. Brewer

Three one hour lectures will be given each week. Topics to be covered:

1. Evolutionary history and classification of the main fish groups.
2. The circulatory system - anatomy and physiology.
3. Structure and function of the gills and air bladder.
4. Reproduction and development.
5. Ecology and Zoogeography.

Laboratory Work - four hours per week

This will be divided into two sections:-

- A. Fish will be collected from a variety of marine habitats (eel grass, kelp beds etc.) and classified in the laboratory.
- B. Coho salmon (Oncorhynchus kisutch) will be maintained in the laboratory and subjected to a variety of experimental treatments eg. increasing or decreasing photoperiods, differing salinities and temperatures, so as to determine optimum conditions for growth. Treatment with hormones may also be carried out. Results from this investigation will be presented as a scientific paper.

If time allows, a visit to salmon spawning beds will also be carried out.

ALLOCATION OF MARKS

- | | |
|------------------|-----|
| 1. Final exam | 40% |
| 2. Mid-term exam | 35% |
| 3. Coho paper | 25% |

TEXTS

1. Pacific Fishes of Canada - J.L. Hart.
F.R.B. of C. 1973.
2. Ichthyology - K.F. Lagler et al. 1977.

Department of Biological Sciences

Course Outline

Fall 1978

BiSc. 472 (Group 01)

(2 - 1 - 0)

Dr. C. van Netten

Special Topics in Biology: Selected Topics in Toxicology

Prerequisite: BiSc. 201 or permission of the Department.

This course will investigate the available information regarding the modern chemical environment and its effect on living organisms. Topics dealt with will include heavy metals, pesticides, PCBs, food additives, synthetic hormones, and drugs. Special attention will be given to the physiological and biochemical principles involved and their relationship to cancer.

Enrollment: 46

Department of Biological Sciences

Course Outline

Fall 1978 (at Bamfield) Environmental Physiology

BiSc. 472

(3 - 0 - 4)

Dr. K. Brewer

Three one hour lectures will be given each week. Topics to be covered:

1. Diving in vertebrates - whales, seals, otters, amphibians and reptiles.
2. Animal rhythms. Photoperiodism.
3. Life at high altitudes.
4. Thermal relations - endothermy and ectothermy. Life in hot and cold environments. Hibernation.
5. Regulation of salt and water levels in vertebrates and invertebrates. Life in hypo-and hyperosmotic environments.

Laboratory work - Four hours per week.

The theme of the course will be osmo - and ionoregulation in different animal groups. Two projects from the following will be carried out and results presented as scientific papers.

1. Ion levels and osmotic pressure will be monitored in a variety of experimental situations in an invertebrate species. Depending on availability, annelids, crustaceans or molluscs will be used.
2. The ability of euryhaline and stenohaline fish species to withstand changes in the ambient medium. If possible, beach fish will be collected at various times after the tide has receded and plasma samples analysed for various ions. Oxygen concentrations and water temperatures in tidal pools will be recorded.
3. The marine green turtle, Chelonia mydas, has modified orbital glands which function to rid the body of excess salt. A study of the role played by the salt gland and the kidney/cloacal complex in Na⁺ and K⁺ homeostasis will be carried out.

ALLOCATION OF MARKS

1. Final exam - 40%
2. Mid-term exam - 30%
3. Project - 30%

TEXTS - Comparative Physiology of Animals - an environmental approach.
R.W. Hill.

Enrollment: 13

DEPARTMENT OF BIOLOGICAL SCIENCES

Course Outline

Semester: 78-3

Vector: 3-0-4

BISC. 473-3, Special Topics:

Prof. Dr. L. Druehl

Experimental Ecology of Benthic Marine Algae

Lectures, Readings and Laboratory exercises dealing with various biological functions of seaweed particularly as they relate to ecology.

Text: Selected reprints

Evaluation technique:

2 Papers and an examination.

Enrollment: 18

Course Outline for Chem 472 Fall 1978

Prof. G. Malli

Texts: (i) F.A. Cotton: Chemical Applications of Group Theory. Wiley Interscience Second Edition 1971.

