Problem Solving Fall 2019
Central Connecticut State University Department of Mathematical Sciences

I. Course Title: Problem Solving I, II, III
MATH 120, 220, 320
1 credit

II. Course Details:

Section: MATH 120, 220, 320 meets Tuesdays 10:50 am-12:30 pm in NC 24404
Instructor: Dr. R. S. Kalder
e-mail: kalderr@ccsu.edu
Phone: (860) 832-2842
Office: Marcus White 129

Office Hours: 11 am - 4 pm MW
1 pm - 5 pm T
10 am to 4 pm R
and by appointment

III. Students for Whom the Course is Intended:

Secondary Mathematics (B.S.) majors. This is one of three one-credit seminars (MATH 120, MATH 220, and MATH 320), which are required for the B.S. degree in Secondary Mathematics. It also may be taken as an elective by B.S. Elementary majors and other interested students.

IV. Attendance:
Since this is a seminar that meets only once a week and interaction among students is an essential part of the course, attendance at every class is expected. Absences will adversely affect the class participation portion of your final grade.

V. Prerequisites:
For Math 120: Math 115 (C- or higher) or Math 119 (C- or higher) or Placement Exam
For Math 220: Math 120 (C- or higher) and Math 152 (C- or higher)
For Math 320: Math 220 (C- or higher) and Math 228 (C- or higher)

VI. Textbook:
There is no textbook for this course. You will be provided with handouts containing problems to be worked on. In addition, a list of resources for additional problems is attached to this syllabus and occasionally supplemental problems will be made available.

VII. Work load:
The norm for university courses is that a minimum of two hours of homework per week is required for every credit hour. Consequently, for this class you are expected to spend at least 2 hours per week outside of class.
VIII. Expectations:

All three seminars, MATH 120, MATH 220, and MATH 320 meet at the same time. Students in MATH 220 and MATH 320 will have had the experience of taking this seminar at least once previously. In addition, in most cases they will have completed more of the standard courses in the major. For instance, all students in MATH 220 will have at least one semester in calculus. Students in MATH 320 will have completed courses in discrete mathematics and linear algebra. The mixing of the three groups is deliberately designed to enable students in MATH 120 to learn from more experienced problem solvers.

Because of the heterogeneous nature of the class, expectations are set on an individual basis. You will be given a wide variety of problems to choose from. Work on those that you find challenging, but not impossible. The problems will be weighted according to the level of difficulty. The easiest problems will be worth 1 point each, more difficult problems 2 points each and so on.

IX. Portfolios:

On four occasions during the semester, you will submit a portfolio containing detailed solutions to some problems you have worked over the past few weeks. The problems submitted must carry a total weight of at least 6 points for MATH 120 students, 7 points for MATH 220, and 8 points for MATH 320. Along with each solution you will reflect on the process you went through to solve the problem, using Polya's four steps as a framework. We are particularly interested in problems that prove challenging to you, those for which your initial approach was unfruitful, and situations that lead to significant insights and discoveries. The problems submitted in the portfolio may include some you have worked on by yourself and some you have discussed with classmates. Please acknowledge instances where other class members or the instructor have contributed to the solution or where you have used hints provided by the author of the textbook or other sources. Portfolios will be assessed for the level of difficulty of the problems, the accuracy and elegance of the solutions, and your analysis of the problem solving process. All portfolio solutions must be typed. You must use the Equation Editor and Geometer’s Sketchpad or Geogebra for a professional looking document. A sample-grading sheet is attached to this syllabus.

Each portfolio must be stapled with a cover sheet that contains the following information:

<table>
<thead>
<tr>
<th>Your name</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 220 Portfolio #</td>
<td></td>
</tr>
<tr>
<td>Problems submitted:</td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>2 points</td>
</tr>
<tr>
<td>#10</td>
<td>2 points</td>
</tr>
<tr>
<td>#27</td>
<td>3 points</td>
</tr>
<tr>
<td>total</td>
<td>7 points</td>
</tr>
</tbody>
</table>

ALSO:

Begin each problem at the top of a new page. Place the problem solutions in numerical order. Submit your grade sheet with each portfolio.
X. Final Presentation:

In place of a final examination, you will choose one problem to present (from any set of portfolio questions) to the class on November 19, December 3, or December 10. You will give a ten to fifteen-minute oral presentation explaining your solution, including Polya’s four-step problem solving process. A sample grading sheet for this presentation is attached to this syllabus.

