You may use a single (one-sided) page of hand-written notes prepared by you and approved by the instructor in advance.
Problem 1. (20 pts.) Evaluate the following expressions:

\[(a) \ (4 \text{ pts.}) \ 100 \mod 5 = \underline{\phantom{0}} \]

\[(b) \ (4 \text{ pts.}) \ 100 \mod 7 = \underline{\phantom{0}} \]

\[(c) \ (4 \text{ pts.}) \ 100 \mod 98 = \underline{\phantom{0}} \]

\[(d) \ (4 \text{ pts.}) \ -100 \mod 98 = \underline{\phantom{0}} \]

\[(e) \ (4 \text{ pts.}) \ -100 \mod 101 = \underline{\phantom{0}} \]
Problem 2. (20 pts.) A 12-hour clock is set at midnight and gains a minute every hour.

(a) (5 pts.) What time will the clock show in 3 hours?

(b) (5 pts.) What time will the clock show in 100 hours?

(c) (10 pts.) When will the clock show the correct time again?
Problem 3. (20 pts.)

(a) (10 pts.) Convert the following numbers to the decimal system:

(a.1) (5 pts.) \(101_3 = \) ____________

(a.2) (5 pts.) \(101_{11} = \) ____________

(b) (10 pts.) Convert the following numbers to the binary and the hexadecimal systems:

(a.1) (5 pts.) 12

(a.2) (5 pts.) 123
Problem 4. (20 pts.) You are planning to use the RSA with \( N = 33 \). For the given pairs of numbers, determine if they form a valid public/private key pair.

(a) (10 pts.) \( e = 3, d = 17 \).

(b) (10 pts.) \( e = 13, d = 17 \).
Problem 5. (20 pts.) Five friends are trying to decide where to go out for dinner. The table below shows their preferences:

<table>
<thead>
<tr>
<th></th>
<th>Fred</th>
<th>Daphne</th>
<th>Shaggy</th>
<th>Velma</th>
<th>Scooby</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top choice</td>
<td>Chinese</td>
<td>Salad bar</td>
<td>Pizza</td>
<td>Indian</td>
<td>Pizza</td>
</tr>
<tr>
<td>Second choice</td>
<td>Indian</td>
<td>Chinese</td>
<td>Chinese</td>
<td>Tacos</td>
<td>Indian</td>
</tr>
<tr>
<td>Third choice</td>
<td>Pizza</td>
<td>Indian</td>
<td>Indian</td>
<td>Chinese</td>
<td>Tacos</td>
</tr>
<tr>
<td>Fourth choice</td>
<td>Tacos</td>
<td>Pizza</td>
<td>Tacos</td>
<td>Salad bar</td>
<td>Chinese</td>
</tr>
<tr>
<td>Fifth choice</td>
<td>Salad bar</td>
<td>Tacos</td>
<td>Salad bar</td>
<td>Pizza</td>
<td>Salad bar</td>
</tr>
</tbody>
</table>

(a) (4 pts.) Which option is chosen by the plurality vote? _______________________

(b) (8 pts.) Which option is chosen by the Borda count? _______________________

(c) (8 pts.) Which option is chosen by the Condorcet method? ___________________
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