(ii) I.G. Kaplan: Symmetry of Many-Electron Systems: Academic Press 1975.

- Course Contents:
1. Groups: Subgroups, Classes, . . . Some examples of groups. .
 2. Molecular Symmetry and Symmetry groups: Finite groups, classification of molecular symmetry groups. Proper axes and rotations. Improper axes and rotations. Symmetry point groups.
 3. Group Representations - Matrix Representation of Groups: Character, Irreducible representations, Group representations
 4. Group Theory and Quantum Mechanics: Wavefunctions as bases for (IR's). Direct Product. Symmetry adapted Linear Combinations (SALC). Projection operators. . . .
 5. Application of Group Theory: Molecular orbital theoretical methods and group theory. LCAO/MO/ISCF - Scheme of Roothaan, CI. Hybrid orbitals, Ligand Field Theory Molecular Vibrations. Selections Rules.

Instructor: Dr. G. Malli

Vector: 3-1-0

Prerequisite: CHEM 361-3

Enrolment: 1

Selected Topics in Mathematics

MATH 292-3

FALL 78

Title: INTRODUCTION TO ACTUARIAL MATHEMATICS
(Evening)

Vector: 3-1-0

Instructor: Mr. R. Norman

Enrolment: 7

An introduction to the theory of interest, life insurance and pensions. Topics to be covered include mortgages, annuities, life insurance, registered retirement savings plans and the funding of pension plans.

1. Introduction - what is an actuary?
 - where do actuaries work?
 - training of actuaries.
2. Compound Interest
 - accumulation with interest: $(1 + i)^n$
 - discounting: v^n , the present value
 - annuity certain $a_{\overline{n}|}$
 - accumulation $s_{\overline{n}|}$
 - payment in advance, and more frequently than annual $\ddot{a}^{(12)}$, $\bar{a}$
 - use of compound interest tables
 - finding effective rate of interest
3. Payment schedules (loans, mortgages, etc.)
 - equivalence of two sets of payments
 - relationship between $a_{\overline{n}|}$ and $a_{\overline{n-1}|}$
 - repayment of loans.
 - mortgage schedules
4. Life annuities
 - life tables. l_x, d_x, p_x, q_x
 - expectation of life t_x, e_x^o
 - present value of life annuity; definition of D_x, N_x
 - $\ddot{a}_x = N_x/D_x$, other modes of payment
 - guaranteed annuities, use of tables
 - relationship between a_x and a_{x+1} : the reserve
5. Life insurance
 - value of whole-life insurance, definition of $M_x, A_x = M_x/D_x$
 - $A_x = 1 - \ddot{a}_x$; net premiums for whole life assurance, endowment, term assurance

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5. Life insurance - cont'd

- office premiums for insurances and annuities
- policy reserves (no expenses) for whole life, endowment, term, annuities
- loans against policies, surrender values, paid up policies

6. Pensions

- types of pension plans, final earnings, money purchase, career average, fixed benefit.
- funding of pension plans (e.g. Canada Pension Plan, Registered Retirement Savings Plans, etc.)

Additional topics, as time permits.

7. Accounts and Investments.

- development of balance sheet and income and expenditure
- accounts, from a common sense point of view.
- equity and fixed interest capital, the stock exchange, book values and market values.
- valuation of investments for actuarial purposes.

8. The Actuarial Valuation.

- types of valuation (i.e. reason for valuation)
- the valuation basis
- valuation of life insurance companies - solvency and distribution of surplus.
- valuation of pension funds - solvency and funding.

Prerequisites: (1) Math 101 (with a grade of A or B) and one of Math 151, 154, or Math 157

or (2) Math 371

or (3) (with permission of the Department) equivalent experience.

Special Topics in Physics

PHYSICS 493-3

R.H. Enns, Instructor

"Nonlinear Problems in the Physical World"

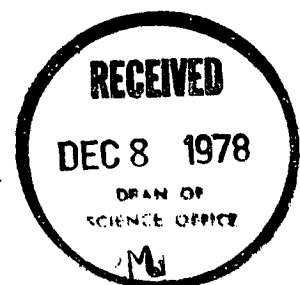
Text: Chapter 10 of "An Introduction to
the Methods and Tools of Theoretical
Physics" by R.H. Enns and
S.S. Rangnekar (a text in preparation).

