BMEG 315 – Transport Phenomena in Biological Systems

Student Outcome a: an ability to apply knowledge of mathematics, science, and engineering.

Performance Criterion #1: *Students can apply conservation laws and constitutive equations to problems related to the convective and diffusive transport of mass, energy, and momentum.*

Scoring Rubric:

Aspect	1: Not proficient	2: Progressing to proficiency	3: Proficient	4: Superior proficiency
Students can account for appropriate mechanisms of transport (convective and/or diffusive)	Cannot determine which mechanism is applicable	Correctly determines the mechanisms to use but has major errors in application.	Correctly determines the mechanism to use but has minor errors in application.	Correctly solves problems where the mechanism for transport was determined
Students apply conservation laws and constitutive equations to solve transport problems	Does not identify the appropriate equations to the given transport problem.	Identify the equations but does not correctly apply the equations to solve the problems.	Applies the equations to solve the transport problem with only minor errors.	Provides accurate analysis of the transport problem using the right equations with appropriate assumptions.

Performance Criterion #2: *Students can distinguish between modes of mass transfer.*

Scoring Rubric:

Aspect	1: Not proficient	2: Progressing to proficiency	3: Proficient	4: Superior proficiency
Students distinguish	Does not distinguish	Distinguishes mass transfer	Distinguishes mass transfer	Provides accurate

between modes of mass transfer	between mass transfer modes.	modes but cannot identify the application	modes and utilization of the modes to solve problems with only minor calculation errors	solution to a problem that utilizes mass transfer modes.

Student Outcome e: an ability to identify, formulate, and solve engineering problems.

Performance Criterion #1: *Students can apply conservation laws and constitutive equations to formulate and solve problems related to the convective and diffusive transport of mass, energy, and momentum.*

Scoring Rubric:

Aspect	1: Not proficient	2: Progressing to proficiency	3: Proficient	4: Superior proficiency
Students can account for appropriate mechanisms of transport (convective and/or diffusive)	Cannot determine which mechanism is applicable	Correctly determines the mechanisms to use but has major errors in application.	Correctly determines the mechanism to use but has minor errors in application.	Correctly solves problems where the mechanism for transport was determined
Students apply conservation laws and constitutive equations to solve transport problems	Does not identify the appropriate equations to the given transport problem.	Identify the equations but does not correctly apply the equations to solve the problems.	Applies the equations to solve the transport problem with only minor errors.	Provides accurate analysis of the transport problem using the right equations with appropriate assumptions.

Performance Criterion #2: *Students can formulate governing equations using macroscopic balances to obtain solutions for both simple flow geometries and biologically realistic flow geometries*

Scoring Rubric:

Aspect	1: Not proficient	2: Progressing to proficiency	3: Proficient	4: Superior proficiency
Students analyze biologically relevant flow	Does not demonstrate accurate understanding of biologically relevant flow pattern.	Rarely demonstrates understanding of biologically relevant flow pattern.	Usually demonstrates understanding of biologically relevant flow pattern.	Provides accurate understanding and analysis of biologically relevant flow pattern.
Students formulate governing equations to the given problem	Does not identify the equations appropriate to the flow.	Demonstrates understanding of the equations but not complete assumptions to the given problem.	Identify the equations and major assumptions to formulate the governing equations.	Identify the equations and complete assumptions to formulate the governing equations.

Performance Criterion #3: *Students can formulate governing equations using microscopic balances to determine appropriate boundary conditions and to solve simple 1-D mass, energy, or momentum transport problems or problems in physiological systems.*

Scoring Rubric:

Aspect	1: Not proficient	2: Progressing to proficiency	3: Proficient	4: Superior proficiency
Students analyze 1-D mass, energy, or momentum transport problems or problems in physiological systems	Cannot analyze a transport problem related to physiological systems of the problem.	Has major errors in analysis of a transport problem related to physiological systems of the problem.	Has minor errors in analysis of a transport problem related to physiological systems of the problem.	Provides accurate solution and analysis of the problem.
Students formulate governing	Does not identify either the equations	Identifies appropriate equations or	Identify the equations and key boundary	Identify the equations and complete

equations to the given problem	appropriate to the problem or appropriate boundary conditions.	boundary conditions, but not both.	conditions to formulate the governing equations, with minor errors.	boundary conditions to formulate the governing equations.

Performance Criterion #4: *Students can analyze complex fluid flows by approximate analytical methods or computational tools.*

Scoring Rubric:

Aspect	1: Not proficient	2: Progressing to proficiency	3: Proficient	4: Superior proficiency
Students analyze biological fluid flow	Does not demonstrate the ability to use approximate analytical methods or computational tools to the fluid flow.	Correlate approximate analytical methods or computational tools to the fluid flow, but rarely analyze the fluid flow.	Demonstrates application of approximate analytical methods or computational tools to analyze the fluid flow.	Provides accurate analysis of the fluid flow using approximate analytical methods or computational tools.