SIMON FRASER UNIVERSITY

S.79-73

MEMORANDUM

To: Senate

From: N. R. Reilly, Chairman
Senate Committee on
Undergraduate Studies

Subject: Faculty of Science - Analytical Biochemistry Proposal Including New Courses - CHEM 397-0, 398-0, 399-0 - Clinical Hospital Training

Date: 18 May 1979

Action taken by the Senate Committee on Undergraduate Studies at its meeting of May 15, 1979 gives rise to the following motion:

MOTION I

"That Senate approve and recommend approval to the Board of Governors, as set forth in S.79-73 , the analytical biochemistry option proposal, including:

CHEM 397-0 - Clinical Chemistry Hospital Training
CHEM 398-0 - Clinical Chemistry Hospital Training
CHEM 399-0 - Clinical Chemistry Hospital Training."

It was noted that the basic nature of the proposals had earlier gone forward as a new degree program in Clinical Chemistry, with the hospital training courses identified as credit carrying. At that time the proposals had been approved by SCAP, by Senate and by the Board of Governors. The present proposal does not provide for credit for the hospital training programs. It is envisaged that following experience with the program as proposed, it might become clear that it would fit the Cooperative Education model, but the proposal is not being forwarded at the present time in the full Cooperative Education mode.

It is proposed that the fees for these three courses be applied in the same fashion as for the practica courses in Co-Op Ed., i.e. one-half the 15 credit load fee plus the off-campus student activity fee.

It was recognized that these courses should only be introduced if the required funding is obtained and that the request for that funding must be pursued through the normal budget channels available to departments.

Time Waiver: SCUS approved a waiver of the normal time lag requirement in order that CHEM 397-0, CHEM 398-0, and CHEM 399-0 may be first offered in the Fall semester 79-3, subject to approval of the courses by Senate and the Board.

N. R. Reilly

/kb

SIMON FRASER UNIVERSITY

SCUS 79-12
as approved by SCUS
May 15, 1979

MEMORANDUM

To: Mr. H. Evans Registrar	From: J.M. Webster Dean of Science
Subject: ANALYTICAL BIOCHEMISTRY	Date: 1979 05 09

Please be advised that the re-written version of the Analytical Biochemistry Option within the Biochemistry Programme should be forwarded to SCUS at your earliest convenience.

The re-written proposal has been examined by Dr. Kemp, Chairman of the Faculty of Science Undergraduate Curriculum Committe, and he recommends that this proposal go forward for immediate consideration.

J.M. Webster

JMW/mgj

cc: Dr. A.S. Arrott, Chairman
Physics Department
cc: Dr. M. Mackauer, Chairman
Biological Sciences
cc: Dr. E.J. Wells, Chairman
Chemistry Department
cc: Dr. M. Singh, Chairman
Mathematics Department
cc: Dr. C.L. Kemp, Chairman
Faculty of Science Undergraduate
Curriculum Committee
Biological Sciences

DOCUMENTATION FOR ANALYTICAL BIOCHEMISTRY PROPOSAL

OUTLINE

BACKGROUND

PROPOSAL

Comparison with Previous Clinical Chemistry B.Sc. Proposal

ADMISSION

Operation of Option

Objectives of Option

Proposal Calendar Entry

Special Instructions for CHEM 397, 398, 399

Rationale for Operation of CHEM 397, 398, 399 Practica as P/W Courses

Course Proposal Forms and Outlines for Previously Approved CHEM 420, 423, 424 and Course Proposal Forms and Outlines for CHEM 397, 398, 399 (previously approved for B.Sc. clinical chemistry each carrying 15 hours, now proposed for the described option with zero hours)

Budget

Duties of Proposed Appointee in Analytical Biochemistry Involving CHEM 397, 398, 399

BACKGROUND

The growing complexity of analyses of biological materials for medical and environmental purposes has created a need for well qualified B.Sc. biochemistry graduands possessing a sound foundation in analytical biochemistry. It is envisioned that such individuals will fill the void between the levels of the laboratory technologist and the Ph.D. research scientist.

A survey of institutions offering the type of training envisioned revealed that in Canada there are few western universities involved in this area.

Much of the current need for Medical Laboratory Technologists is met by personnel trained in two year programs. In British Columbia training in Medical Laboratory Technology is to the two year level, undertaken by a number of approved and accredited hospitals in cooperation with the B.C.I.T. and Cariboo College. In practice, a grade twelve graduate enrolls in the Medical Technology program at B.C.I.T. or C.C. After one successful year of formal training equivalent to senior matriculation the student applies for sponsorship to an approved hospital. If sponsored, the student completes one further year at the educational institution and proceeds to one year of practical hospital training. After a successful hospital training period, candidates are eligible to apply to write the C.S.L.T. (Canadian Society

of Laboratory Technologists) examinations. These examinations are multifaceted in that they test the candidate's expertise in hematology, clinical microbiology, histology, clinical chemistry (analytical biochemistry) and blood bank technology. Successful completion of these examinations leads to the professional qualification of Registered Technologist with what is termed a General Certificate.

A survey of B.C. hospitals and private laboratories in 1974 indicated a need for persons specializing in the area of Analytical Biochemistry. The provincial need for such trainees is currently estimated at ten per year and is barely met by recruitment from outside the province. The more attractive alternative would be the training of B.Sc. biochemists utilizing the proposed option and upgrading qualifications of technologists with two year's formal training utilizing again the proposed option in biochemistry.

S.F.U.'s initial response to the need for B.Sc. level training in analytical biochemistry was the development of appropriate courses and constituted the mainstay of evening refresher courses in cooperation with the Education Committee of the B.C. Society of Medical Technologists during 1974-78. These were highly successful and well attended by practicing laboratory technologists.

Parallel with these offerings and in consultation with professional groups and hospitals, S.F.U. developed a proposal for a B.Sc. in Clinical Chemistry. This proposal

was built around existing degree offerings but differed from existing degree packages sufficiently in that it was considered a new program. The proposal was endorsed by the hospitals' professional bodies and the University. It was not, however, approved by the University's Council.

The reasons for this rejection did not lie in the program's academic or practical merit but were construed to lie in the nature of the U.C.B.C. program approval process. It was suggested by several authorities involved in the discussion of the proposal at U.C.B.C. that the proposal was worthy of pursuit preferably as an internally arranged option.

PROPOSAL

The Biochemistry Committee undertook a reevaluation of the course offerings in Chemistry, Biosciences, Biochemistry, Kinesiology, Mathematics and Physics at S.F.U. with a view toward development of an undergraduate option with an emphasis in Analytical Biochemistry. This led to the formulation of a core of courses which were considered necessary for the graduate to meet the requirements proposed by Committees on Education in Clinical Chemistry (CSCC). The sequence of courses that evolved from this examination contained the biochemistry majors core program, additional existing S.F.U. courses in the area of analytical biochemistry and allied areas as well as hospital practica which had previously been approved for the proposed clinical chemistry program.

This analytical biochemistry option is minimally changed from the previous proposal in Clinical Chemistry. It is designed so that the student will be eligible to write the Subject Registered Technologist Certification Examination in Clinical Chemistry concurrent with obtaining the B.Sc. degree. This option will also be available to interested medical laboratory technologists who wish to pursue their studies in such a way that they will be eligible to write the Subject Advanced Registered Technologist Examinations in Clinical Chemistry concurrent with obtaining the B.Sc. degree. Because of the requirements of the Canadian Society of Laboratory

Technologists that a student train in an approved laboratory for one year as a partial requirement for an R.T., each student without prior hospital laboratory experience will be required to train in an accredited hospital or biomedical laboratory normally in one semester of each of the second, third and fourth year of study.

A comparison of the two proposals is given below. Using the proposed B.Sc. in Clinical Chemistry as the starting base, the proposed Analytical Biochemistry option is generated as follows:

Courses required of students in Clinical Chemistry B.Sc. with no previous post-secondary training.	+ A (Add)	- D (Delete)	= Analytical Biochemistry Option

Biochemistry:

301-3	**The Structure and Reactivity of Biomolecules**
302-3	**Metabolism**
311-2	**Analytical Biochemistry Laboratory**
312-2	**Metabolism Laboratory**
403-3	**Physical Biochemistry (A)**
412-3	**Enzymology (A)**
413-2	**Physical BIochemistry Laboratory (A)**

Bioscience:

101-4	**Introduction to Biology**
102-4	**Introduction to Biology**
202-3	**Genetics (A)**
302-3	**Genetic Analysis (A)**
401-3	**Biochemistry - Regulatory Mechanisms (A)**
402-3	**Molecular Genetics (A)**
428-3	**Experimental Techniques I**

Chemistry:

104-3	General Chemistry I
105-3	General Chemistry II
115-2	General Chemistry Laboratory
117-2	Quantitative Chemistry Laboratory
233-2	Inorganic Chemistry of Biological Processes
251-3	Organic Chemistry I
252-3	Organic Chemistry II
256-2	Organic Chemistry Laboratory I
261-3	Physical Chemistry (A)
356-2	Organic Chemistry II Laboratory (A)
397-0)	
398-0)	Hospital Training
399-0)	
416-3	Modern Methods of Analytical Chemistry
420-3	Clinical Chemistry II
423-3	Clinical Chemistry II
424-2	Clinical Chemistry Laboratory

Kinesiology:

100-3	Introduction to Human Structure and Function (D)
336-3	Microscopic Anatomy (Histology)
405-3	Human Physiology I
406-3	Human Physiology II
407-3	Human Physiology Laboratory (D)

Mathematics:

101-3	Introduction to Statistics (A)
151-3	Calculus I
152-3	Calculus II
253-3	Calculus III (A)
302-3	Statistical Methods

Physics:

120-3	General Physics I
121-3	General Physics II
333-4	Introduction to Instrumentation in the Life Sciences (D)

Computing Science:

105-3	Introduction to Concepts and Procedures (D)

8

All the preceeding courses in the Analytical Biochemistry Option except

BISC 303-3, 428-3

CHEM 416-3, 420-3, 423-3, 424-2, 397-0*, 398-0* and 399-0*

KIN 336-3, 405-3, 406-3

MATH 101-3, 302-3

are part of the existing Biochemistry majors core. Of these, CHEM 420-3, 423-3, 424-2, and earlier versions of 397-0, 398-0,and 399-0 were previously approved as part of the Clinical Chemistry program and the remainder are part of other B.Sc. programs. Students may be admitted to the B.Sc. Biochemistry program with advanced standing. Transfer credit may be granted for appropriate academic course work completed at other institutions to a maximum of 60 semester hours. Acceptable practical laboratory training (an accepted equivalent of CHEM 397, 398, 399) may also be transferred but only for students who are accepted into the Analytical Biochemistry Option.

Students pursuing the Analytical Biochemistry Option must complete additional university B.Sc. requirements to acquire the necessary credit hours for graduation. For the degree program with a major in biochemistry these requirements involve the completion of an additional 13 semester

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* These courses do not counstitute part of the B.Sc. degree requirements but must be completed by students accepted in the Analytical Biochemistry Option. To be consistent with present generally accepted practice, no formal credit is assigned although students registered in these courses would have all the priviledges associated with full time (15 hours) enrollment.

hours of electives, six of which must be from outside the Faculty of Science.

Students in the Honours Biochemistry Program and also pursuing this option will normally be expected to achieve a cumulative grade average of B and complete an additional 25 semester hours of course work including Biochemistry 491-5 (Undergraduate Research) and six hours from outside the Faculty of Science.

Typical Outline for Analytical Biochemistry

First Year (30)

BISC 101-4, 102-4

CHEM 104-3, 105-3, 115-2, 117-2

MATH 151-3, 152-3

PHYS 120-3, 121-3

Second Year (31)

CHEM 233-2, 251-3, 252-3, 256-2, 261-3, 397-0

BISC 202-3, 302-3

KIN 336-3

MATH 253-3, 101-3 ; Electives, 3hrs.

Third Year (30)

BICH 301-3, 302-3, 311-2, 312-2

CHEM 356-2, 398-0, 416-3, 420-3

KIN 405-3, 406-3

MATH 302-3 ; Electives, 3 hrs.

Fourth Year (31)

BICH 403-3, 412-3, 413-2

BISC 401-3, 402-3, 428-3

CHEM 399-0, 423-3, 424-2; Electives 9 hrs.

TOTAL = 121 Hours

ADMISSION

Entrance requirements, operation and objectives, for the Analytical Biochemistry Option closely parallel those of the earlier clinical chemistry proposal and are described below.

Because of the need for concurrent theoretical and practical training we recommend that only those applicants be admitted into this option who can be placed in teaching hospital, or appropriate biomedical, laboratories during the course of their studies; i.e., registration in CHEM 397, 398, 399. It is recommended that this requirement be waived for those students with one year of similar laboratory experience.

The proposed mechanism of entrance is as follows:

1. The student applies to S.F.U. and is accepted into the University.
2. The student completes first years of basic science courses (per Typical Program Outline) and applied to the Biochemistry Committee for admission into the Analytical Biochemistry Option of the biochemistry program.
3. The Biochemistry Committee, together with the off-campus laboratory personnel (Advisory Board), select students to be admitted. At this time provision for off-campus laboratory training is made.

12

4. Students admitted go forward.

Operation of Option

It is proposed to establish an advisory board to oversee the operation of this Option. Membership should be distributed between the Biochemistry Program Committee and appropriate personnel of the laboratories involved in the off-campus training. The advisory panel should be involved in curriculum review and coordination of the off-campus training. This latter function will involve selection and placement of students in approved laboratories.

