**MTH220A** – *Number Theory
Prerequisite: MTH210A*

**Instructor: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Consultation Hours: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Class days and Time: \_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Contact details: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
Room Class Schedule: \_\_\_\_\_\_\_\_\_\_\_\_**

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| **Course Description**  |
| This is an introductory course in Number Theory taken up as a major course by students in the mathematics programs. Topics discussed include divisibility, the greatest common divisor and least common multiple, prime numbers and their properties, the unique factorization theorem, basic properties of congruences, linear congruences and linear Diophantine equations, the Chinese Remainder Theorem, applications of congruences, the theorems of Fermat, Euler and Wilson, arithmetic functions and their properties, quadratic congruences, quadratic residues and the Quadratic reciprocity law, and primitive roots. |

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| **Learning Outcomes** |
| On completion of this course, the student is expected to present the following learning outcomes in line with the Expected Lasallian Graduate Attributes (ELGA) and the outcomes prescribed by the CHED Memorandum Order for the BS Mathematics program.

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| ELGA | Learning Outcome |  Program Outcome |
| Critical and Creative ThinkerEffective CommunicatorLifelong Learner | At the end of the course, the student will  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| apply appropriate concepts and algorithms in Number Theory , thinking processes, tools, and technologies in the solution to various conceptual or real-world problems. | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 | 🗸 |

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| **Program Outcomes (BS Mathematics)** |
| A graduate of the program should be able to |
| 1. Apply analytical, critical and problem solving skills using the scientific method.
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| 1. Carry out basic mathematical and/or statistical computations and use appropriate technologies in the analysis of data, and in pattern recognition, generalization, abstraction, critical analysis, and problem solving.
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| 1. Gain mastery in the core areas of mathematics: algebra, analysis and geometry
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| 1. Demonstrate skills in pattern recognition, generalization, abstraction, critical analysis, problem-solving and rigorous argument.
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| 1. Develop an enhanced perception of the vitality and importance of mathematics in the modern world, including the interrelationships within mathematics and its connection to other disciplines
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| 1. Appreciate the concept and role of proof and reasoning and demonstrate knowledge in reading and writing mathematical proofs.
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| 1. Make and evaluate mathematical conjectures and arguments and validate their own mathematical thinking
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| 1. Communicate mathematical ideas orally and in writing using clear and precise language
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| **Final Course Output** |
| As evidence of attaining the above learning outcomes, the student is required to submit the following during the indicated dates of the term.

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| Learning Outcome | Required Output | Due Date |
| At the end of the course, the student will apply appropriate linear algebraic concepts, thinking processes, tools, and technologies in the solution to various conceptual or real-world problems. | * Written and oral report on a specific real-life application of concepts in number theory, such as divisibility, congruences, and arithmetic functions. This is a group project with each group made up of at most three students.
 | A written report should include a discussion of the underlying number theory concepts. The chosen application should be discussed in detail and illustrations and examples should be included. The written report is due on the thirteenth week of the term. Each group is given 30 minutes to present their work. The last two weeks of the term will be used for the oral presenta-tions. |
| * Construct a concept map to illustrate the inter-relationships among the various concepts and processes studied in the course
 | Week 13 |

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| **Rubric for assessment of report** |
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| CRITERIA | Excellent (4) | Very Good (3) | Satisfactory (2) | Needs Improvement (1) |
| ***Understanding of mathematical concepts*** | Shows complete understanding of the underlying mathematical concepts and principles used in the application. | Shows nearly complete understanding of the mathematical concepts and principles used in the application. | Shows some understanding of the mathematical concepts and principles used in the application. | Shows very limited understanding of the mathema-tical concepts and principles used in the appli-cation. |
| ***Clarity of Explanation*** | Explanation is well-written, complete and unambiguous.Terminologies and symbols are used correctly, and appropriate pictures and illustrations are used to enhance understanding. | Explanation is clear but few simple details are missed. Terminologies and symbols are used appropriately, and illustrations are used to enhance understanding. | Explanation is sometimes difficult to understand. Some symbols, notations and illustrations are not used appro-priately. | Explanation is difficult to understand. Little or no illustrations were used to enhance under-standing. |
| ***Completeness of presentation*** | All the important concepts, processes and details are presented coherently | Most of the import-ant concepts, processes and details are presented cohe-rently. | Some errors and omissions of the important concepts, processes and details were observed. | Several errors and omissions of the important concepts, processes and details were observed. |
| ***Clarity of oral explanations*** | The structure and organization of the materials presented was appropriate, the explanations were clear and correct, and the answers to the questions were clear and convincing. | A few errors in organization was noted, a few explanations needed greater details, and a few questions needed a more complete responses. | There were errors in the organization of the materials presented, some explanations contained errors and needed some clarity, and some questions were not answered con-vincingly. | The organization of the oral presentation had major errors, many explana-tions are lacking or incorrect, and many questions were not answered convincingly. |

