ASSUMED BACKGROUND: RADIOACTIVITY AND RADIATION SOURCES

1. Activity: specific activity, decay constant, activity concentration.
2. Decay modes: alpha, beta decay, fission, branching ratios, internal conversion, Auger effect, partial half-life.

A. RADIATION MEASUREMENT

1. Gas filled detectors: ionization chambers, proportional counters, Geiger-Muller tubes.
2. Scintillation detectors: alkali halides, plastic scintillators, liquid scintillators.
4. Concepts in detector efficiency: general expression for arbitrary radiation field, intrinsic efficiency, point and disc sources with end-window geometry, beam geometries.
5. Dosimeter response - cavity theory, mixed field dual response system.

B. PULSE STATISTICS AND DATA ANALYSIS

1. Statistics of counting data: the binomial distribution, the Poisson distribution, the normal approximation, Time-interval statistics.
2. Data Analysis: maximum likelihood, mean and variance, $\chi^2$ test, and t-test.
3. Experimental design: optimum counting programs, detection limits.
4. Counting losses: definition of paralyzable and non-paralyzable systems, mean and standard deviation of rate-limited experiments, measurement of response time, application to pulsed systems.

C. PULSE PROCESSING TECHNIQUES

1. Pulse processing: linear, logic pulses, pulse amplitude and height distributions,
discriminators, single channel analyzers.
2. Pulse Spectrometry: charge-sensitive pre-amplification, unipolar and bipolar pulse shaping, active filters, pulse pile-up, pole-zero cancellation.
3. Multi-channel analysis: analogue-to-digital conversion, multi-channel system architecture, the dead-time problem.
4. Time correlated events: cascade radiations, leading edge and cross-over timing, resolving time and the accidental rate, absolute disintegration rates, coincidence summing.

D. PERSONNEL MONITORING
1. Thermoluminescence: mechanism, glow curve, measurement techniques.

E. RADIO-ANALYTICAL METHODS
1. Activation analysis: reactor neutron activation, neutron capture cross-sections and resonance integrals, standard, single comparator and addition methods.

LABORATORIES
(Depending on availability of instruments, 10 laboratories are presented each year.)
1. Preparation of a Reference Beta Source and Operating Characteristics of the GM detector.
2. Pulse statistics and Determination of System Dead Time.
3. Determination of Specific Gamma Constants.
4. Single-Channel Gamma Spectrometry applied to resonance integral measurements.
5. Multichannel Pulse Spectrometry.
7. Anti-coincidence low-level counting.
8. Liquid Scintillation Counting.
11. HPGe Detector Response Characteristics and Efficiency.

Test Schedule:
Test 1 & 2: Posted at the course website.
Test 3 & 4: Posted at the course website.

Marking Scheme:
Tests: 60%
Laboratory Reports: 40%
   Hard copy ONLY!! Submit to the Department Office.
   Get the Date of Submission stamped!
   Delayed submission: one mark per day (5% a day) penalty

Text: Medical Physics 4R06/6R03, Lecture Notes
(available at the Department website: Home => Courses => MED PHYS 4R06 => Class Notes)
**Calculator:** Any calculator may be used in tests and examinations.

**Academic Dishonesty**

Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at: [http://www.mcmaster.ca/senate/academic/ac_integrity.htm](http://www.mcmaster.ca/senate/academic/ac_integrity.htm)

The following illustrates only three forms of academic dishonesty:

1. **Plagiarism**, e.g. the submission of work that is not one’s own or for which other credit has been obtained.

2. **Improper collaboration in group work**. Copying or using unauthorized aids in tests and examinations.

3. **In this course we will be using a software package designed to reveal plagiarism**. Students will required to submit their work electronically and in hard copy so that it can be checked for academic dishonesty.”