Objectives of Option

To prepare the Biochemistry graduate with the following abilities:

1. Work independently in the analytical biochemistry laboratory.
2. Read, understand, develop and standardize methods for routine laboratory use.
3. Understand all phases of analytical biochemistry laboratory operation.
4. Minitor quality control.
5. Troubleshoot a method and spot potential errors.
6. Understand data reduction and dissemination.
7. Understand the physiological significance of the data.
8. With guidance, aid in the training of technicians and technologists in methods of analysis.

9. Understand the fundamentals of instrumental design, operation and methodology as used in analytical biochemistry laboratories.

10. Assist the laboratory director in carrying out research projects.

Proposed Calendar Entry

The following is the proposed calendar entry following the section describing the requirements for Biochemistry honours (Page 363, 1977-78 Calendar).

Analytical Biochemistry Option

The practical training courses, CHEM 397-0, 398-0, 399-0, will be arranged through the program advisor. Registration in these courses constitutes a full semester load. In addition to the regular core requirements of the Biochemistry major or honours program, the following courses must also be included:

BISC 303-3, 428-3

CHEM 416-3, 420-3, 423-3, 424-2

KIN 336-3, 405-3, 406-3

MATH 101-3, 302-3

Upon satisfactory completion of the practical training courses, students will be eligible to apply for examination and certification by the Canadian Society of Laboratory Technology.

Special Instructions for CHEM 397, 398, 399

1. Students must complete normal University registration procedures and be admissible to the University before enrolling in CHEM 397, 398 or 399. It is highly recommended that such students complete their University registration sixty days in advance of the commencement of the semester in which they plan to enroll in these courses. In addition, students desiring to enroll in these courses must make written application to the Biochemistry Committee at least sixty days before the commencement of the semester in which the course commences. Later applicants will be considered only if space is available.

2. In the event that the number of applicants to CHEM 397, 398 and 399 exceeds facilities and staffing capabilities, the Biochemistry Committee will select those applicants considered to be the best qualified. Candidates on a waiting list will be ranked together with new applicants.

3. Students who have indicated their intention to undertake a given semester of CHEM 397, 398 or 399 and who do not honour this commitment, must consider that re-enrollment in these prescribed courses is not given automatically. Such permission must be sought by written request from the student to the Biochemistry

program chairman three months prior to the start of the semester in which the student proposes to re-enroll in these courses.

4. Students may request or be required by the supervisor to discontinue enrollment in the practical training courses.

5. CHEM 397, 398 and 399 are considered full time professional studies and may not normally be taken in conjunction with other academic or professional courses. These courses will be graded on a pass/withdraw basis and do not constitute part of the grade-point average.

End of Calendar entry.

Rationale for Operation of CHEM 397, 398, 399 as P/W Courses

These courses are designed to give students practical experience in various areas or phases of laboratory work ordinarily required and conducted in biomedical laboratories. Should during the conduct of the these courses it become evident that the student is incapable of conducting the prescribed experimentation, the student would voluntarily withdraw or be required, by the supervisor, to withdraw. Compulsory withdrawal preserves the right of the employer to properly manage a laboratory particularly where safety of personnel and equipment might be involved.

During the last several years two types of practica designed to help bridge the gap between a student's academic experience and the world of work have evolved at S.F.U. The following is an analysis of the similiarities and differences between the professional program practicum and the Co-op. work semester prepared in 1978-05-09 by Dr. Dan Birch.

Comparison of Two Types of "Practicum"

		Professional Program Practicum	Co-op Education Work Semester
1.	Purpose	To develop and demonstrate competence; perhaps for certification.	To gain work experience to field of study.
2.	Optional or Mandatory	Required for professional recognition and, in the case of Education, for the degree (B.Ed.).	Required for addition of "Co-op" designation to degree but degree program itself can be completed without it.
3.	Registration	Normal registration procedures including pre-registration.	Normal registration procedures including pre-registration.
4.	Placement	Assigned by the University after some consultation.	Opportunity to interview arranged by University.
5.	Primary Responsibility	To University for fulfillment of specified requirements.	To employer for fulfillment of job requirements.
6.	Payment to Student	Possible subsidy; usually minor, if any.	Full salary or wages.
7.	Supervision	Close and regular supervision by University personnel and agency personnel.	Regular employment supervision, little University supervision.
8.	Withdrawl or Discontinuation	At the option of the student or of the University; under some circumstances University will arrange another placement.	At the option of the student or the employer; University will not intervene.
9.	Grading	"P" representing professional adequacy or "W" indicating voluntary of involuntary withdrawal.	"P" representing completion of term's employment; "W" indicating failure to complete.
10.	Place in Degree Requirements	Added on as part of a "fifth year" (Education) or integrated.	Added on, cannot displace other courses.

	Professional Program Practicum	Co-op Education Work Semester
11. Credit	Full course credit for time spent e.g. EDUC 401 - 8, EDUC 405 - 15.	No course credit but fulfillment of co-op requirements.
12. Fees	Full fees in recognition of services, supervision and credit.	"Half" fees in recognition of administrative services, including job-finding; very limited supervision.

These points were considered by SCAP in 1975 in a discussion of mode of operation of CHEM 397, 398 and 399. The results of these deliberations are summarized in the attached (S76-10).

Course Proposal Forms and Outline for Previously Approved CHEM 397, 398, 399, 420, 423, 424.

The laboratory training program is designed to allow the student to gain practical experience in a functional clinical chemical laboratory. This practical training will supplement the theoretical courses (Chem. 420 and 423).

Budget

1. Personnel

Faculty Position (2 X 1/2) $25,000+/year

- Instructor for CHEM 420, 423 and 424.
- To act as a student counsellor on matters pertaining to the program.
- To supervise the selection and placement of students for field training.
- To coordinate, monitor and assess the progress of students while in field training.
- To conduct a related research program.
- To liaise with off-campus offices, institutions and individuals as may be necessary for the proper operation of the program.

Adjunct Professors (10)

These will be hospital or private-laboratory based clinical chemists who will be responsible for the day-to-day teaching of students in field training.

Teaching Assistant

For CHEM 424 whenever offered (1 per year, $3,000)

Teaching Assistants

For CHEM 420 and CHEM 423 (1 per year, $6,000 each)

2. Equipment

For CHEM 424 Laboratory $10,000/year.

3. Laboratory Supplies $3,000/year

4. Travel Expenses $1,500/year

TOTAL = $48,500

Duties of Proposed Appointee in Analytical Biochemistry Involving CHEM 397, 398, 399

1. To promote good public relations with hospital laboratories and such other institutions as may be involved in the training of students.
2. To liase with hospital laboratory administrators and provincial government offices in connection with wages or stipends for students while in training in hospital laboratories.
3. To jointly arrange a syllabus of instruction with each training laboratory for the training of students pursuant to the objectives of CHEM 397, 398 and 399. The syllabus will vary depending on the patterns of work-flow within the specific laboratory, and on the individual student's prior experience.
4. To supervise the selection and placement of students for training purposes in (CMA) approved laboratories.
5. To coordinate, monitor and assess the progress of students while in practicum tra-ning and to maintain records thereof.
6. To advise hospital laboratories in the selection and assignment of suitable laboratory exercises to fulfill the requirements of the syllabus (attached).

7. To hold regular, probably bi-weekly, tutorials for these students in the lower mainland, and to arrange for same in other areas as needed.

8. To act as a student counsellor on matters pertaining to the practical training.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

Department: Chemistry

1. Calendar Information

Abbreviation Code: CHEM Course Number: 397 Credit Hours: 0 Vector:

Title of Course: Clinical Chemistry Hospital Training

Calendar Description of Course: Full-time practical Training in approved hospital and biomedical laboratories in the use of chemical diagnostic tests.
This course is required for the completion of the Analytical Biochemistry option and is not transferable to other degree programes at S.F.U.

Nature of Course

Prerequisites (or special instructions):

CHEM 117 or permission of the Department of Chemistry and Biochemistry program advisor

What course (courses), if any, is being dropped from the calendar if this course is approved: None

2. Scheduling

How frequently will the course be offered? Every semester

Semester in which the course will first be offered? Fall, 1979

Which of your present faculty would be available to make the proposed offering possible? None.

3. Objectives of the Course

To give the student practical clinical laboratory experience in approved laboratories and to meet Canadian Society of Laboratory Technologists requirements for registration as a medical technologist in Clinical Chemistry.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty A S.F.U. employed coordinator will be required.*

Staff Nil

Library Nil

Audio Visual Nil

Space Nil

Equipment Nil

* Same person as instructing Chem. 420, 423 and 424.

5. Approval

Date: 9 May 79

Department Chairman

Dean

28 May 1979

Chairman, SCUS

SCUS 73-34b:- (When completing this form, for instructions see Memorandum SCUS 73-34a. Attach course outline).

GENERAL CERTIFICATE SYLLABUS

CLINICAL CHEMISTRY

I. INTRODUCTORY STUDIES

A. ANATOMY AND PHYSIOLOGY

1. CELL. The student shall
   a. describe the structure and functional organization of the nucleus and cytoplasm
   b. describe, in general, cell transport mechanisms (metabolism); specifically, permeability, filtration, diffusion, and osmosis
   c. describe cell division - mitosis

2. CIRCULATORY SYSTEM. The student shall
   a. describe and differentiate between: blood, serum, and plasma; body water; lymph
   b. describe the structure and function of the heart
   c. describe the function of arteries, capillaries, and veins

3. DIGESTIVE SYSTEM. The student shall
   a. describe the structure and function of the component parts (including the liver and pancreas)
   b. describe the major pathways of digestion and metabolism of carbohydrates, lipids, and proteins

4. NERVOUS SYSTEM. The student shall
   a. describe the general structure of the brain and spinal cord
   b. describe the formation, function, and reabsorption of spinal fluid

5. RESPIRATORY SYSTEM. The student shall
   a. describe the structure and function of the lungs
   b. describe the transport and exchange of gases in the blood and lungs
   c. describe the mechanism of chloride shift

6. URINARY SYSTEM. The student shall
   a. describe the structure and function of the kidney
   b. describe the structure and function of the nephron
   c. state the function of ureters, urinary bladder, and urethra
   d. describe the formation of urine, stating the factors governing formation and volume
   e. define threshold substances
   f. describe three ways in which the kidney maintains homeostasis

7. ENDOCRINE SYSTEM. The student shall
   a. define hormone
   b. name the hormones associated with the pituitary, thryoid, parathyroid, adrenals, pancreas, gonads, and placenta
   c. in simple terms describe for the organs in 7.b. location, structure, and function

B. ORGANIC CHEMISTRY RELATING TO CLINICAL CHEMISTRY. The student shall

1. NOMENCLATURE
   a. describe the International Union of Pure and Applied Chemistry (IUPAC) system of nomenclature for:
      (1) alcohols
      (2) aldehydes
      (3) ketones
      (4) carboxylic acids
   b. given the IUPAC systematic name of any of the above types of compounds state the functional group in that molecule
   c. given the structural formula for an alcohol, aldehyde, ketone, or carboxylic acid, state the IUPAC name for that compound

d. recognize the [illegible] and structure of compounds that are used routinely in Clinical Chemistry and state the functional group of the compound
e. recognize the functional groups of amino acids using their common names

2. describe briefly covalent, ionic, and hydrogen bonding
3. state the structural characteristics of aliphatic and aromatic compounds
4. state the characteristic of each of the following groups that is commonly used in its measurement
   a. aldehyde
   b. ketone
   c. carboxylic acid
   d. amino acid

C. LABORATORY MATHEMATICS AND STATISTICS. The student shall

1. use common logarithms
2. use the slide rule
3. convert from the imperial to the metric system units of linear and volume measurement, weights, and temperature
4. prepare calibration curves requiring semilogarithmic and linear graph paper
5. round off figures and determine significant figures
6. define and use units specified in the International System of Units (SI) which are applicable to Clinical Chemistry
7. define: accuracy, precision, histogram, mean, median, mode, range, variance, coefficient of variation, and standard deviation
8. given data from replicate or duplicate analysis, calculate the mean, median, mode, variance, standard deviation and coefficient of variation where applicable

II. BASIC LABORATORY KNOWLEDGE AND PROCEDURES

A. LABORATORY SAFETY. The student shall

1. recognize sources of danger from explosives (e.g., gas cylinders, volatile, flammatory liquids), laboratory equipment, chemical burns, poisoning
2. exercise precautions to lessen the dangers of infectious hazards in the laboratory
   a. centrifuge aerosols
      (1) use of suitable containers to prevent breakage or leakage
      (2) operation of centrifuges within safety cabinets
   b. spillage of infectious materials - decontamination following laboratory accidents
   c. handling clinical specimens - personal hygiene practices
3. prevent laboratory accidents by using safety devices provided in the laboratory
4. apply primary first aid when necessary
5. be familiar with fire fighting equipment and procedures in the institution
6. follow institutional procedures for reporting accidents

B. GLASS AND PLASTIC WARE. The student shall

1. state the properties of common types of laboratory glass and plastics
2. select and correctly use beakers, burettes, centrifuge tubes, flasks, funnels, graduated cylinders, syringes, and test tubes
3. pipettes
   a. identify and correctly use volumetric, Mohr, Folin-Wu, Folin and serological pipettes and micropipettes of constriction (Lang-Levy "Lambda") and transfer (Kirk or polyethylene Lenz type self-levelling)

b. describe and [illegible] of TC, TD, and frosted ring ("blow out") pipettes
c. describe the [illegible] of automatic pipettes and burettes, syringe pipettes, and bulk type safety pipettes
d. describe the use and maintenance of syringe type micropipettes