XI. Class participation:

Your class participation will be graded. An important part of this grade will be oral presentations of problems that carry at least five points and are not included in your portfolios. You will be permitted to sign up for the problems that you wish to present up until the time that the problem set portfolio is due. Once the portfolio for that set of problems has been collected you may no longer sign up for a problem from that set. You are advised to make these presentations early and throughout the course. When your classmates are presenting you are expected to listen attentively and provide feedback to them. Failure to do this will adversely affect the class participation portion of your final grade.

XII. Evaluation:

Your grade for the course will be determined on the following basis:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class participation</td>
<td>20%</td>
</tr>
<tr>
<td>Portfolios (four, 15% each)</td>
<td>60%</td>
</tr>
<tr>
<td>Final presentation</td>
<td>20%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

Calendar

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday, August 27, 2019</td>
<td>class, introductory thoughts about problem solving</td>
</tr>
<tr>
<td>Tuesday, September 3, 2019</td>
<td>class, introduction to Equation Editor and Geometer’s Sketchpad for portfolio preparation</td>
</tr>
<tr>
<td>Tuesday, September 10, 2019</td>
<td>class</td>
</tr>
<tr>
<td>Tuesday, September 17, 2019</td>
<td>Portfolio #1 Due</td>
</tr>
<tr>
<td>Tuesday, September 24, 2019</td>
<td>class</td>
</tr>
<tr>
<td>Tuesday, October 1, 2019</td>
<td>class</td>
</tr>
<tr>
<td>Tuesday, October 8, 2019</td>
<td>Portfolio #2 Due</td>
</tr>
<tr>
<td>Tuesday, October 15, 2019</td>
<td>class</td>
</tr>
<tr>
<td>Tuesday, October 22, 2019</td>
<td>class</td>
</tr>
<tr>
<td>Tuesday, October 29, 2019</td>
<td>Portfolio #3 Due</td>
</tr>
<tr>
<td>Tuesday, November 5, 2019</td>
<td>class</td>
</tr>
<tr>
<td>Tuesday, November 12, 2019</td>
<td>class</td>
</tr>
<tr>
<td>Tuesday, November 19, 2019</td>
<td>Final Presentations, Portfolio #4 due</td>
</tr>
<tr>
<td>Tuesday, December 3, 2019</td>
<td>Final Presentations</td>
</tr>
<tr>
<td>Tuesday, December 10, 2019</td>
<td>Final Presentations</td>
</tr>
</tbody>
</table>
University Policies:

1. Statement on Discrimination and Harassment (Title IX)
Central Connecticut State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon age; ancestry, color; gender identity and expression; intellectual disability; learning disability; mental disorder; physical disability; marital status, national origin; race; religious creed; sex, (including pregnancy, transgender status, sexual harassment and sexual assault); sexual orientation; or any other status protected by federal or state laws. Any student who has concerns about this should contact the Office of Diversity and Equity (ODE) at 860-832-1652, Student Affairs at 860-832-1601, or his/her faculty member. The ODE is located in Davidson Hall, Room 102. Central Connecticut State University (CCSU) will not tolerate sexual misconduct against students, staff, faculty, or visitors in any form, including but not limited to: sexual assault, sexual exploitation, sexual harassment or stalking, as defined in CCSU policies. For additional information, please consult the CCSU policies at http://www.ccsu.edu/diversity/policies/index.html.

   To file a report, contact: Diversity and Equity (860-832-1652); Student Affairs (860-832-1601); Student Conduct (860-832-1667) or the University Police (860-832-2375).