Outline attached.

Vector: 3-0-0

Prerequisite: Permission of the Department

Enrolment: 7



Chapter 10 - Nonlinear Problems in the Physical World

10.1 Introduction (pp 1-3).

10.2 Some Interesting Nonlinear Systems (pp 3-36)..

- A. Nonlinear Mechanics
(Simple pendulum, Jacobian elliptic functions, the eardrum, nonlinear damping.)
- B. Competition Phenomena
(Volterra competition equations (big fish-little fish, rabbits-foxes, etc.), Eigen's theory of selection and evolution of biological molecules, interacting laser beams, arms race between nations.)
- C. Nonlinear Electrical Phenomena
(Nonlinear inductance, electronic oscillator circuit (Rayleigh equation, Van der Pol equation).)
- D. Solitons
(Water waves and the KdV equation, the Sine-Gordon equation, self-induced transparency.)

10.3 Methods of Solution (pp 37-72).

A. Exactly Soluble Equations:

- i) Equations whose variables can be separated.
- ii) The Bernoulli Equation.
(Laser beam problem, nonlinear diode.)
- iii) The Riccati Equation.
(Competition between two species.)
- iv) Equations of the structure $d^2y/dx^2 = f(y)$.
(Simple pendulum, elliptic integrals, elliptic functions, phase plane diagram for pendulum.)

B. Variation of Parameters.

(Nonlinear damping, introduction to Krylov-Bugoliubov method.)

10.4 Topological Analysis and Graphical Solutions (pp 73-138).

A. Topological Analysis

(Phase plane diagram, types of singular points (vortex, saddle point, focal point, nodal point), criteria for classification of singular points, stability criteria, higher order singularities, Poincaré's theorem for the vortex and applications.)

B. Graphical Methods of Solution

- 1) The Isocline Method
(Solution of Van der Pol equation, introduction to limit cycles.)
- 2) The Delta (δ) Method
(Nonlinear spring, Rayleigh equation, relaxation oscillations.)

- 10.5 Limit Cycles (pp 139-153).
(Examples of stable, unstable and semi-stable limit cycles, multiple limit cycles, first theorem of Bendixson and applications, Poincaré-Bendixson theorem and examples.)
- 10.6 Analytical Methods (pp 154-203).
- A. The Perturbation Method.
 - i) Poisson's Method
(Theory, application to nonlinear diode, nonlinear spring, secular terms.)
 - ii) Lindstedt's Method
(Theory, removal of secular terms, nonlinear spring, Van der Pol equation, introduction to Duffing's equation.)
 - B. The Krylov-Bogoliubov (K-B) Method
(Theory, nonlinear spring, nonlinear damping, Coulomb friction.)
 - C. Ritz Method
(Theory, nonlinear diode, nonlinear spring.)
 - D. Galerkin's Method
(Theory, applications.)
- 10.7 Forced Oscillations of Nonlinear Systems (pp 204-232).
- A. Iterative Solution of Duffing's Equation
 - B. The Nonlinear Response Curve
 - C. Effect of Damping on the Nonlinear Response Curves.
 - D. The Jump Phenomenon and Hysteresis
(Stability considerations.)
 - E. Subharmonic Response
- 10.8 Elementary Soliton Calculations (pp 233-243).
(Solution of KdV equation, solitary wave solutions of 3-wave problem in nonlinear optics.)
- 10.9 Numerical Techniques (pp 243-264).
- A. Finite-Difference Approximations to Derivatives.
 - B. Some Finite-Difference Methods
 - i) Euler Method
(Application to rabbits-foxes problem.)
 - ii) Modified Euler Method
 - iii) Runge-Kutta Methods
 - iv) An Explicit Method of Solving P.D.E.
(Heat flow.)
 - v) Crank-Nicolson Implicit Method
 - vi) Method of Characteristics
(Interacting laser beams, Sine-Gordon equation.)
 - C. Conclusion