4. determine the tolerance of volumetric glassware using reference tables (see National Bureau of Standards classification and tolerance of volumetric glassware and the Canadian Government Specifications Board)
5. cleaning and storing
   a. prepare and use cleaning solutions (acid dichromate, nitric acid) and detergents (ionic and nonionic)
   b. describe procedures for manual washing, rinsing, and drying
   c. describe the operation of semi-automatic pipette washers
   d. state the correct method of storing glass and plastic ware

C. SOLUTIONS AND REACTIONS. The student shall

1. differentiate between grades of chemicals - analytical, technical, commercial, C.P., U.S.P. or B.P., certified A.C.S.
2. prepare, standardize, and correctly store the following types of chemical solutions: molar, molal, normal, isotonic, standard , and percentage (w/w, v/v, w/v)
3. use tables to determine viscosity and the solubility of solids, liquids and gases
4. use tables to determine freezing, melting, and boiling points
5. prepare and adjust the pH of the buffered solutions used in Appendix - SELECTED METHODOLOGY
6. store, safely handle, and dispose of unstable and dangerous reagents commonly used in the Clinical Chemistry laboratory in accordance with the recommendations of the Fire Marshal and government regulations

D. STANDARDIZATION

1. QUALITY CONTROL. The student shall
   a. define the characteristics of, prepare, and use a primary, secondary, stock, and working standard
   b. recognize sources of error in calibrating Clinical Chemistry methods
   c. monitor precision of tests using duplicate and replicate analysis
   d. assist in the maintenance of a laboratory quality control program and its use of pooled samples and commercially available materials
   e. prepare quality control charts
   f. recognize, from quality control charts, problems of random and systematic error

2. NORMAL VALUES. In determining normal values the student shall
   a. state the number of analyses required for a valid statistical analysis
   b. state criteria for the selection of subjects
   c. represent data for statistical purposes using
      (1) histograms showing Gaussian and non-Gaussian distribution
      (2) mean and ± standard deviation

E. STERILIZATION AND DISINFECTION. The student shall

1. be aware of the potential hazard of patient samples
2. chemically disinfect or sterilize all equipment contaminated by known infectious material
3. chemically disinfect or sterilize all equipment involved with CSF analysis
4. terminally sterilize by autoclaving or incineration known infectious material before discarding
5. follow personal good hygiene practices to reduce hazards to self

F. COLLECTING AND [illegible] SPECIMENS. The student shall

1. select the correct equipment and anticoagulants required for blood collection
2. identify the sites for blood taking - both venous and peripheral punctures
3. describe, discuss, blood taking by venipuncture and peripheral puncture
4. correctly and effectively perform a venipuncture and a peripheral capillary puncture
5. collect rapidly by [illegible]ed blood
6. list the hazards to the patient of blood taking
7. state the importance of safety checks for proper patient and/or sample identification in all stages from collection to final disposal of the specimen
8. state the procedures for 24 hour urine collection
9. specify, with examples, the [illegible] in tests due to patient's
   a. diet - glucose and uric acid
   b. exercise - CO_2 and glucose
   c. intravenous fluids - protein, glucose and electrolytes
10. state the stability of blood, C.S.F., and urine constituents (including cells) with respect to substances determined in the diagnostic laboratory
11. describe the reliable methods for collection, preservation, and safe shipment of biological specimens.
12. describe the shipment of specimens through the mail in accordance with postal regulations.

G. BASIC ELECTRICITY

The student shall define: ampere, ohm, volt, watt, circuit, direct current (DC), and alternating current (AC)

III. CLINICAL ANALYTICAL PROCEDURES AND INSTRUMENTATION

A. WEIGHING AND BALANCES. The student shall

1. state the theory of weighing using principles of addition and substitution
2. demonstrate the correct care and use of laboratory balances(rough and analytical)
3. describe the classification and use of standard weights

B. CENTRIFUGES

1. THEORY OF CENTRIFUGATION. The student shall
   a. define centrifugal force, revolutions per minute (RPM) and relative centrifugal force (RCF)
   b. apply centrifugal theory to the separation of liquid-solid and liquid-liquid mixtures
2. APPLICATION (bench types, large capacity normal temperature floor models, and hematocrit type centrifuges). The student shall
   a. list component parts and their function (rotating shaft, brushes, horizontal and angle heads, metal shields or buckets, trunnions, and cushions)
   b. demonstrate correct procedure of operation (location, balancing tubes, loading, starting, and stopping)
   c. demonstrate the use of a tachometer for measuring speed of rotation
   d. demonstrate simple maintenance (routine cleaning of bowl and buckets, lubrication, and checking for replacement of brushes)

C. THERMAL EQUIPMENT. The student shall

1. convert from one scale to another: Celsius (centigrade), Fahrenheit, and Kelvin (absolute)
2. state the principle involved in bimetallic thermostats
3. operate temperature control systems of ovens and water baths

D. PRODUCTION OF PURE WATER. The student shall

1. state the principle of operation and the use of a still
2. state the basic theory of ion exchange resins and describe their use in demineralizers
3. describe the use of charcoal and membrane filters
4. test for the specific resistance of water

E. HYDROGEN ION ACTIVITY MEASUREMENT. The student shall

1. state the Brönsted theory of pH
2. state the characteristics of appropriate indicators for visual comparison in titration for any specific acid-base titration
3. define buffer and state the uses
4. prepare buffer solutions using standard preperation charts
5. determine hydrogen ion activity (pH) using a pH meter
6. describe the design and care of glass and reference electrodes
7. state the effect of temperature on pH measurement

F. VOLUMETRIC ANALYSIS. The student shall

1. state the principles and uses of acid-base titrations
2. perform acid-base titrations using both indicator and electrometric end-points
3. describe the preparation of an acid-base titration curve
4. use an acid-base titration curve to select the most appropriate indicator system
5. state the basic theory of oxidation - reduction reactions
6. perform an oxidation - reduction titration using permanganate - oxalic acid system

G. GASOMETRIC ANALYSIS. The student shall

1. state Charles' Law and Boyle's Law
2. differentiate between manometric and volumetric techniques
3. cite examples of manometric and volumetric tests

H. OPTICS AND LIGHT (Theory and Application)

1. RADIANT ENERGY. The student shall
   a. give a simple explanation of the nature of light
   b. relate the ultraviolet, visual, and infrared spectra to their approximate wave lengths
   c. relate velocity to wave length and frequency and state the significance of each
   d. define reflection, refraction, and diffraction
2. OPTICAL THEORY AND ITS APPLICATION IN MICROSCOPY. The student shall
   a. demonstrate an understanding of light paths in a compound microscope and the significance of refractive index and resolution
   b. identify and state the function of objectives, oculars, condenser, condenser and field iris diaphragm, stage, and light source
   c. calculate magnification using a compound microscope
   d. for a compound microscope demonstrate proper use, including Kohler illumination, and maintenance (clean and replace and center light bulb)
3. THEORY OF COLORIMETRY. The student shall
   a. identify three major reasons why photoelectric colorimetry is preferred to visual colorimetry in Clinical Chemistry
   b. explain the phenomena of light absorption and transmittance in liquids in terms of the Beers'-Lambert Law

4. MONOCHROMATIC SYSTEMS. The student shall
   a. state the function and limitation of a glass filter and demonstrate the correct selection for a specific test
   b. state the function and limitations of a prism
   c. state the function and limitations of a defraction grating
   d. demonstrate the selection of the correct wavelength using an instrument with a prism or a grating
   e. explain the need for an entrance and exit slit with a prism or diffraction grating
   f. in general terms, explain the use of interference filters
   g. differentiate between single and double beam spectrophotometers
   h. define and use the symbols of the terms absorbance , transmittance , absorptivity , molar absorptivity
   i. describe the relationships between concentration, percent transmittance and absorbance and [illegible] graphically
   j. state the effect of band width on measurements

5. COLOR AND LIGHT MEASURING DEVICES
   a. Photoelectric Colorimeter (filter type). The student shall
      (1) state the principles, application, and limitations
      (2) conduct minor maintenance
      (3) calculate results from readings using single and multiple standards
   b. Spectrophotometers (prism and grating monochrometers). The student shall
      (1) state the principles, application and limitations of these instruments
      (2) state the uses of each of the following light sources: tungsten bulb, mercury vapor, hydrogen and deuterium lamps
      (3) sample holders (cuvettes)
         (a) state the effects of different sizes, shapes and materials and their handling techniques
         (b) match a set of cuvettes
      (4) photo cells - describe, state the principles involved and give the uses of: a barrier layer cell, a photo emissive cell and a photo multiplier
      (5) explain the function in the measuring system of a galvanometer, a potentiometer and a null-point meter
      (6) calculate results from readings using single and multiple standards
   c. Flame Photometer. The student shall
      (1) state the principle, applications and limitations of flame photometry

f. Refractometers. The student shall describe the principle of a refractometer and give examples of its application

I. AUTOMATED ANALYSIS (continuous flow)
The following requirements can be applied to any "Technicon Analysis System" (e.g., either AAI or AAII). The student shall

1. describe the samples and the use of steady state in the selection of sample-wash ratio and speed of determination
2. demonstrate knowledge of appropriate sizes and types of pumps and the pump tubing and the function thereof
3. give principles of dialysis, stating the effect of temperature, pressure, particle size, proteins, and type of membrane in the dialyser
4. describe mixing coils and time delay coils; define "time delay"
5. define "reaction bath" and state the purpose of controlled temperature
6. state the principle of design of the colorimeter
7. describe the flow cuvette
8. state the function of a bubble pattern; describe its adjustment
9. state the basic principle of operation of a recorder
10. convert peak heights of recorder tracings into concentrations
11. use flow diagrams to set up methods
12. perform routine maintenance according to the manufacturer's "routine check chart"

J. ELECTROPHORESIS. The student shall

1. state the principles and uses
2. list the properties of ampholytes
3. state the effects of pH and ion concentration of the buffer, support media, temperature, time, current, and voltage on electrophoretic separation
4. perform an electrophoretic separation of serum proteins

IV. BASIC BIOCHEMISTRY AND ITS APPLICATION TO CLINICAL CHEMISTRY

A. CARBOHYDRATES

1. THEORY. The student shall
   a. state the functional groups of any carbohydrate
   b. differentiate between a monosaccharide, disaccharide and polysaccharide
   c. define triose, pentose, and hexose
   d. state the property and the functional group involved in most measurements of mono or disaccharides
   e. state the structural difference between a reducing sugar and a nonreducing sugar
   f. identify the following as reducing or nonreducing carbohydrates: glucose, lactose, galactose, sucrose, and starch
   g. give an abbreviated description of carbohydrate metabolism
2. APPLICATION. The student shall
   a. determine glucose quantitatively in blood and C.S.F. (See Appendix SELECTED METHODOLOGY)
   b. determine glucose semiquantitatively in urine (See Section V RENAL FUNCTION)
   c. state the common sources of error in performing an oral and intravenous glucose tolerance test that occur before the samples are analysed
   d. perform the chemical analysis involved in glucose tolerance tests and record the data in graphic form

B. LIPIDS

1. THEORY. The student shall
   a. define a lipid
   b. differentiate between a simple lipid and a compound lipid
   c. state the solubility characteristics of lipids in polar and nonpolar solvents
   d. describe the general structure of cholesterol and triglycerides
   e. state the origin of ketone bodies

2. APPLICATION. The student shall
   a. state the principles of cholesterol determination using iron color reagent
   b. test for ketone bodies in urine
   c. test for fats qualitatively in feces

C. PROTEINS

1. THEORY. The student shall
   a. give a simple description of the primary, secondary and tertiary structure of protein stating the significance of peptide and hydrogen bonds in protein structure
   b. state the structural characteristic of a protein that is commonly used in the measurement of serum protein (peptide bond)
   c. describe the general chemical structure of hemoglobin
   d. state the physiological significance of hemoglobin

2. APPLICATION. The student shall
   a. differentiate between albumin and globulin using physical (electrophoresis) and chemical (salt fraction) techniques
   b. describe dye binding techniques in the analysis of albumin
   c. state the principles of and perform the biuret reaction
   d. state the significance of and describe the detection of protein in urine (See Section V, RENAL FUNCTION)
   e. state the significance, detection, and measurement of protein in CSF and urine using turbidimetric techniques (See Section V," CEREBROSPINAL FLUID)
   f. state the significance of fibrinogen and immunoglobulins in serum and urine
   g. demonstrate the techniques for the detection of hemoglobin
   h. detect occult blood in feces

D. ENZYMES

1. THEORY. The student shall
   a. given the common name, the International Union of Biochemists (IUB) systematic name, or the chemical equation representing an enzyme catalysed reaction, classify the enzyme involved as one of the following types: oxidoreductase, transferase, hydrolase or isomerase
   b. state an introductory theory of enzyme kinetics
   c. state the effect of time, temperature, pH, substrate concentration, activators, noncompetitive inhibitors, competitive inhibitors and co-enzymes on enzyme activity
   d. draw a graphic representation of zero order kinetics
   e. define "endpoint" and "rate reaction" types of enzyme measurements
   f. given the unit definition and the appropriate data, calculate enzyme level

g. define International Unit
h. explain the use of enzymes as reagents in terms of the problems involved and the concentration required