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| **Rubric for assessment of concept map** |
| CRITERIA | Excellent (4) | Very Good (3) | Satisfactory (2) | Needs Improvement (1) |
| ***Understanding of Mathematical Concepts*** | Shows complete mastery of the concepts and processes studied in the course as well as their inter-relationships with one another | Shows an almost complete mastery of the concepts and processes studied in the course as well as their inter-relationships with one another.  | Shows a moderate degree of under-standing of the concepts and processes studied in the course as well as their inter-relationships with one another. | Shows a limited degree of under-standing of the concepts and processes studied in the course as well as their inter-relationships with one another. |
| ***Clarity of Presentation*** | The ideas present-ed are easily understood and the existing inter-rela-tionships among the concepts and processes are clearly indicated. | Except for a few minor details, the ideas presented are easily under-stood and the existing inter-rela-tionships among the concepts and processes are clearly indicated. | Some ideas are not clearly presented and some inter-rela-tionships are either lacking or not correctly presented, | Many of the ideas presented and inter-relationships among concepts and processes are incorrect or lacking. |
| ***Creativity and Completeness*** | The objects in the concept map are aesthetically organized and includes all the important concepts included in the course. | A few objects in the map are not properly organized and a few concepts were not included. | Some major concepts and processes and their inter-relation-ships are either misplaced or not included | Majority of the concepts, processes and inter-relationships are incorrectly placed or described, or are missing from the concept map. |

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| **Additional Requirements** |
| * **Quizzes/Seatwork**
* **Homework**
* **Final Exam**
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| **Grading System** |
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|  | **FOR EXEMPTED STUDENTS** **(w/out Final Exam)** | **FOR STUDENTS** **with FINAL EXAM** |
| *with* *no missed quiz* | *With* *one missed quiz* |
| Average of quizzes  | 90% | 60% | 55% |
| Project | 10% | 10% | 10% |
| Final exam | - | 30% | 35% |

 | **Scale:**95-100% 4.089-94% 3.583-88% 3.078-82% 2.572-77% 2.066-71% 1.560-65% 1.0<60% 0.0 |

