This syllabus is provided as a general informational guide. Some of the information may vary depending on the specific course section and instructor. Different sections of the same course may require different textbooks. Verify the section specific textbook information in the CUNY’s Academic Course Schedule Web Page. Modifications of the grading system presented here will be communicated by the instructors of the sections when they meet the class.

BOROUGH OF MANHATTAN COMMUNITY COLLEGE
The City University of New York
Department of Science

Title of Course THERMODYNAMICS I
ESC 211 Section __________
Credits 3
Semester:

Class hours 4
Lab hours (if applicable)

Instructor Information
Name:
Office:
Room:
Email:

Course Description
This course covers introductory concepts and definitions that include Absolute Temperature, Work, Heat, First Law and applications, Second Law, Carnot Theorem, Entropy, Thermodynamic state variable and functions, Reversibility, irreversibility, Power and Refrigeration cycles, Ideal Gas Mixtures, Mixtures of vapor and gas, Humidity calculations.

Prerequisites/Co-requisites
Prerequisite: CHE 201, Chemistry I
Pre or co-requisities: PHY 225, University Physics II, MAT 303 Calculus III

Student Learning Outcomes

<table>
<thead>
<tr>
<th>Course Student Learning Outcomes (Students will have…)</th>
<th>Measurements (means of assessment for student learning outcomes listed in first column)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of thermodynamic laws and an ability to formulate mass, energy and entropy balances for systems and control volumes.</td>
<td>1. In class exam.</td>
</tr>
<tr>
<td>An ability to apply thermodynamic principles to the analysis of modern electromechanical devices.</td>
<td>2. In class exam.</td>
</tr>
<tr>
<td>Knowledge of thermodynamic power and refrigeration cycles.</td>
<td>3. In class exam.</td>
</tr>
<tr>
<td>Knowledge of ideal gas mixtures, gas-vapor mixtures, and the psychrometric chart.</td>
<td>4. In class exam.</td>
</tr>
<tr>
<td>Knowledge of statistical thermodynamics, including statistical models, microscopic interpretation of heat and work, and statistical concept of entropy.</td>
<td>5. In class exam.</td>
</tr>
<tr>
<td>An ability to use thermodynamic charts and software to calculate thermodynamic properties and analyze systems.</td>
<td>5. In class exam.</td>
</tr>
</tbody>
</table>
Below are the college’s general education learning outcomes, the outcomes that are checked in the left-hand column indicate goals that will be covered and assessed in this course. (Check at least one.)

<table>
<thead>
<tr>
<th>General Education Learning Outcomes</th>
<th>Measurements (means of assessment for general education goals listed in first column)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Communication Skills</strong>- Students will be able to write, read, listen and speak critically and effectively.</td>
<td></td>
</tr>
<tr>
<td><strong>Quantitative Reasoning</strong>- Students will be able to use quantitative skills and the concepts and methods of mathematics to solve problems.</td>
<td>Graded homeworks and exams will measure how students apply mathematics to solve thermodynamics problems.</td>
</tr>
<tr>
<td><strong>Scientific Reasoning</strong>- Students will be able to apply the concepts and methods of the natural sciences.</td>
<td></td>
</tr>
<tr>
<td><strong>Social and Behavioral Sciences</strong>- Students will be able to apply the concepts and methods of the social sciences.</td>
<td></td>
</tr>
<tr>
<td><strong>Arts &amp; Humanities</strong>- Students will be able to develop knowledge and understanding of the arts and literature through critiques of works of art, music, theatre or literature.</td>
<td></td>
</tr>
<tr>
<td><strong>Information &amp; Technology Literacy</strong>- Students will be able to collect, evaluate and interpret information and effectively use information technologies.</td>
<td></td>
</tr>
<tr>
<td><strong>Values</strong>- Students will be able to make informed choices based on an understanding of personal values, human diversity, multicultural awareness and social responsibility.</td>
<td></td>
</tr>
</tbody>
</table>

**Required Text & Readings**
Title: Thermodynamics, an Engineering Approach 8th Edition
Author: Cengel, Y. and Boles, M.

**Other Resources**

**Evaluation & Requirements of Students**
Three examinations, comprehensive final examination, homework and project assignments.
Outline of Topics
LECTURE SYLLABUS

<table>
<thead>
<tr>
<th>WEEK</th>
<th>TOPIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction, definition &amp; terminology temperature scales and the Zeroth law of thermodynamics.</td>
</tr>
<tr>
<td>2, 3</td>
<td>Properties of pure substance, phase diagrams, tables of thermodynamics properties and the ideal gas equation of state.</td>
</tr>
<tr>
<td>4</td>
<td>Work and Heat.</td>
</tr>
<tr>
<td>5, 6</td>
<td>Energy balance for closed system, internal energy, enthalpy, specific heats, energy relation for ideal gases. Control volume, conservation of mass and energy for open system, Steady State Steady Flow process, Uniform State Uniform Flow process.</td>
</tr>
<tr>
<td>7</td>
<td>Heat engine and refrigerators, second law of thermodynamics, reversibility Carnot cycle, Carnot theorems and consequences.</td>
</tr>
<tr>
<td>8, 9</td>
<td>Clausius inequality, entropy, irreversibility, principle of increase of entropy, entropy change of ideal gases, polytropic and isentropic processes, second law for a control volume, isentropic efficiency</td>
</tr>
<tr>
<td>10</td>
<td>Irreversibility and Availability. Available energy, reversible work and irreversibility, availability and second - law efficiency</td>
</tr>
<tr>
<td>11</td>
<td>Mixture of ideal gases, gas vapor mixture, humidity calculation.</td>
</tr>
<tr>
<td>12</td>
<td>Introduction to power and refrigeration cycles. Rankin cycles, Otto and Diesel cycles, vapor compression refrigeration cycles</td>
</tr>
</tbody>
</table>
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Class Participation
Participation in the academic activity of each course is a significant component of the learning process and plays a major role in determining overall student academic achievement. Academic activities may include, but are not limited to, attending class, submitting assignments, engaging in in-class or online activities, taking exams, and/or participating in group work. Each instructor has the right to establish their own class participation policy, and it is each student’s responsibility to be familiar with and follow the participation policies for each course.