2. APPLICATION. The student shall
a. state the physiological factors influencing levels of the following enzymes in blood: amylase, acid and alkaline phosphatases, aspertate aminotransferase, lactate dehydrogenase
b. state the principles used in measuring
(1) amylase by amyloclastic and the dyed-substrate methods
(2) acid phosphatase using Gutman and Gutman modification of King-Armstrong procedure
(3) alkaline phosphatase using the Bessey-Lowry method
(4) aspartate aminotransferase using a dye for color reaction (e.g., Babson method)
(5) lactate dehydrogenase using a kinetic technique (U-V) and a colorimetric technique
c. define isoenzyme and give an example of clinical application using LDH isoenzymes
d. perform the enzyme test listed under Appendix SELECTED METHODOLOGY

E. NONPROTEIN NITROGENOUS SUBSTANCES. The student shall
1. give a simple description of urea, creatinine, and uric acid in the body and their excretion
2. state the significance of measurement of individual nonprotein nitrogenous substances
3. state the principles of the following methods:
a. urea determinations by urease with Nesslerization - Berthelot's method, and diacetyl monoxime techniques
b. creatinine - Jaffe's reaction
c. uric acid phosphotungstate and uricase techniques
4. perform the urea nitrogen and uric acid tests by the methods listed in Appendix SELECTED METHODOLOGY

F. ACID-BASE BALANCE AND ELECTROLYTES
1. THEORY. The student shall
a. describe the buffer systems in the body control of pH
b. describe the respiratory and renal control of acid-base regulation
c. state the compensation that occurs in respiratory acidosis and alkalosis and in metabolic acidosis and alkalosis
d. state the Henderson-Hasselbach equation, incorporating pCO_2 and total CO_2, and describe its use
e. state the role of hemoglobin as an oxygen carrier in acid-base balance
f. define electrolyte balance
g. describe briefly the metabolism of electrolytes and water (osmoregulation)

2. APPLICATION. The student shall
a. state the general principles used in the measurement of potassium, sodium, chloride, CO_2/bicarbonate, calcium, and phosphorus
b. state the use of nomograms based on the Henderson-Hasselbach equation
c. state the normal values of pO_2 and pCO_2 in arterial and venous blood
d. perform the tests listed in Appendix SELECTED METHODOLOGY

CLINICAL CHEMISTRY

Syllabus Sources

Section I.

A. 1,2 Guyton
3 Guyton, Tietz
4,5 Guyton
6 Guyton, Tietz

B. Masterton

C. Davidsohn, Henry, Tietz, Tonks

Section II.

A. Davidsohn, Lynch, MacFate

B. Lynch, Masterton, Tietz

C. Henry, Masterton, Tietz

D. Henry, Tietz, Tonks

E. Davidsohn, Lynch, MacFate

F. Davidsohn, Henry, Lynch, Tietz

G. Ackermann, Masterton

Section III.

A. Masterton, Tietz

B. Davidsohn

C. Baker, S.L., Lynch, MacFate

D. Tietz, Winstead

E,F. Masterton

G. Henry, Tietz

H. 1-4 Henry, Tietz

H. 5 a,b,d,e Ackermann, Henry, Tietz, White

H. 5 c,f Tietz

I. Tietz, White

J. Henry, Tietz, White

Section IV.

A. Henry, Tietz

B. 1. Tietz

B. 2 Henry

C. 1. Tietz

C. 2. Henry, Tietz

D. 1. Tietz

D. 2. Henry

E,F,G. Henry, Tietz

Section V.

A-D. Henry, Tietz

E. Tietz

F. Levinson, MacFate

G. --

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

Department: Chemistry

1. **Calendar Information**

Abbreviation Code: CHEM **Course Number:** 398 **Credit Hours:** 0 **Vector:**

Title of Course: Clinical Chemistry Hospital Training

Calendar Description of Course:

Full-time practical training in approved Hospital or biomedical laboratories in use of chemical diagnostic test. This course is required for the completion of the Analytical Biochemistry option and is not transferable to other degree programs at S.F.U

Nature of Course

Prerequisites (or special instructions):

Chem.397 or permission of the department of Chemistry in consultation with the Biochemistry program advisor.

What course (courses), if any, is being dropped from the calendar if this course is approved: None

2. **Scheduling**

How frequently will the course be offered? Every Semester

Semester in which the course will first be offered? Spring 1980

Which of your present faculty would be available to make the proposed offering possible? None

3. **Objectives of the Course**

To give the student practical clinical laboratory experience in approved laboratories and to meet Canadian Society of Laboratory Technologists requirements for registration as a medical technologist.

4. **Budgetary and Space Requirements** (for information only)

What additional resources will be required in the following areas:

Faculty A part-time teaching appointee will be required.*

Staff Nil

Library Nil

Audio Visual Nil

Space Nil

Equipment Nil

* Same person as instructing Chem. 420, 423 and 424.

5. **Approval**

Date: 4 May 79

Department Chairman

Dean

22 May 1979
Chairman, SCUS

SCUS 73-34b:- (When completing this form, for instructions see Memorandum SCUS 73-34a. Attach course outline).

34

V. CLINICAL CHEMISTRY. OTHER TESTS

LIVER FUNCTION. The student shall

1. briefly describe the metabolism of bilirubin
2. describe the measurement of total and conjugated bilirubin and state the principles of the procedure
3. describe calibration procedures for bilirubin assay
4. state the significance of normal and abnormal bilirubin results
5. describe procedures for the determination of total protein, albumin, and albumin/globulin ratios
6. state the principles and describe the bromsulfophthalein excretion test
7. describe the procedure for detecting bile and urobilinogen in feces and urine
8. perform the alkaline phosphatase test (See Appendix SELECTED METHODOLOGY)

B. GASTRIC FUNCTION. The student shall

1. state the normal composition of gastric fluid
2. gastric function tests
   a. tube method. Name the stimulants, describe and perform the procedures for quantitation of free hydrochloric acid and total acid by titration and pH measurement; perform the calculations and state the normal values; describe the test for and state the significance of occult blood
   b. tubeless method - "Diagnex blue test". Describe and perform the procedure, the interpretation of results and causes of false positive results.

C. FECES The student shall

1. describe the macroscopic appearance of normal feces and state the significance of abnormalities in color and consistency
2. state the principle and test for occult blood
3. test for fecal fats qualitatively

D. RENAL FUNCTION. The student shall

1. define renal threshold
2. describe the following tests for renal function and state the principles
   a. concentration (Fishberg and Mosenthal) and dilution tests
   b. phenosulfonphthalein (PSP) excretion
   c. specific gravity measurement
   d. creatinine clearance
3. apply laboratory mathematics in calculating renal clearance tests
4. perform tests for urea nitrogen in blood. (See Appendix SELECTED METHODOLOGY)
5. state the significant mode of excretion of creatinine
6. state the principles of measurement of creatinine in blood
7. perform a complete routine (semi-quantitative) urinalysis, stating the principles of the tests, purposes, and normal values, using tablets, paper or powder methods where applicable
   a. color and appearance
   b. pH
   c. specific gravity
   d. protein
   e. glucose
   f. bile pigments (bilirubin, urobilin)
   g. blood (hemoglobin)
   h. ketones (acetone and aceto-acetic acid)
   i. microscopic examination of urinary sediment for casts, cells and significant crystals
   j. recognition of the significance of variations in the macroscopic and microscopic appearance of urine

8. state the principles of and perform the following semi-qualitative tests on urine
   a. Bence-Jones protein
   b. urobilinogen and porphobilinogen
   c. differentiation of glucose, lactose, galactose

E. CEREBROSPINAL FLUID. The student shall

1. list the normal composition
2. recognize variations in the macroscopic appearance
3. state the principles involved and perform quantitative tests for protein and glucose and state the normal values

F. TRANSUDATES AND EXUDATES. The student shall

1. define "transudate" and "exudate"
2. differentiate between transudates and exudates using tests for specific gravity and quantitative protein and state the significance of the difference

G. PREGNANCY TESTS

The student shall state the basic principle of one immunological test for human chorionic gonadotropin (HCG)

CLINICAL CHEMISTRY APPENDIX

SELECTED METHODOLOGY

The student shall have practical knowledge of

1. the collection, preservation and handling of specimens for chemical analyses to include the selection of the appropriate anticoagulant where applicable and the reason for any special precautions that must be taken
2. the reagents, the preparation and components
3. the procedures of the tests
4. the calculation and reporting of results

In addition the student shall state

1. the principles of the specific methods employed
2. normal values, including the general significance of abnormal values
3. the principle sources of error in the determinations

A. GLUCOSE

1. METHODS
   a. Nelson-Somogyi (an example of a classical manual method)
   b. automatic analyzer ferricyanide (the original automated method)
   c. glucose oxidase (a manual or automatic enzyme method)
2. SPECIFIC POINTS TO BE EMPHASIZED
   a. manual colorimetric procedure using a single pure standard for calculation
   b. two basic types of protein precipitation
   c. redox reaction
   d. specificity of the three recommended methods

B. UREA NITROGEN

1. METHODS
   a. diacetyl monoxime reaction on "automatic analyzer"
   b. a method using urease - with Nesslerization and Berthelot's method

2. SPECIFIC POINTS TO BE EMPHASIZED - common approach to automation
   a. continuous flow system
   b. dialysis
   c. standardization and calculation using a recorder
   d. identification of samples
   e. carryover contamination
   f. steady state analysis
   g. using an enzyme as a reagent

C. SODIUM AND POTASSIUM

1. METHOD - manual flame photometry

2. SPECIFIC POINTS TO BE EMPHASIZED
   a. principles of flame photometry
   b. problems of ion contamination - preparation of redistilled water
   c. significance of lithium as internal standard

D. CO_2 CONTENT

1. METHOD - gasometric method (Natelson)

2. SPECIFIC POINTS TO BE EMPHASIZED
   a. calculations involving gases at standard temperature and pressure
   b. anaerobic collection and handling of specimens
   c. principles of gasometric analyses

E. URIC ACID

1. METHODS
   a. uricase
   b. phosphotungstic method using Na_2CO_3 in place of cyanides (e.g., Caraway)

2. SPECIFIC POINTS TO BE EMPHASIZED
   a. use of an enzyme to measure substrate concentration
   b. principles and use of U.V. spectrophotometry
   c. comparison of precision of these methods

F. ALKALINE PHOSPHATASE

1. METHOD - p-nitrophenyl phosphate (Bessey-Lowry)

2. SPECIFIC POINTS TO BE EMPHASIZED
   a. conditions required to determine enzyme concentration
   b. example of an enzyme activator
   c. pH dependence of the colorimetric determination of p-nitrophenol concentration
   d. preparation of standard curve in manual colorimetric procedure
   e. conversion of results to international units
   f. use of timed sequences

REFERENCES

CLINICAL CHEMISTRY

Ackermann, P. G., Electronic Instrumentation In The Clinical Laboratory. 1st ed., 1972. Little-Brown Company, Boston.

Baker, F. J., Silverton, R.E., Luckock, E.D., An Introduction to Medical Laboratory Technology. 3rd ed., 1962. Butterworth and Co. (Canada), Ltd., Toronto.

Davidsohn, I., and Henry, J.B., Todd-Sanford Clinical Diagnosis By Laboratory Methods. 14th ed., 1969. W.B. Saunders Company, Toronto.

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Lynch, M.J., Raphael, S.S., Mellor, L.D., Spare, P.D., and Inwood, M.J.H. Medical Laboratory Technology and Clinical Pathology. 2nd ed., 1969. W.B. Saunders Company, Toronto.

Masterton, W.L., and Slowinski, E.J., Chemical Principles. 3rd ed., 1973. W.B. Saunders Company, Toronto.

Tietz, N.W., Fundamentals Of Clinical Chemistry. 1st ed., 1970. W.B. Saunders Company, Toronto.

Tonks, D.B., Quality Control In Clinical Laboratories. Diagnostics Reagents Division, Warner-Chilcott Laboratories, Ltd., Scarborough, Ontario.

White, W.L., Ericksen, M., and Stevens, S.C., Practical Automation For The Clinical Laboratory. 2nd ed., 1972. Mosley Company, St. Louis, Mo.

Winstead, M., Reagent Grade Water: How, When, and Why? 1st ed., 1967. Steck Company, Austin, Texas.

TUTORIAL SUBJECTS

Chem. 307/308

1. Auto Analysers with reference to BUN and Total Protein

   (a) Manual of AutoAnalysers

   (b) VARLEY: Practical Clinical Biochemistry, 4th ed., page 162.

2. Quality Control

   (a) Warner Chilcott Manual of Quality Control.

   (b) TEITZ: Clinical Chemistry, pages 46-72.

   (c) HENRY: Clinical Chemistry, pages 122-151.

   (d) VARLEY: pages 35-40.

3. Electrolytes and Flame Photometry

   (a) TEITZ; pages 99-102, 612-636.

   (b) HENRY: pages 48-63, 345-356.

   (c) VARLEY: pages 485-511, 513-548.

   (d) ZILVA and PANNALL: Clinical Chemistry in Diagnosis and Treatment pages 25-87.

4. Calcium and Phosphorus

   (a) TEITZ: pages 636-650.

   (b) HENRY: pages 356-378, 409-416.

   (c) VARLEY: pages 431-452.

   (d) ZILVA and PANNALL: pages 175-197.

5. Glucose Methods

   1. Reducing and Enzymatic Methods

      (a) TEITZ: pages 154-166

      (b) HENRY: pages 625-662.