   For support and advocacy, contact: Joanna Flanagan in the Office of Victim Advocacy at 860-832-3795 or at jflanagan@ccsu.edu; Student Wellness Services at 860-832-1945 (confidential), the Women’s Center at 860-832-1655, the local YWCA’s Sexual Assault Crisis Services Hotline at 860-223-1787 (confidential) and Prudence Crandall Center for Domestic Violence (confidential) at 888-774-2900(24-hour hotline).

   NOTE: Any student should also feel free to discuss issues of concern with a faculty member he/she trusts. Students should know, however, that all faculty members and staff have a duty to report incidents of sexual harassment including sexual misconduct, intimate partner violence and stalking to Nancy "Rusty" Barceló, Office of Diversity and Equity, Davidson Hall, 102. (860) 832-1653.

2. Special Needs Accommodations: If you are a student with a documented disability, and would like to request academic accommodations, you are encouraged to contact Student Disability Services (SDS) at 860-832-1952, or email disabilityservices@ccsu.edu. Please visit the SDS website at http://www.ccsu.edu/sds/ to download an Intake form and documentation requirements. Temporary impairments may also qualify for accommodations. Central Connecticut State University provides reasonable accommodations in accordance with the Americans with Disabilities Act and Section 504 of the Rehabilitation Act for students with documented disabilities on an individualized basis.

3. Academic Integrity: All students are expected to demonstrate integrity in the completion of their coursework. Academic integrity means doing one's own work and giving proper credit to the work and ideas of others. It is the responsibility of each student to become familiar with what constitutes academic dishonesty and plagiarism and
to avoid all forms of cheating and plagiarism. Students who engage in plagiarism and other forms of academic misconduct will face academic and possibly disciplinary consequences. Academic sanctions can range from a reduced grade for the assignment to a failing grade for the course. From a disciplinary standpoint, an Academic Misconduct Report may be filed and a Faculty Hearing Board may impose sanctions such as probation, suspension or expulsion. The Department of Mathematical Sciences rigorously enforces this policy. Don’t cheat; it’s not worth it.

For further information on academic misconduct and its consequences, please consult the Student Code of Conduct (http://www.ccsu.edu/StudentConduct/codeofconduct.asp) and the Academic Misconduct Policy (http://www.ccsu.edu/AcademicIntegrity/).

4. Student Behavior - Taken from the BOR/CSCU STUDENT CODE OF CONDUCT
https://web.ccsu.edu/studentconduct/files/Student%20Code%20of%20Conduct%201.15.15.pdf

All members of CSCU must at all times govern their social and academic interactions with tolerance and mutual respect...Because of the BOR’s and CSCU’s commitment to principles of pluralism, mutual respect, and civility, certain activities are not acceptable on CSCU campuses.

Please be aware that any violations of this Code of Conduct will result in a report of misbehavior to the Office of Student Conduct. Severe violations can result in dismissal from CCSU.

5. In the event of a weather emergency which requires curtailment or cancellation of classes, listen to WTIC (1080 AM) or call (860) 832-3333 for the “general snow message.” Even quicker – check the CCSU website!

6. The last day to withdraw from a course and receive the grade of “W” is Monday, November 18th. Approvals for withdrawal prior to this date are not required; but we strongly recommended that students consult with their instructors and their academic advisors before to deciding to withdraw. Not coming to class, telling the instructor, and calls to the Registrar’s Office are not considered official notice of a your intention to drop a course - you have to fill out the official form and bring it to the Registrar’s office by November 18th. After November 18th withdrawals are allowed only under extenuating circumstances and require approval of the course instructor AND the department chair. Poor academic performance is not considered an extenuating circumstance.
Polya’s problem solving steps:

**First. You have to understand the problem.**

UNDERSTANDING THE PROBLEM
What is the unknown? What are the data? What is the condition? Is it possible to satisfy the condition? Is the condition sufficient to determine the unknown? Or is it insufficient? Or redundant? Or contradictory? Draw a figure. Introduce suitable notation. Separate the various parts of the condition. Can you write them down?