BMCC Mask Mandate Policy for In-Person Classes
CUNY has put in place a temporary mask mandate policy that requires the wearing of masks indoors in all campus buildings. See: https://www.cuny.edu/coronavirus/university-updates/clarity-new-mask/

Face masks help prevent the spread of COVID-19. As it is possible to have or carry the coronavirus without having or showing symptoms, it is necessary for every person in our community to wear a mask even if you are fully vaccinated and/or have tested negative for COVID19, or think you are completely healthy. For appropriate/acceptable masks and guidelines on use, see CDC guidelines at: https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/diy-cloth-face-coverings.html.

While the mask mandate is in effect, the following will apply to all in-person classes (including in-person classes associated with hybrid courses):

- In a classroom, if a fully vaccinated instructor is teaching a class and can maintain social distance from all others in the classroom, he/she may choose not to wear a mask (subject to any additional Department guidelines regarding the use of face shields or other layers of protection).
- Students who attempt to enter a classroom without wearing masks will be asked by the instructor to put on their masks before entering. Students who remove their masks during a class session will be asked by the instructor to put on their masks. Masks will be available for distribution for those who need one.
- Students may remove their masks momentarily during class (to drink something quickly), in classrooms other than labs, but must replace their masks immediately after that. The consumption of food is not permitted in any classroom or lab.
- Students who are not fully vaccinated are also required to maintain social distancing between themselves and all others in a classroom.

BMCC Policy on Plagiarism and Academic Integrity Statement
Plagiarism is the presentation of someone else’s ideas, words or artistic, scientific, or technical work as one’s own creation. Using the idea or work of another is permissible only when the original author is identified. Paraphrasing and summarizing, as well as direct quotations, require citations to the original source. Plagiarism may be intentional or unintentional. Lack of dishonest intent does not necessarily absolve a student of responsibility for plagiarism. Students who are unsure how and when to provide documentation are advised to consult with their instructors. The
library has guides designed to help students to appropriately identify a cited work. The full
policy can be found on BMCC’s Web site, www.bmcc.cuny.edu. For further information on
integrity and behavior, please consult the college bulletin (also available online).

FREE BMCC STUDENT SUPPORT SERVICES
BMCC is committed to the health and well-being of all students. It is common for everyone to
seek assistance at some point in their life, and there are free and confidential services on campus
that can help.

Advocacy and Resource Center (ARC) https://www.bmcc.cuny.edu/student-affairs/arc/ room
S230, 212-220-8195, arc@bmcc.cuny.edu. If you are having problems with food or housing
insecurity, finances, health insurance or anything else that might get in the way of your studies at
BMCC, contact the Advocacy and Resource Center (formerly Single Stop) for assistance. Please
contact us at arc@bmcc.cuny.edu, call 212-220-8195, or come by the office at room S230. You
may also contact the Office of Student Affairs, S350, 212-220-8130,
studentaffairs@bmcc.cuny.edu, for assistance.

Counseling Center www.bmcc.cuny.edu/counseling, room S343, 212-220-8140,
counselingcenter@bmcc.cuny.edu. Counselors assist students in addressing psychological and
adjustment issues (i.e., depression, anxiety, and relationships) and can help with stress, time
management and more. Counselors are available for walk-in visits.

Office of Compliance and Diversity https://www.bmcc.cuny.edu/about-bmcc/compliance-
diversity, room S701, 212-220-1236. BMCC is committed to promoting a diverse and inclusive
learning environment free of unlawful discrimination/harassment, including sexual harassment,
where all students are treated fairly. For information about BMCC's policies and resources, or to
request additional assistance in this area, please visit or call the office, or email
olevy@bmcc.cuny.edu, or twade@bmcc.cuny.edu. If you need immediate assistance, please
contact BMCC Public safety at 212-220-8080.

Office of Accessibility www.bmcc.cuny.edu/accessibility, Students who need academic
accommodations in connection with a disability must initiate the request with BMCC’s Office of
Accessibility (OA). Students need to register with the Office of Accessibility in order to
officially disclose their disability status to the College and to determine eligibility for appropriate
reasonable accommodations (including any prior IEPs or 504s). Please contact the OA at the
start of the semester (or as soon as possible) to coordinate any accommodation request/s:
www.bmcc.cuny.edu/accessibility, Room N360 (accessible entrance: 77 Harrison Street), 212-
220-8180, accessibility@bmcc.cuny.edu.