      (c) VARLEY: pages 80-109, 126-135.

      (d) ZILVA and PANNALL: pages 125-151.

   2. Differentiation of Urinary Sugars

      (a) TEITZ: pages 166-176.

      (b) HENRY: pages 620-624.

      (c) VARLEY: pages 110-124.

6. Non Protein Nitrogen

1. Urea: Diacetyl monoxime, Berthelot reaction.
2. Creatinine: Jaffe picrate method.
3. Uric Acid: Chemical and enzymatic methods.
4. Clearances: Urea, creatinine, PSP.

(a) TEITZ: pages 707-742.
(b) HENRY: pages 262-302, 887-895.
(c) VARLEY: pages 168-177, 181-183, 190-210.

7. Enzyme Methodology. LDH, SGOT

(a) TEITZ: pages 362-387, 434-449.
(b) HENRY: pages 504-518.
(c) VARLEY: pages 275-284, 289-297.
(d) ZILVA and PANNALL: pages 285-297.

8. Amylase: Phosphatases

(a) TEITZ: pages 392-415.
(b) HENRY: pages 468-477, 482-492.
(c) VARLEY: pages 452-465, 394-408.
(d) ZILVA and PANNALL: pages 126, 206, 215-216 and as for LDH, SGOT

9. Liver Function Tests. Bilirubin and Bile Pigments in Serum and Urine

(a) TEITZ: pages 755-766.
(b) HENRY: pages 571-597.
(c) VARLEY: pages 349-370.
(d) ZILVA and PANNELL: pages 263-284.

10. Liver Function: Cholesterol, BSP,

(a) TEITZ: pages 784-788, 775-781, 352-359.
(b) HENRY: pages 548-569, 843-851.
(c) VARLEY: pages 373-389, 390-391, 309-317.
(d) ZILVA and PANNALL as above.

11. Routine Urinalysis (colour, SG, pH, ketones, blood microscopic)

(a) KARK et al., Primer of Urinalysis, pages 8-17, 40-45, 60-75.
(b) WELLER and GREEN: Examination of the Urine, pages 4-11, part II.
(c) WELLER and GREEN: Examination of the Urine, pages 1-100, Part I.

12. Miscellaneous

Pigments:

(a) TEITZ: pages 284-295, 255-260.

(b) HENRY: pages 334-344.

(c) VARLEY: pages 724-730, 600-603.

(d) ZILVA and PANNALL; pages 323-332.

Odd Urine Tests:

(a) TEITZ: pages 248-260.

(b) HENRY: pages 334-339.

(c) VARLEY: pages 219-228. 150

(d) ZILVA and PANNALL: pages 333-350.

13. Review of Tests of Renal Function

(a) TEITZ: pages 698-741.

(b) HENRY: pages 884-896.

(c) VARLEY: pages 185-188.

(d) ZILVA and PANNALL: pages 1-24.

14. Proteins and Protein Fractionation

(a) TEITZ: pages 177-202, 207-241.

(b) HENRY: pages 173-253.

(c) VARLEY: pages 230-272.

(d) ZILVA and PANNALL: pages 227-247.

15. Cerebrospinal Fluid

(a) TEITZ: pages 202-207.

(b) HENRY: pages 186-199.

(c) VARLEY: pages 698-712.

(d) ZILVA and PANNALL: pages 384-388.

16. Gastric Analysis: Occult Blood

(a) TEITZ: pages 792-805, 279-281.

(b) HENRY: pages 903-913, 780-785.

(c) VARLEY: pages 327-348.

(d) ZILVA and PANNALL: pages 219-222.

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

Department: Chemistry

1. **Calendar Information**

Abbreviation Code: CHEM **Course Number:** 399 **Credit Hours:** 0 **Vector:**

Title of Course: Clinical Chemistry Hospital Training

Calendar Description of Course: Full-time practical training in approved Hospital or biomedical laboratories in the use of chemical diagnostic tests. This course is required for completion of the Analytical Biochemistry option and is not transferable to other degree programs at S.F.U.

Nature of Course

Prerequisites (or special instructions)

Chem 398 or permission of the Chemistry Department in consultation with the Biochemistry Program advisor.

What course (courses), if any, is being dropped from the calendar if this course is approved: None

2. **Scheduling**

How frequently will the course be offered?

Semester in which the course will first be offered?

Which of your present faculty would be available to make the proposed offering possible? None

3. **Objectives of the Course**

To give the student proactical clinical laboratory experience in approved laboratories and to meet Canadian Society of Laboratory Technologists requirements for Registration as a medical technologist in Clinical Chemistry.

4. **Budgetary and Space Requirements** (for information only)

What additional resources will be required in the following areas:

Faculty A part time teaching appointee will be required*

Staff Nil

Library Nil

Audio Visual Nil

Space Nil

Equipment Nil

* same person as instructing Chem 420, 423 and 424

5. **Approval**

Date: 9 May 79 — 22 May 1979

E.J. McNeil — Dean — Norman A. Reilly

Department Chairman — Chairman, SCUS

SCUS 73-34b:- (When completing this form, for instructions see Memorandum SCUS 73-34a. Attach course outline).

92

CHEMISTRY 399

(Tutorial Topics)

Students will study and discuss those items which are within their comprehension . They will audit those items which tend to be basically medical during discussions between clinical chemists and medical biochemistry residents, and participate to whatever extent possible.

Week 1: Laboratory Principles, Instrumentation, Mathematics and Introduction to Quality Control

1. Introductory reading material and mathematical problems will be provided for a general introduction.

2. Become thoroughly familiar with the quality control programme as operated at own and one of the regional hospitals.

3. Think about the following questions, which you should be able to handle by the end of the first three months:

   a) Mr. Jones from Clodd and Funk has a new cholesterol kit he feels would save your laboratory considerable technologist time. How do you go about evaluating the kit?

   b) You are asked to set up a chemistry section for a 100 acute bed and 100 chronic bed general hospital. Medical and surgical beds comprise approximately 50% each. There is a small pediatric service, mostly for tonsillectomies. There is no obstetrics or neonatology. Excluding benches, sinks and building expenses, propose a total capital expense budget, tests you would offer, instruments required and costs, and the number of technical staff you would anticipate needing.

   c) Answer the above questions for a 500 bed general hospital with obstetrics and a neonatal nursery, general surgery and an emergency room service.

   d) What are the pros and cons of routine laboratory screening in clinical chemistry under:

      i) Out-patient screening
      ii) Admission screening
      iii) Organ profiles

   e) What are normal values? How are they derived? What are the problems and pitfalls? When can you call the result "abnormal" ($\pm$ 2 S.D. concept)?

   f) How will you deal with the problem of establishing normal values for your laboratory?

   g) Begin accumulating a list of commonly used drugs and other conditions which interfere with the interpretation of chemistry data. This may be conveniently based on:

      i) Changes in the physiology of the patient, such as:

         A) Protein synthesis
         B) Induction of microsomal enzyme systems
         C) Displacement of substances from binding proteins, etc.
         D) Interference with chemical determinations

ii) Direct end-organ damage, such as cholestasis - methyl testosterone, hepatic necrosis - PAS, etc.
iii) Interference with chemical determination such as enzyme inhibition - fluoride, colorimetric interference - bilirubin contamination - I.V. solution

h) What stat laboratory tests would you provide in a 150 acute bed hospital and a 600 acute bed hospital? Be able to defend your choice.

Literature

1. Drug interferences with clinical laboratory tests. Clin. Chem. 18(10):1041-1304, October 1972.

2. Barnett. Clinical Laboratory Statistics. Little, Brown and Co.

Week 2: Laboratory Approach to Disorders of Carbohydrate Metabolism

1. Carbohydrate Biochemistry - physiology. What are the glucose regulating mechanisms?

2. Hyperglycemia

a) Differential Diagnosis and Diagnostic Approach to a patient with:

i) Glycosuria on routine urinalysis
ii) Hyperglycemia on routine blood sugar.
Classify as follows: Physiologic alteration
Pathogenic
Methodologic

b) i) Discuss the laboratory diagnosis of diabetes mellitus
ii) What are the pathophysiologic changes of diabetic ketoacidosis and the laboratory findings A) at admission, B) following initial therapy, and C) What are the complications of therapy?
iii) Name the most valuable tests in A) treatment of diabetic ketoacidosis, B) follow up of juvenile diabetic, C) follow up of maturity onset diabetic.
iv) Discuss the presentation and laboratory findings as well as the pathophysiology of hyperosmolar non-ketotic diabetic coma.
v) What does a positive Clinitest and negative Clinistix test suggest? What would you do to further investigate the patient?

c) What is the clinical laboratory use of the following test? How are they done? What are the problems and pitfalls (include patient preparation, physiologic, drug and pathologic factors affecting test, interpretation of results, i.e. glucose tolerance curves).

i) Fasting blood sugar
ii) Two hour postprandial sugar
iii) Oral G.T.T.
iv) I.V. G.T.T.
v) Cortisone G.T.T.
vi) What are the three most useful tests in the diagnosis of diabetes mellitus?

d) Discuss 3 glucose methods. What are the problems and the pitfalls?

- What drugs give false increased or decreased values with 2 of the methods?
- What is the difference between serum or whole blood glucose levels?
- Which method would you select for a laboratory doing A) 8 glucoses a day. Why? B) 35 glucoses a day. Why?

Week 3: Laboratory Approach to Disorders of Protein Metabolism

1. Protein Biochemistry

   a) Know in general terms, mechanism of protein synthesis, i.e. transcription-translation

   b) What are the principles and problems of protein electrophoresis? Include pseudomonoclonal peaks.

   c) Discuss the structure and function of the five major immunoglobulins.

   d) Read Tietz, Chapter 5, and Lab. Synopsis on Immunoelectrophoresis: polyclonal and monoclonal gammopathies.

   e) List methods available for measuring total protein.

2. Albumin (Advances Clin. Chem. 1970)

   a) Read albumin synthesis. N.E.J.M. 286:748, 1972.

   b) Classify causes of hypoalbuminemia

   c) What is the known physiologic role of albumin?

   d) What method of albumin determination is optimal for a routine laboratory? Why?

   e) What is bisalbuminemia, analbuminemia?

3. What test would you suggest if you saw a 34-year old man with a pO_2 of 70 mmHg; pCO_2 of 38 mmHg; chest X-ray - emphysema? Discuss disease entity. Med. Clin. North America 57:691, 1973.

4. Do you think routine protein electrophoresis is clinically more useful than albumin and total globulins? Why or why not?

5. What is important in reading electrophoresis?

6. What conditions would be suggested and laboratory investigations planned for a patient presenting with headache, recurrent mucosal bleeds, disturbances in vision, Raynaud's phenomenon? Seminars in Hematology 10:2, April 1973.

7. a) Know in general terms the complement sequence (Good: Immunobiology).
   b) In what conditions is a complement assay useful?

8. Hypergammaglobulinemia

   a) Classify as polyclonal, monoclonal, oligoclonal gammopathies, etc.
   b) What are the complications of hypergammaglobulinemia?
   c) Discuss causes and laboratory investigation of patient with

      i) Polyclonal gammopathy
      ii) Monoclonal gammopathy

3. Hypoglycemia

a) What is the differential diagnosis of hypoglycemia? Classify as:

i) Fasting hypoglycemia
ii) Non-fasting hypoglycemia

b) What is a "significantly" low glucose in adults, neonate?

c) What are the common symptoms of hypoglycemia and how would you investigate a patient complaining of i) neurologic symptoms relating to fasting, ii) dizziness, sweating, three hours following meals?

d) Know use of five hour G.T.T. - glucagon, leucine and tolbutamide test.

4. Laboratory investigation of comatose patient:

a) Differential diagnosis
b) Most common causes in order of frequency
c) Cascade of laboratory tests (include bacteriology and hematology)

5. Optional

a) Classify glycogen storage diseases - laboratory investigations
b) Galactosemia
c) Discuss sorbital metabolisms

Literature

Marks' Hypoglycemia. NEJM, December 1974, female and male
" Diabetic ketoacidosis
Diabetes (GTT)

d) Discuss the laboratory diagnosis of multiple myeloma:

i) Include hematology as well as chemical changes
ii) What are complications of multiple myeloma?
iii) What are the problems and pitfalls in detection of Bence Jones proteins? What is the best screening test?

e) Discuss use of immunoelectrophoresis (IEP) in investigation of immunoglobulin disorders.

9. Hypogammaglobulinemia

a) Classify hypogammaglobulinemia. N.E.J.M. 281:1120, 1969. What further laboratory investigation would you do on a patient with low gammaglobulins on electrophoresis and diarrhea?

b) What is the laboratory investigation of an 18-year old boy with recurrent pulmonary infection. Ped. Clin. North America 18:49, February 1971.

10. Discuss the laboratory investigation of a 21-year old girl with +1 proteinuria; a 45-year old man with +4 proteinuria. Know differential diagnosis of nephrotic syndrome.

11. What are the indications for doing quantitative urinary protein? What is the relationship between quantitative and qualitative tests for urinary protein?
What is prognostic significance of proteinuria?