**Second. Find the connection between the data and the unknown.**

DEVISING A PLAN
Have you seen it before? Or have you seen the same problem in a slightly different form? Do you know a related problem? Do you know a theorem that could be useful? Look at the unknown! And try to think of a familiar problem having the same or a similar unknown. Here is a problem related to yours and solved before. Could you use it? Could you use its result? Could you use its method? Should you introduce some auxiliary element in order to make its use possible? Could you restate the problem? Could you restate it still differently? Go back to definitions. If you cannot solve the proposed problem try to solve first some related problem. Could you imagine a more accessible related problem? A more general problem? A more special problem? An analogous problem? Could you solve a part of the problem? Keep only a part of the condition, drop the other part: how far is the unknown then determined, how can it vary? Could you derive something useful from the data? Could you think of other data appropriate to determine the unknown? Could you change the unknown or the data, or both if necessary, so that the new unknown and the new data are nearer to each other? Did you use all the data? Did you use the whole condition? Have you taken into account all essential notions involved in the problem?

**Third. Carry out your plan.**

CARRYING OUT THE PLAN
Carrying out your plan of the solution, check each step. Can you see clearly that the step is correct? Can you prove that it is correct?

**Fourth. Examine the solution obtained.**

LOOKING BACK.
Can you check the result? Can you check the argument? Can you derive the result differently? Can you see it at a glance? Can you use the result, or the method, for some other problem? DO NOT JUST LOOK OVER YOUR WORK AND SAY IT LOOKS CORRECT!!

Problem solving heuristics from George Polya, Princeton University Press, 1973
Mathematics 120/220/320 Portfolio Assessment

Name____________________________

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Possible Points</th>
<th>Student’s points on Portfolios</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The portfolio is complete in that it contains the solutions of problems with a total number of points appropriate to the level of the course (6 for 120, 7 for 220, 8 for 320).</td>
<td>10</td>
<td>#1 #2 #3 #4</td>
</tr>
<tr>
<td>2. Solutions to the problems are accurate and complete.</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>3. The student uses Polya’s four steps effectively to solve problems.</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>4. The student demonstrates significant insight and creativity.</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5. The selection includes items that were challenging to the student and varied in topics.</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>6. The writing is clear and easy to understand.</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>7. The writing is free of errors in the use of mathematical terminology.</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>8. The writing is free of grammatical and spelling errors.</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Total 100 grade ______ ______ ______ ______
Problem Solving Evaluation of Presentation

Presenter:  
Score:_________of 100

1. 60 points Application of Polya’s problem solving strategies  
   a. _______Understanding the problem (15 points)  
      i. _______What is the unknown?  
      ii. _______What are the conditions?  
      iii. _______Are the conditions sufficient?  
      iv. _______Draw a figure  
      v. _______Introduce notation  
   b. _______Devise a plan (15 points)  
      i. _______Have you seen it before? Or in a slightly different form?  
      ii. _______Do you know a useful theorem?  
      iii. _______Do you know a related problem?  
      iv. _______Did you include all the data? All the conditions?  
   c. _______Carry out the plan (15 points)  
      i. _______Followed the plan  
      ii. _______Check that each step is done correctly?  
      iii. _______Can you prove that your solution is correct?  
   d. _______Looking back (15 points)  
      i. _______Can you check your result?  
      ii. _______Can you check the argument?  
      iii. _______Is there another way to see the result at once? (elegance)  
      iv. _______Can you use the result or the method for some other problem?

2. 40 points Presentation methods  
   a. _______Visual resources (looking for effectiveness of use, not a particular resource.) Some options are listed below:  
      i. Chalk board  
      ii. Overheads  
      iii. Handouts  
      iv. Models  
      v. Other  
   b. _______Timing planned effectively  
   c. _______Voice pleasant, easy to hear  
   d. _______Used correct Mathematical terminology and English grammar  
   e. _______Adequate awareness of the audience  
   f. _______Presentation planned to respond to the interest and ability level of the audience

3. General Comments