Hostos Community College
Department of Mathematics

MAT 105	MATHEMATICS FOR ALLIED HEALTH SCIENCES
Credits Hours:	3.0
Equated Hours:	3.0
Class Hours:	3.0
Pre-requisite:	Passing Score on the Compass/MAT 20
Pre/Co-requisite	ENG091 or ESL091
Required Text(s):	MATHEMATICS FOR ALLIED HEALTH SCIENCES AUTHOR: Lacay, J., Baker, W., Stalmark, J.. PEARSON CUSTOM PUBLISHINGS 2018
Description:	The course is designed for Radiography professionals and will aid them in applying mathematical concepts to “on job situations” as well as in their development of proportional thinking. The course will include an integrated review of mathematical skills and concepts required in radiography, in particular the topics pertaining to formation and manipulation of analog and digital images. Mathematics of the course will address, units of measurements, formula equations, proportionality, inverse proportionality, direct square and inverse square proportionality. Proportionality and involved proportional thinking will have three representations: algebraic, geometric and percent. Each particular formula equation originating in radiology will be generalized to at least one other domain. For example together with Coulombs force, there also will be examples of gravitational force which has the same algebraic structure but different physical meaning.

Instructional Objectives:

The course is designed to:

1) To reinforce students' knowledge of basic mathematics and algebra topics including rates, ratios, percent, and proportional reasoning.
2) To familiarize students with the common systems of measurements and formula that underly essential concepts used in the field of radiographic technology. These include current in milli-Amps (mA), total electrical input in milliamp-seconds 'mAs', and time in milli-seconds (ms).
3) To introduce students with customary and SI radiographic units used for dose-intensity these include Roentgens 'R,' milli-Roentgens 'mR' the Standard International equivalent of Air Kerma 'Gya' and 'mGya.' Also included are the related concepts of absorbed dose (rad, mrad, Gy, mGy) and equivalent dose (rem, mrem, Sv, mSv)
4) To familiarize students with the use of direct, direct square, inverse and inverse square proportions (variations) in determining how technique changes would affect the intensity and how a radiograph technician would compensate to maintain the dose-intensity and hence the quality of the imaging process.
5) To familiarize students with the coordination of percent and proportional reasoning in determining how changes in kilovolts (kV) would affect intensity and the resulting compensation in mAs required to maintain intensity.
6) To introduce students to electrical concepts of Physics including: Volts, Watts, and Ohms and how these are related by Ohm's Law, and the power equation.
7) To familiarize students with the use of exponents and scientific notation in solving application problems

Student Learning Outcomes:
Students should be able to:

1) Demonstrate proficiency with conversion between systems of measurements as well as within a given system of measurement. With an emphasis on conversion between USA and international units for intensity: exposure, dose absorbed, and equivalent dose as used in radiographic technology.

2) Demonstrate ability to apply the principle of conservation of energy to the direct relationship between electrical input (mAs) settings and the intensity-exposure of the output radiation for a radiographic machine. The ability to apply the compensation property to adjust the input mAs settings in order to maintain intensity during changes in radiographic techniques.

3) Formulate and solve proportional thinking 1 & 2 step problems involving: direct, inverse, direct squared, and inverse squared variations. Apply such reasoning to applications involving multi-step changes in radiographic technique changes for both pre-digital and digital machines.

4) Apply tabulated data alongside formulas to solve grid conversion and conversion problems between body and organ dose. Apply such conversions within 2 step problems involving conversion between English and International units.

5). Coordinate percent and proportional reasoning within the 15% rule to determine how kV changes affect intensity, what compensation would be required to maintain intensity and how kV could be used to compensate for other radiographic technique changes.

6) Demonstrate good problem-solving habits including: the ability to recognize appropriate strategies involving direct, inverse, direct square, and inverse square proportional reasoning to determine the effect of technique changes on intensity and corresponding reverse proportional reasoning actions required to maintain intensity. Ability to coordinate tabulated data alongside proportional reasoning to determine intensity of dose and appropriate technique settings. Ability to coordinate percent and proportional reasoning. The ability to estimate solutions and interpret reasonability of one's answer, while applying proportional and percent reasonings is essential.

7) Generate solutions through modeling real-on the job situations. In this process they will use calculators and/or virtual reality technology to enhance their mathematical thinking and understanding, solve mathematical problems, and judge the reasonableness of their results.

8) Demonstrate ability to work effectively with logarithms and elementary concepts in Radiographic Physics, this requires use of proportional reasoning and calculator and/or logarithm tables.

Examinations: Test 1 20%
Midterm 20%
Test 3 20%
Departmental Final 40%

Grades: A, A−, B+, B, B−, C+, C, F

Course Outline:

Unit 1 Week One: Review of Basic Mathematics Skills with applications: Ratio, Rates, Direct Proportions-Variations formula in Mathematics. Applications to Radiography The mAs formula. Direct variations between mAs and mA (t constant) or mAs and t (mA constant) General Principle: Conservation of electric input energy (mAs) and radiographic intensity - output energy (mR) & the resulting direct relationship.

Unit 2 Week two: Dimensional Analysis & Inverse proportions: Conversions within and between the English System & International System of measurements. Application to Radiology: Conversion between milliseconds (ms) and second within the mAs formula. Conversion between the Roentgen/milli-Roentgen (mR) and Air Kerma Gya/mGya. Conversion between Measurement System Temperature Conversion

Fahrenheit and Celsius. The inverse relationship between mA and time (when mAs in constant)

Unit 3 Week 3: Introduction to Radiographic technique changes 1&2 step
Concepts and terminology involving distance and property of compensation to maintain optical density or intensity. Review Direct & Inverse Variations, introduce Direct Square and inverse square Variation Formula. Two step (3-variable) problems involving direct, inverse, and direct square variations. Application to Radiography: Extend direct relationship between Grid Ratio & mAs to include Grid & mA/time. Inverse relationship between Grid Ratio and intensity (mR,R,Gya,mGya). Direct square variation between distance and mAs, mA or time.

Week 4: Review and Test #1

Unit 4 Week 5 & 6: Radiographic technique changes 2 & 3 step
Radiographic concepts and terminology based upon the compensation property to maintain intensity–continued. Focus on Inverse and Inverse Square Variations, two step (3-variable) problems involving, direct, inverse, direct square and inverse square variations. Applications to Radiography: Inverse square relationship between distance and intensity, review of compensation (direct square mAs & Distance) to maintain intensity. Two step problems involving intensity; Grid and distance or the compensation to maintain intensity involving mAs; Grid and distance. The inverse relationship in pre-digital equipment between Relative Screen Speed (RS) and mAs. Three step problem involving mAs; grid, distance, and RS.

Week 7 Review and Midterm Exam

Unit 5 Radiographic technique changes involving dose conversion and 15% Rule
Week 8: Radiographic concepts- Units of Exposure Conversion problems involving intensity: exposure, absorbed dose, and equivalent dose. Relationship between body dose and organ dose.
Week 9&10: 15% rule (Digital) 15% rule between kV and mAs and its effect on intensity

Week 11 Review and test #3

Unit 6 Week 12&13 Fundamentals of Physics, Scientific Notation & Logarithms: *Electrostatics and Magnetism (Coulomb's Law**),** Electrodynamics (Ohms Law and Electric Power)*
Exponents, Scientific Notation and Logarithms, Rules of exponents, Powers of 10 and Scientific NotationDefinition of Logarithms, Characteristic and Mantissa, Properties of Logarithms and Determining Logarithms using Tables

Week 14 Review for Final Exam