Literature, general

1. Carson, P.H. Serum proteins. Diagnostic significance of electrophoresis. Human Path. 5:629, 1974.

2. Karle, R.M. et al. A Primer of Urinalysis. Harper and Row, 1970.

WEEK 4: Introduction to Enzymology

1. Discuss in general terms with specific examples the problems and pitfalls of enzyme determinations. Include:

   a) Physiologic variations
   b) Drug effects on i) patient physiology
      ii) methodology
   c) Factors in collection and transport, i.e. effect of temperature, anticoagulants, hemolysis, light, etc.
   d) Methodologic considerations, i.e.

      i) Substrates
      ii) Activators
      iii) Stabilizers
      iv) Inhibitors
      v) Product inhibition
      vi) pH optimum
      vii) Temperature optimum, etc.

2. What is zero order kinetics and how do you check that your method is at 0 order kinetics?

3. Discuss problems with:

   a) Standardising enzyme tests
   b) Arriving at an international agreement on units of measurement of enzyme activity

   Can you compare the results of enzyme measurements obtained by different methods?

4. Define international unit of enzyme activity.

5. A patient is admitted with a 4-hour history of chest pain.

   a) He has a left bundle branch block on ECG
   b) He is in mild congestive heart failure with +2 hepatomegaly
   c) The LDH is 500 i.u.; SGOT 80
   d) He was given intramuscular morphine in the E.R.
   e) What laboratory studies would you recommend?

6. Review the physiologic, therapeutic and diagnostic, non-cardiac disease and methodologic factors in CPK determinations.

7. What is the role of CPK isoenzymes in clinical diagnosis at the present time?

8. You are a pathologist in a 250-bed hospital. What enzymes would you set up in your lab? Consider:

   a) Distribution of physicians at hospital, i.e. surgeons, G.P.s, specialists, internists, etc.
   b) Regional hospital or a self-contained hospital
   c) What cardiac enzymes would you set up in a 250-bed hospital and an 800-bed hospital?

9. Discuss total and isoenzymes of LDH. Include:

a) Molecular structure
b) Tissue distribution
c) Methods of determination

i) Total LDH
ii) Methods of isoenzyme determinations: Substrate
Heat inactivation
Electrophoresis
iii) Discuss relationship of HBD to LDH

d) In what clinical settings would LDH isoenzymes be of value?
e) Where is the optimum region of LDH measurement?
f) What are the problems and pitfalls in collection, transport and storage of LDH?

10. What is the difference between end-point and kinetic enzyme determinations? Discuss the advantages with kinetic methods and the advantages of end-point methods.

<u>Literature</u>, general

1. Tietz, N. Fundamentals of Clinical Chemistry.

2. Schmidt, G. and F.W. Guide to Practical Enzyme Diagnosis.

3. Wolf, P.L. et al. Practical Clinical Enzymology and Biochemical Profiling. Techniques and Interpretation. John Willey and Sons, 1973.

WEEK 5: Laboratory Diagnosis of Liver Disease

1. Discuss bilirubin metabolism (reference folder).

2. What are the major physiologic and biochemical functions of the liver? (Diseases of the Liver, Sherlock)

3. Discuss the biochemical changes seen in liver failure under changes in:

   a) Fluid and electrolytes
   b) Protein synthesis
   c) Enzyme release
   d) Carbohydrate metabolism
   e) Lipid metabolism
   f) Failure of detoxification and conjugation (endogenous and exogenous)
   g) Hormonal changes
   h) Renal changes
   i) Respiratory changes
   j) Immunologic and coagulation changes

4. Briefly list useful liver function tests.

5. Which combination of laboratory tests would you suggest to use as a screen for liver disease? (M.L.O. September 1973, p. 15)

6. What are the typical laboratory changes of viral hepatitis, and which biochemical parameter is most useful in detection of early hepatitis?

7. What is the differential diagnosis of jaundice in:

   a) Neonate
   b) Adult

   What daily increase in bilirubin would you expect in a patient with total obstruction? At what concentration does bilirubin usually "level off"? Why?
   Can high level of bilirubin interfere with other chemical tests? Which ones?

8. What laboratory tests are useful in the differential diagnosis of jaundice?

9. What is the clinical and laboratory approach in the differential diagnosis of hepatocellular necrosis and intrahepatic cholestasis versus extrahepatic obstruction? (Med. Clin. North America, November 1968, pp. 14-17)

10. What are the conditions that result in postoperative jaundice and what laboratory studies are indicated? (N.E.J.M., February 8, 1973, p. 305)

11. Discuss alkaline phosphatase under:

    a) Tissue distribution
    b) A five assay method for total alkaline phosphatase with advantages and disadvantages of each (which method would you pick for your laboratory?).
    c) Clinical significance of total alkaline phosphatase
    d) Methods of separating isoenzymes
    e) Clinical usefulness of alkaline phosphatase isoenzymes (Am. J. Clin. Path. February 1974, p. 142 and May 1972, p. 25; J. Clin. Path. 27:392, 1974)

12. A 45-year old man presented with facial lacerations. Rouleaux formation was seen on the peripheral blood smear, and the serum alkaline phosphatase was slightly elevated. SGOT and bilirubin were normal. What further tests if any, are indicated?

13. Discuss GGT and its possible use in assessing liver damage.

14. What are the typical changes seen during the course of acute viral hepatitis in bilirubin, SGOT, alkaline phosphatase, urobilinogen and urine bilirubin glucuronide?

15. What are the best tests for following a post-hepatitis patient to detect progression to chronic aggressive hepatitis?

16. Does serum ammonia have any clinical value (read Sheila Sherlock's book).

17. What are the diagnostic and prognostic uses of alpha fetoprotein? See Lancet 7854:373, 1974.

18. Discuss bile acids:

    a) Therapeutic use (N.E.J.M. 289:655, 1973)
    b) Value of serum bile acid determination

19. Discuss serum protein abnormalities in liver disease, LpX, etc. (Clin. Chem. 19:86, 1973).

<u>Literature</u>, general

1. Tietz, N. Fundamentals of Clinical Chemistry.

2. Sherlock, S. Diseases of the Liver.

3. Guidelines for selection and appraisal of diagnostic tests from NEJM, 1971-1972.

WEEK 6: Laboratory Diagnosis of Renal Disease

1. Review renal physiology (Diseases of Kidney, Strauss and Welt, and for the enthusiast, Physiology of the Kidney and Body Fluids, Robert Pitts).

2. Discuss the counter current multiplier system of the kidney.

3. Review Question 10, Week 3.

4. Review Question 2 a) i), Week 2.

5. Discuss the biochemical changes in chronic renal failure.

6. Discuss tests used to measure glomerular function (N.E.J.M. 285: 385, 1971). What about children and infants where it is hard to collect urine (N.E.J.M. 287:1109, 1972)? Discuss different methods of estimating GFR (Scand. J. Clin. Lab. Invest. 34:1, 1974). Calculate the creatinine clearance on several in-hospital patients and know the concept of clearance thoroughly. What is "standard clearance"?

7. Discuss tests used to measure tubular function (N.E.J.M. 285:489, 1971). What is the role of concentration tests and how are they performed? What about BSP? What are the risks involved? How would you prevent them?

8. What is the relation of serum BUN and creatinine levels in early end stage renal failure?

9. What are the changes in the following parameters which may be useful in differentiating pre-renal versus renal and post-renal acute renal failure?

   a) CVP
   b) BUN:creatinine ratio. Name causes of abnormal ratio
   c) Urine sodium and potassium
   d) Urine and plasma osmolality
   e) Manitol response, etc.

10. Discuss the synthesis of urea - extra renal conditions that raise and lower BUN and two methods of urea determination (urease and diacetyl monoxime) - advantages and disadvantages of each.

11. Discuss the synthesis of creatinine. What is the relation of serum creatinine to creatinine clearance in progressive renal impairment? Discuss the determination of serum and urine creatinine, methodology problems, etc. In a small hospital using manual methods, would you do routine BUN or creatinines to screen renal function?

12. Supposing the creatinine clearance decreases by 50%, how much creatinine will be excreted into the urine in comparison with the previous normal daily excretion?

13. Is it worthwhile to do urinary sediment on urines with good concentration and negative chemical findings?

14. What type of substances may greatly increase osmolality? Where is this used practically?

15. What would you advise as a simple battery of tests to screen renal function?

16. What should be included in a routine urinalysis? Know the problems and pitfalls of each method, how it is done and how it is interpreted.

17. What is the principle of a urometer, a refractometer and osmometer? Which instrument would you use in a routine urinalysis in

    a) A general hospital
    b) A pediatric hospital

    Define osmolarity and osmolality. What is the major contributor to serum osmolality? Give causes of:

    a) High serum osmolality
    b) Low serum osmolality

18. Be able to interpret a complete urinalysis, including identification of common crystals, white and red blood cells, oval fat bodies, various casts, etc. Know which crystals are present in acid and alkaline urine and how one identifies the specific crystals.

19. Read discussion of 24-hour urine chemistry(folder).

20. What is the differential diagnosis of polyuria and the laboratory tests sequence to define the etiology? What is the osmotic diuresis (N.E.J.M. 291: , 1974)?

21. What conditions result in appropriate and inappropriate antidiuretic hormone secretion?

22. Current topics:

    a) On the pathogenesis of the uremic state. N.E.J.M. 286:1093, 1972.
    b) Proteinuria. Am. J. Med. 56:71, 1974.
    c) Excretion of acid by the kidney. N.E.J.M. 278:1102, 1968.
    d) Tubular reabsorption of sodium ion: Influences of factors other than aldosterone and glomerular filtration rate. N.E.J.M. 285: 1231, 1971.
    e) Cyclic AMP and urine concentrating ability. N.E.J.M. 54:1049, 1974.
    f) Clinical evaluation of kidney function in Guidelines for selection and appraisal of diagnostic tests, NEJM, 1971-1972, pp. 22-46

WEEK 7: Adrenal Disease and Hypertension

1. Outline:

   a) The control mechanism of the hypothalamic-pituitary-adrenal axis.
   b) The renin angiotensin aldosterone relationship (N.E.J.M. 291:446, 1974).
      What factors control renin production?
      What factors control aldosterone secretion?
   c) Synthesis metabolism and actions of catecholamines.
   d) Synthesis metabolism and actions of i) mineral corticoids, and ii) glucocorticoids.
   e) What are the usual changes in the following parameters with Addison's disease and Cushing's disease:

      i) Glucose, lipids, plasma proteins, electrolytes, calcium, phosphorous, Vitamin D and bone metabolism
      ii) Hematologic changes
      iii) Changes in inflammatory response

2. a) What are the causes of hypocorticism under congenital, acquired, primary and secondary? Know the clinical and biochemical differences between primary and secondary conditions.

   b) A surgeon suspects Mrs. Jones may have Addison's disease. She has lost weight, is slightly hypotensive and has a hemoglobin of 11.5, WBC 6,000 with 8% eosinophils, 50% lymphocytes, 4% basophils and 48% polymorphs. What is the diagnostic cascade in evaluating this patient?

      Another patient has had lupus which has been treated with 60 mg Prednisone for several years. This was discontinued two months prior to admission for an elective cholecystectomy. Her serum cortisol level is normal. Would you advise further tests or is it safe to operate?

3. a) What are the causes of hypercorticism - review the metabolic changes.

   b) Discuss the relative value of screening tests for Cushing's syndrome and Cushinoid obesity. Am. J. Med. 55:621, 1973. Know the difference between primary and secondary conditions.

   c) What is a reasonable diagnostic cascade in a patient suspected of having Cushing's syndrome? Include the principle tests "classically" used to attempt to separate Cushing obesity, Cushing's disease, adrenal adenoma, adrenal carcinoma and ectopic ACTH producing tumors. Include serum cortisol levels, a.m. and p.m., urinary free cortisol, dexamethasone suppression both overnight and classic 3-day method, role of ACTH stimulation test, metapyrone blockade test, ACTH assay, as well as localising procedures such as angiography, cholesterol, I131 scan, etc.

d) What conditions alter the diurnal cortisol variation?

4. What are the principles of the following tests:

a) Norynberski 17-KGS) and the Allen correction
b) Zimmerman reaction 17-KS)
c) Mattingly reaction for plasma cortisol
d) Competitive protein binding and RIA for cortisol

For the above tests, what causes:

a) Physiologic elevations
b) Drug interference in vivo and vitro
c) Pathologic elevations for specific steroids measured by each assay

5. Following an outline of steroid synthesis, where are the metabolic blocks which are manifested in "adrenogenital syndromes" and what are the salient biochemical findings and diagnostic tests used in diagnosis? Also be familiar with the clinical presentation of these patients in that the appropriate tests can only be ordered if the diagnosis is initially included in the differential.

6. a) List an etiologic differential diagnosis of hypertension, and indicate which are surgically treatable.
b) What is the current status of renin and aldosterone levels in the diagnosis of hypertension?
c) A general practitioner stated he documented hypertension in a 27 year old man and routine urinalysis and CBC were apparently normal. There were no significant physical findings and plasma renins and aldosterone levels are requested.

i) What further information and tests would you suggest?
ii) Following i), what would you suggest if the renin level were low and aldosterone elevated?
iii) If the renin level were normal and the aldosterone level normal?
iv) The renin was elevated as well as the aldosterone level?

(See Low renin hypertension, N.E.J.M. 287:343, 1972).

v) Is it necessary to do both renin and aldosterone at the same time?

7. What is the relative value of VMA, metanephrines and catecholamines in diagnosing pheochromocytoma?

8. What are the interfering substances with some VMA determinations (general) and what are the principle steps in the Pissano method?

9. What protocol would you set up in screening for pheochromocytoma?

10. What conditions cause an elevated urine catecholamine level? Which drug and what are the physiologic and pathologic causes of elevation? What is the principle of one catecholamine method?