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| **Learning Plan** |
| **LEARNING OUTCOMES** | **TOPIC** | **WEEK NO.** | **LEARNING ACTIVITES** |
| At the end of the course, the student will apply appropriate and algo-rithms, number theory concepts, thinking pro-cesses, tools, and tech-nologies in the solution of various conceptual or real-world problems. | **I. Fundamental Concepts**1.1 The Summation Notation1.2 Mathematical Induction | Week 1 | * Cooperative Learning
* Skills exercises
* Seatwork
* Computer Aided Exercises
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| **2. Divisibility in the Set of Integers**2.1 The Division Algorithm2.2 The Greatest Common Divisor2.3 The Euclidean Algorithm2.4 The Least Common Multiple2.5 Prime Numbers and Their Properties2.6 The Unique Factorization Theorem | Weeks 2-4 | * Cooperative Learning
* Skills exercises
* Seatwork
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| Q U I Z 1 |
| **3. The Theory of Congruences**3.1 Basic Properties of Congruences3.2 Linear Congruences3.3 Linear Diophantine Equations3.4 The Chinese Remainder Theorem | Weeks 4-6 | * Cooperative Learning
* Library work
* Skills exercises
* Seatwork
* Problem Set
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|  | **4. Applications of Congruences**4.1 Divisibility Tests4.2 Modular Designs4.3 Check Digits4.4 Perpetual Calendar | Weeks 7-8 | * Library work
* Cooperative Learning
* Skills exercises
* Seatwork
* Problem Set
* Project Discussion
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| Q U I Z 2 |
| **5. The Theorems of Euler and Fermat**5.1 Fermat’s Little Theorem5.2 Euler’s Generalization of Fermat’s Theorem5.3 Wilson’s Theorem | Week 9 | * Cooperative Learning
* Library work
* Skills exercises
* Seatwork
* Problem Set
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| **6. Arithmetic Functions**6.1 The Totient Function and its Properties6.2 Multiplicative Functions6.3 The Functions and and Their Properties | Weeks 10-11 | * Cooperative Learning
* Skills exercises
* Seatwork
* Problem Set
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| QUIZ 3 |
| **7. Primitive Roots and Quadratic Residues**7.1 Exponents and Orders7.2 Primitive Roots7.3 Quadratic Residues | Weeks 12-13 | * Cooperative Learning
* Skills exercises
* Seatwork
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| FINAL EXAMINATION |

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| **References** |
| Burton, David M. *Elementary Number Theory,* 7th ed., 2011, McGraw-Hill, Inc. Koshy, Thomas. *Elementary Number Theory With Applications*, 2nd ed., 2007. Elsevier, IncRobbins, Neville. *Beginning Number Theory*, 1993. Iowa: Wm. C. Brown Rosen, Kenneth. *Elementary Number Theory and its Applications*, 5th ed., Reading, Massachusetts: Addison-Wesley. |
| **Online Resources** |
| *Elementary Number Theory* Accessed July 6, 2018 from: joshua.smcvt.edu/numbertheory/book.pdfRaji, Wissam. (2013) *An Introductory Course in Elementary Number Theory* Accessed July 6, 2018 from: <https://www.saylor.org/site/wp-content/uploads/2013/05/An-Introductory-in-Elementary-Number-Theory.pdf> |

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| **Class Policies** |
| 1. The required minimum number of quizzes for a 3-unit course is 3, and 4 for 4-unit course. No part of the final exam may be considered as one quiz.
2. Cancellation of the lowest quiz is not allowed even if the number of quizzes exceeds the required minimum number of quizzes.
3. As a general policy, no special or make-up tests for missed exams other than the final examination will be given. However, a faculty member may give special exams for
4. approved absences (where the student concerned officially represented the University at some function or activity).
5. absences due to serious illness which require hospitalization, death in the family and other reasons which the faculty member deems meritorious.
6. If a student missed two (2) examinations, then he/she will be required to take a make up for the second missed examination.
7. If the student has no valid reason for missing an exam (for example, the student was not prepared to take the exam) then the student receives 0% for the missed quiz.
8. Students who get at least 89% in every quiz are exempted from taking the final examination. Their final grade will be based on the average of their quizzes and other prefinal course requirements. The final grade of exempted students who opt to take the final examination will be based on the prescribed computation of final grades inclusive of a final examination. Students who missed and/or took any special/make-up quiz will not be eligible for exemption.
9. Learning outputs are required and not optional to pass the course.
10. Mobile phones and other forms of communication devices should be on silent mode or turned off during class.
11. Students are expected to be attentive and exhibit the behavior of a mature and responsible individual during class. They are also expected to come to class on time and prepared.
12. Sleeping, bringing in food and drinks, and wearing a cap and sunglasses in class are not allowed.
13. Students who wish to go to the washroom must politely ask permission and, if given such, they should be back in class within 5 minutes. Only one student at a time may be allowed to leave the classroom for this purpose.
14. Students who are absent from the class for more than 5 meetings will get a final grade of 0.0 in the course.
15. Only students who are officially enrolled in the course are allowed to attend the class meetings.
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Approved by:

 **DR. JOSE TRISTAN F. REYES**

Chair, Mathematics and Statistics Department

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*T3, AY 2017-2018 / L. Ruivivar*