11. Follow several hypertensive workups with Dr. Ted Wilkins at St. Paul's Hospital.

REFERENCES

For the Enthusiast

1. CIBA Clinical Symposia on Hypertension, 25:2, 1973.
2. Symposium on Hypertension: Mechanisms and Management. Am. J. Med. 55:261, 1973.
3. Puzzle of Essential Hypertension. M.M.C. 28:726, 1973.

Aldosterone-Renins

1. General Discussion: Aldosterone in Clinical Medicine. Searle 1972.
2. Control of Renin Release. Am. J. Med. 55:333, 1973.
3. Hyperaldosteronism. Med. Residents' Seminar, M. Melville, 1972.
4. Outline of Routine Clinical Laboratory Approach to Primary Aldosteronism. J.W. Conn (folder).

Adrenal Cortical Steroids

1. Cushing's Syndrome: a prospective study of diagnostic methods. Am. J. Med. 55:621, 1973.
2. Diagnostic approach to hypofunction and hyperfunction of the adrenal cortex. Forsham, P.H. and Smile, R.P., U.C.M.C.

Catecholamines

1. General Review, N.E.J.M. 287:237, 1972.
2. General Review, N.E.J.M. 273:637, 747, 1965.
3. Extra-adrenal pheochromocytoma. Literature Review, Surgery 63:268, 1968.
4. Catecholamines. Medical Residents' Seminar, M.K. Miller, 1970.
5. Catecholamines. Pathology Residents' Seminar, S.K. Ting, 1972.

WEEK 8: Laboratory Diagnosis of Thyroid Dysfunction

Basic Concepts

1. Outline the feedback control system of thyroxin regulation, i.e. TRH, TSH, T3 and T4.

2. Review iodine metabolism under intake, total body pool, thyroid iodine (uptake, oxidation, coupling, storage, release) and cellular action of T4 and T3.

3. How is T4 and T3 transported in plasma and what factors cause an elevation and decrease in these binding proteins?

4. What is the relationship between T4 and T3 (gland, periphery)?

Tests

Know the principles and problems of the following tests. Concentrate on the pertinent tests (will discuss).

1. Concentration of thyroxin in blood:

   a) By measuring PBI or T4 by CPB.
   b) T3 determination

2. Measuring thyroid hormones - protein interaction:

   a) T3 resin
   b) ETR
   c) Free T4
   d) Thyroid binding protein
   e) Calculation and use of free thyroxin index

3. Metabolic response BMR, cholesterol, CPK ↑

4. T3

5. TSH assay

6. Dynamic function

   a) I^{131} uptake 4/24 hours
   b) TSH stimulation
   c) T3 suppression
   d) TRH stimulation with assay of TSH

7. Morphology:

   a) I^{131} scan
   b) Needle biopsy. For what conditions would you recommend this procedure?

8. LATS and thyroid antibody determination

Hypothyroidism

1. List the causes of hypothyroidism under:

a) Congenital
b) Acquired - primary thyroid failure
- secondary failure to pituitary and hypothalamic disease

2. Briefly list the symptoms and signs of hypothyroidism

3. Discuss laboratory diagnosis of hypothyroidism under:

a) Screening tests. Know the enzyme and lipid changes (primary versus secondary)
b) Confirmatory tests and tests to determine primary thyroid or secondary pituitary or hypothalamic etiology
c) Tests for specific etiology. Include T4, I^{131} uptake, free thyroxin index, TSH, TSH assay and TRH stimulation. In discussion, mention the role of skull films, visual field examination and role of measuring other trophic hormones.

4. What factors can cause a falsely elevated or depressed PBI, T4 by column, T4 by radioimmunoassay?

5. What are the problems with the ETR?

6. What information must be determined before one interprets an I^{131} uptake result?

7. What are the problems with the TSH stimulation test? Do you think TSH assay and TRF stimulation will replace the TSH stimulation? Why?

8. What tests are available to diagnose Hashimoto's disease? How specific are they and what is the role of needle biopsy?

Thyroid Hormone Levels

What is the use of thyroid hormone levels in the following therapy:

1. A general practitioner has his hypothyroid patient on dessicated thyroid and wonders what level of T4 indicates a euthyroid state. What is your response? What about L-thyroxin (synthyroid), L-triiodothyronine (cytomel) and thyroid extract?

2. What static thyroid function tests are affected by inorganic iodine and organic iodine? What physiologic conditions and drugs affect thyroid binding globulin, thyroid binding prealbumin and binding of thyroxin to the carrier protein?

Hyperthyroidism

1. List the causes of hyperthyroidism under:

a) Primary thyroid
b) Hypothalamic pituitary
c) Ectopic
d) Factitious
e) Induced (Jod Basdow effect)

60

2. Briefly list the symptoms and signs of hyperthyroidism. How can it present in the elderly?

3. Discuss laboratory diagnosis under:

   a) Screening tests. Include T4, free thyroxin index and ETR.
   b) I^{131} uptake and scan. What are the clinical times to measure uptake?
   c) T3 suppression. Dose of T3, time and interpretation.
   d) What is the role of the TSH level in diagnosis of hyperthyroidism and what is the role of the TRF stimulation and TSH assay?
   e) A general practitioner has described to you a patient who clinically is hyperthyroid. The T4, T3 and free thyroxin index are normal. There is a moderately increased uptake of I^{131} at 4 hours. What tests would you suggest in this situation?

4. A patient presents with unilateral exophthalmus. The ETR and T4 are borderline elevated. What three tests might one suggest and which would you prefer?

REFERENCES

1. Thyroid function test. Adv. Int. Med. 18:345-362, 1972.
2. Evaluation of thyroid function. Progress in Clin. Path. 3: 308-336, 1970.
3. Clinical Experience with the TRH Stimulation Test. Acta Endocrin. 72:697-713, 1973.
4. Free thyroxin index. Am. J. Clin. Path. 51:118, 1974, and 60:499, 1973.
5. Replacement dosage of L-thyroxine in hypothyroidism. N.E.J.M. 290:529, 1974.
6. Assessment of thyroid function. Medical Residents' Seminar, J.D.A. Elliott, 1971.
7. Hypothalamic regulatory hormones - a review. J. Clin. Path. 27:173-184, 1974.
8. Role of plasma proteins in the binding distribution and metabolism of the thyroid hormone. N.E.J.M. 278:1153, 1968.
9. Principles of and pitfalss in thyroid function tests. J. Nuc. Med. 6:853, 1965.
10. Evaluation of thyroid function. N.E.J.M. 286:924, 1972.

Additional references present in file

WEEK 9: Parathyroid Disease

1. a) Outline the major regulatory mechanisms of calcium homeostasis and know the emerging concepts in Vitamin D metabolism (DeLuca, P. N.E.J.M. 289:359, 1973; Sherwood, L.M., N.E.J.M. 278:663, 1968; Sherwood, L.M. Am. J. Med. 50:658, 1971).

   b) What factors facilitate and inhibit calcium and Vitamin D absorption?

   c) What are the target organ effects of PTH Vitamin D and metabolites and calcitonin?

2. List the causes of hypercalcemia. Which of the foregoing causes are most commonly encountered in a general hospital? Include falsely elevated values due to collection, storage, contamination and methodology.

3. What may be the presenting symptoms of acute and chronic hypercalcemia? What is a reasonable approach to the laboratory diagnosis in each situation (Raisz, L.G., N.E.J.M. 285:1006, 1971).

4. A 38-year old woman is admitted with a urinary tract infection. In a screening battery of tests a calcium of 10.9 mg% was found (normal 8.5 - 10.5). What additional information would you like and what further laboratory studies would you consider?

5. What tests do you feel are most useful in establishing the diagnosis of hyperparathyroidism? Goldsmith, R.S., N.E.J.M. 281: 367, 1969.
   What is the current status of radioimmunoassay for parathormone?

6. In the previous woman a diagnosis of hyperparathyroidism has been established. What associated conditions come to mind?

7. Review the UMMC protocol for diagnosis of hyperparathyroidism. What methods are available for localising sites of parathormone production (Potts, J.T., N.E.J.M. 286:1169, 1972; Am. J. Med. 50, 1971).

8. List typical parameters expected in serum calcium, phosphorous, alkaline phosphatase and urine calcium, phosphorous and TRP in diseases associated with hypercalcemia. What can serum Cl and CO2 tell you: Why? (Duncan - Diseases of Metabolism).

9. Know the principles and some advantages and disadvantages of the following tests for calcium:

   a) Clark Collip
   b) One EDTA titration method
   c) Cresolphthalein complexone
   d) Atomic absorption spectrophotometry

   References: Gambino, S.R. and Zettner, A. ASCP Clin. Chem. CC-33, 1955.

a) Which would you pick for a 150-bed hospital?
b) A 500-bed hospital?

10. Be familiar with non-parathyroid humeral hypercalcemia in patients with neoplastic diseases (Potts, J. N.E.M.J. 289:176, 1973).

11. List the causes of hypocalcemia. Which are most commonly encountered in a general hospital? In what type of patients can you expect the most dramatic fall of calcium following surgical treatment of hyperparathyroidism?

12. What laboratory studies may be appropriate in a patient complaining of tingling in the legs and muscle cramps?

13. Review neonatal hypocalcemia, its causes and treatment (N.E.J.M. 278:1163, 1968).

14. What laboratory studies may be useful in the diagnosis of convulsions and tremors in a two day old infant? Include all underlined pertinent studies.

15. Do you think it is worthwhile routinely reporting albumin when a serum calcium is ordered?

16. What are the pathophysiologic events leading to an increased serum phosphorous, decreased calcium and increased alkaline phosphatase level in chronic renal failure? Include pertinent features from Vitamin D metabolism, calcium absorption, parathyroid hormone levels and so forth.

17. What are the causes of hypoparathyroidism?

18. What routine precautions should be taken in the determination of urine calcium by atomic absorption spectrophotometry?
Additional reading: Reiss, F. and Canterbury, J.M. Genesis of Hyperparathyroidism. Am. J. Med. 50:679, 1971.
Look over the July or August 1974 issue of the American Journal of Medicine on Diseases of the Parathyroid, Part 2. Also see the new issue of Clinics in Endocrinology on Parathyroid Disease is available.

19. What is the pathogenesis of renal osteodystrophy?

20. What is the test useful in the diagnosis of pseudohyperparathyroidism? What is the role of cyclic AMP in the differential diagnosis of hypercalcemia.

<u>Literature</u>

1. Kodicek, E. The story of Vitamin D. The Lancet, March 2/74:325.
2. CPC, NEJM 291:780, 1974.
3. CPC, NEJM 290:504, 1974.

WEEK 10: Blood Gases and Acid Base Problems

1. The "buffer systems" of the body. Their relative importance.

2. Write and explain Henderson-Hasselbach equation, taking HCO_3^-:CO_2 system as a practical example. Explain the relationship between pCO_2 and mmol of CO_2.

3. How is pCO_2 measured in practice. Define terms pCO_2, total CO_2, total bicarbonate, standard bicarbonate, base excess. Explain how the above entities are measured and/or calculated.

4. Practical measurement of pH, pO_2 - the underlying principle, methodology. Calculations of HCO_3^-, Sigaard Anderson, nomograms, how to use them.

5. Explain the pathophysiology of a metabolic and respiratory acidosis and alkalosis, compensatory mechanisms.

6. Name the main electrolytes:

   a) Extracellular
   b) Intracellular

7. What factors affect the distribution of electrolytes between intra and extracellular space.

8. Classify hypo and hyperkalaemias. Know the clinical symptoms and EKG changes typical of those two situations.

9. What are the most frequent causes of hypo and hyperkalemia at V.G.H?

10. Classify hypo and hypernatremia. What are the clinical symptoms? Causes?

11. Know how to estimate total body losses of water, sodium and potassium and the guidelines for the replacement.

12. Define "anion gap".

13. What are the causes of:

   a) An increased
   b) A decreased anion gap.

14. What other information can be derived from the anion gap?

15. Name the causes of increased (decreased) serum chloride. Is measurement of chloride a) essential, b) useful, c) superfluous?

16. Name conditions in which measurement of serum phosphate is of value.

17. Do the same for serum magnesium.

18. Principles of flame photometry. Problems.

19. Principles of atomic absorption. Difficulties.

20. Know the autoanalyser II and Technicon 6/60.

21. Are there other ways of measuring electrolytes?

Practical Examples

1. **Electrolytes**

Cl.	93
CO2	36
Na	148
K	4.3

Blood Gases

pH	7.35
pCO2	74
pO2	50
HCO3	40

2.

pH	6.87
pCO2	125
pO2	54
HCO3	21.3

3.

Cl.	120
CO2	29
Na	170
K	3.3

4.

Cl.	88
CO2	15
Na	117
K	2.3

5.

Cl.	103
CO2	5
Na	145
K	7.9

pH	6.90
pCO2	14
pO2	102
HCO3	--

6.

Cl.	110
CO2	25
Na	152
K	4.4

7.

Cl.	103
CO2	7
Na	135
K	74

8.

Cl.	79
CO2	32
Na	118
K	7.5

9. Electrolytes

Cl	:	87
CO2	:	38
Na	:	138
K	:	3.0

10.

Cl	:	75
CO2	:	23
Na	:	113
K	:	4.6

Discuss the clinical and laboratory possibility that may fit the above results.

Literature

1. Filley, G. Acid base and blood gas regulations. Lea and Febiger, 1971.

2. Fleischer, W.R. and Gambino, S.R. Blood pH, pO2 and oxygen saturation. ASCP 1972.

WEEK 11: Toxicology

1. What are the most frequent overdoses? Has there been any change in the pattern lately.

2. What equipment is in your opinion necessary for a 500-bed general hospital to handle basic toxicology?

3. Describe two methods for the determination of blood alcohol. Give details of specimen handling before analysis, possible interferences.

4. Know the difference between arterial and venous levels of alcohol, pattern of elimination and metabolism, dangerous levels - any precise correlation with mental impairment.

5. What acid base and electrolyte disturbances can you expect in alcoholics?

6. What disturbances of CHO, lipid and protein metabolism may occur in alcoholics?

7. What are the most frequent vitamin deficiencies in alcoholics?

8. Name methods for:

   a) Screening
   b) Quantitative determination

   of barbiturates in blood and urine. Know the principles of extraction, principle of quantitative determinations (spectrophotometric and GLC).

9. Patient has a blood barbiturate of 5 ug/ml. What other information is needed to decide whether this is a dangerous level?

10. What method is used for qualitative determination of drugs?

11. Explain the pathophysiology of salicylate poisoning. Predict the disturbances in acid-base and electrolyte balance which may occur. Suggest treatment.

12. Know the screening and the quantitative tests for salicylates, specificity (interferences), therapeutic and toxic levels.

13. Know the principles of GLC determination of the common anti-convulsants.

14. Explain the rationale behind the determination of blood levels of common drugs - when and how to use it (relationship to last dose, metabolism of drug, etc.).

15. How would you determine and interpret:

   a) Blood level of lithium
   b) Bromide

16. How frequently is coma due to O.D. at V.G.H.? Is there any poison centre in B.C.? How would you organise such a centre?

17. Name method for detection of CO in blood. Can you analyse an "out of town" specimen? What are the dangerous levels?

References: N. Tietz, Fundamentals of Clinical Chemistry.

WEEK 12 (a): Gastric Analysis

1. In what situations is gastric analysis of value?

2. How is it done (step by step) practically?

3. What is the basal HCl secretion?

4. What stimuli are used to augment gastric secretion? Which one is the most specific? Is insulin a useful stimulus? Hollander test - how to do it.

5. Define terms free HCl, total HCl, maximal acid output.

6. In what disease is the ratio of basal:stimulated acid secretion decreased?

WEEK 12 (b): Pancreatic Disease and Malabsorption

7. What is secretin test used for? How is it performed? What is pancreozymin test used for? How is it performed?

8. Name tests for malabsorption (including "non-chemical") and divide them into useful and "obsolete".

9. In interpreting carotene levels, what do you have to know about the patient?

10. What is the major practical problem with 3 (or 5) day stool fat analysis (fat balance)?

11. What is the methodology used for the analysis of fecal fat? What is the composition of fecal fat in the normal individual? In malabsorption?

12. What is the most frequent pathology found in malabsorption in

    a) Pediatric?
    b) Adult age group?

13. What are the most useful tests of pancreatic function? How great a loss of pancreatic tissue must occur before the patient develops pancreatic malabsorption?

14. What is the value of fecal trypsin determination?

15. Define malabsorption and maldigestion (Cecil-Loeb, 13th Edition, pp. 1285-1312).

16. List causes of:

    a) Malabsorption
    b) Maldigestion

Ref: Gastroenterology, Ed. 1, Gillespie and Thorsen, London, 1972.

17. Describe the biochemical steps for successful digestion and absorption of fat.

18. Specifically discuss micelle formation and role of bile salts in fat absorption.

19. A 50-year old man has weight loss, bulky stools. The xylose tolerance test is normal, pro time normal. How would you investigate further re malabsorption, maldigestion?

20. Describe briefly:

    a) Xylose tolerance test
    b) Quantitative 3-day stool fat determination (Ref: Clin. Chem. 19:499, 1973)
    c) Serum carotene

21. What screening tests do you advocate for malabsorption?

22. Discuss current concepts and laboratory findings in celiac disease; role of gliadin.

23. A severely dehydrated infant is brought to hospital with a history of having many bowel movements and a problem keeping down certain foods. From examination, a resident suspects celiac disease and immediately starts a 3-day stool collection, along with appropriate I.V. therapy for the dehydration. Discuss the implication of the 4 gm/day stool fat result from the laboratory.

24. Why is prothrombin time the only "stat" test usually required from a suspected malabsorption case admitted to Emergency?

Literature

Guidelines for selection and appraisal of diagnostic tests from NEJM, 1971-1972, pp. 98 and 105.

S76-10

SIMON FRASER UNIVERSITY

MEMORANDUM

To SENATE	From SENATE COMMITTEE ON ACADEMIC PLANNING
Subject CLINICAL CHEMISTRY	Date DECEMBER 18, 1975

Action taken by the Senate Committee on Academic Planning at its meeting of December 17th, 1975 gives rise to the following motion:

MOTION 1

That Senate approve and recommend approval to the Board of Governors of the proposal for a program in Clinical Chemistry as set forth in SCAP 75-4 revised.

There was considerable discussion within the Senate Committee on Academic Planning regarding the assignment of credit to the three clinical chemistry practica (Chemistry 397, 398, and 399). While a number of alternatives were considered, the consensus of the Senate Committee on Academic Planning was that the Clinical Chemistry Training Program experience most closely resembled the Professional Development Program in the Faculty of Education and that, therefore, credit should be assigned in an analogous manner. It is thus recommended that each of the three Clinical Chemistry practica be assigned credit of fifteen semester hours. Because of the specialized nature of the practica, it is also recommended that credit for the practica not be transferred to other degree programs in the University.

FOR INFORMATION

May, 1979

Registrar's Note:- This page and those following are for information only. The courses were approved previously.

FOR INFORMATION

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

Department: Chemistry

Calendar Information

Abbreviation Code: CHEM Course Number: 420 Credit Hours: 3 Vector: 3-1-0

Title of Course: Clinical Chemistry I

Calendar Description of Course:
An introduction to the biochemical processes in the organs, tissues and fluids of the human body and the effect of disease on these processes. Biochemical methods and laboratory diagnoses as applied to the study of disease.

Nature of Course Lecture Tutorial

Prerequisites (or special instructions):
Prerequisite: Third year standing in Chem or Biochem or permission of department.*

What course (courses), if any, is being dropped from the calender if this course is approved: This is a course similar in content to Chemistry 420-3 offered in 74-3 as an evening course.

2. **Scheduling**

How frequently will the course be offered? once per year

Semester in which the course will first be offered? Fall 1976

Which of your present faculty would be available to make the proposed offering possible? None

3. **Objectives of the Course**

To relate the principles of chemistry as they apply to the nature and detection of disease.

4. **Budgetary and Space Requirements** (for information only)

What additional resources will be required in the following areas:

Faculty	An additional professional appointment will be required*
Staff	Nil
Library	Nil
Audio Visual	Nil
Space	Nil
Equipment	Nil

* Same person as instructing Chem 423, 424

5. **Approval**

Date: 11 Sep 75

Department Chairman | Dean | Chairman, SCUS

* In consultation with the Biochemistry Committee.

SCUS 73-34b:- (When completing this form, for instructions see Memorandum SCUS 73-34, Appendix A)

1

CHEMISTRY 420-3

COURSE OUTLINE

FOR INFORMATION

wk	Topics
1	--Course introduction, review of development of clinical chemistry
	--Differentiation of health and disease, pathological processes, concept of normal physiological ranges.
2	--Quality assurance systems, reference materials, error analysis.
	--Specimen collection, handling and storage, deproteinization
3	--Respiratory function and biochemical acid-base balance
	--Disorders and assessment of acid-base equilibria
4	--Fluid and electrolyte regulation osmolality
5	--Renal anatomy, biochemistry of urine formation
6	--Assessment of renal function
7	--Anatomic considerations of the liver, bilirubin metabolism
8	--Liver function tests and their role as diagnostics
9	--Electrophoretic assessment of protein disturbances
	--The immunoglobulins: classes, structure and function
	--Immune mechanisms and deficiency states
10	--Biochemical disorders of carbo-hydrate metabolism
11	--Lipids: methods of transport, inter-relationship with carbo-hydrate metabolism
	--Lipoprotein patterns in disease, cholesterol, tribycerides
12	--Pancreatic secretions and malfunction in disease
	--Biochemistry of the gastro-intestinal system and assessment
	--Malabsorption
13	--The cerebrospinal fluid system
	--Iron and magnesium metabolism, diagnostic implications

FOR INFORMATION

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

Calendar Information

Department: Chemistry

Abbreviation Code: CHEM Course Number: 423 Credit Hours: 3 Vector: 3-1-0

Title of Course: Clinical Chemistry II

Calendar Description of Course:

A continuation of Chem 420-3 dealing with the nature and appraisal of disease-affected systematic function; pharmacological and analitical aspects of clinical toxicology; clinical laboratory systems.

Nature of Course Lecture Tutorial

Prerequisites (or special instructions): Chem 420-3 or permission of department*

What course (courses), if any, is being dropped from the calendar if this course is approved: None

2. **Scheduling**

How frequently will the course be offered? Once per year

Semester in which the course will first be offered? Spring 1977

Which of your present faculty would be available to make the proposed offering possible? None

3. **Objectives of the Course**

To relate the principles of chemistry as they apply to the nature and detection of disease.

4. **Budgetary and Space Requirements** (for information only)

What additional resources will be required in the following areas:

Faculty	An additional professional appointment will be required*
Staff	Nil
Library	Nil
Audio Visual	Nil
Space	Nil
Equipment	Nil

* same person as instructing Chem 420 and 424

5. **Approval**

Date: 11 Feb 75 22

Department Chairman Dean Chairman, SCUS

* In consultation with the Biochemistry Committee.

SCUS 73-34b:- (When completing this form, for instructions, see Memorandum SCUS 73-34a. Attach course outline)

14

2

CLINICAL CHEMISTRY 423-3

COURSE OUTLINE

FOR INFORMATION

Week	Topics
1	--Pathophysiology of the thyroid gland: laboratory findin in disease.
2	--Steroid hormones, biochemical inter-relationships of the pituitary and adrenal glands.
	--Laboratory assessment of the pituitary-adrenal axis.
3	--Adrenal medullary hormones.
4	--Porphyrins: metabolism and measurement.
	--Hormones of the reproductive system.
5	--Amino acids, inborn errors of metabolism.
6	--Diagnostic enzymology.
	--Cardiac enzyme disturbances and their diagnostic implications.
7	--Principles of pharmacology, classes of drug action.
8	--Clinical toxicology, drugs of abuse.
9	--Toxicological analyses.
10	--Automated analyses, discrete sampling and flow systems.
11	--Drug interaction in biochemical testing.
12	--Laboratory data processing, and patterns of work-flow.
13	--Clinical chemistry in industrial and occupational health.

75

FOR INFORMATION

SENATE COMMITTEE ON UNDERGRADUATE STUDIES

NEW COURSE PROPOSAL FORM

Calendar Information

Department: Chemistry

Abbreviation Code: CHEM Course Number: 424 Credit Hours: 2 Vector: 0-0-4

Title of Course: Clinical Chemistry Laboratory

Calendar Description of Course:
This course is designed to teach the principles used in the development and assessment of analytical procedures for established diagnostic tests; practical exercises in trouble-shooting of chemical methods will be undertaken.

Nature of Course Laboratory

Prerequisites (or special instructions):
Chem 398, Chem 420 or permission of department; ordinarily taken with Chem 423.*

What course (courses), if any, is being dropped from the calendar if this course is approved: None

2. Scheduling

How frequently will the course be offered? Once per year

Semester in which the course will first be offered? Spring 1977

Which of your present faculty would be available to make the proposed offering possible? None

3. Objectives of the Course
This course will enable the student to recognize and remedy the sources of error in chemical diagnostic tests. It is also anticipated that students completing the course will be equipped to independently improve and/or introduce new diagnostic tests.

4. Budgetary and Space Requirements (for information only)

What additional resources will be required in the following areas:

Faculty An additional appointment will be required*

Staff 1/4 time Demonstrator

Library Nil

Audio Visual Nil

Space Laboratory space for 20 persons is available

Equipment

* same person as instructing Chem 420 and 423.

5. Approval

Date: 11 Sept 75

Department Chairman | Dean | Chairman, SCUS

* In consultation with the Biochemistry Committee.

SCUS 73-34b:- (When completing this form, for instructions see Memorandum SCUS 73-34a. Attach course outline.)

CHEMISTRY 424

COURSE OUTLINE

FOR INFORMATION

Week	
1	Colorimetric determination of glucose in serum, and systematic study of the effect of procedural variables.
2	Measurement of serum amylase activity with differ... substrates and assessment of precision, and correlation of results.
3	Evaluation and comparison of a kinetic and ... nd-point method for the quantitation of lactate dehydrogenase activity in serum.
4+5	Use of criteria for the systematic evaluation of test procedure for the measurement of cholesterol in serum.
6	Development of a procedure for the quantitation of urea using p-dimethylamino-benzaldehyde.
7	Error detection in a troublesome procedure for the measurement of urea in serum by the Berthelot reaction
8	Introduction of modifications to improve a procedure for serum bilirubin quantitation
9	Assessment of test sensitivity for the detection of hemoglobin and ketonic substances
10	Evaluation of serum reference materials for use as standards.
11) 12) 13)	Student selection of a test procedure for an endocrine hormone on the basis of published appraisals, followed by setting it up in the laboratory.