CEE 2105 Learning Outcomes

Lecture #	Learning Outcomes
1	• Identify the base units for length, time, mass, and force in the US Customary and SI unit systems. • Convert quantities between two different units. • Express a computed value to the appropriate number of significant figures.
2	• Resolve a vector into components in two mutually perpendicular directions. • Express a vector in Cartesian form, given information about the angle between the vector and coordinate axis. • Determine the resultant of two or more vectors by addition of rectangular components.
3	
4	• Calculate the moment of a force or set of coplanar forces about a point by scalar methods.
5	• Calculate the moment of a couple or set of coplanar couples by scalar methods.
6	• Solve for unknowns in a 2-D particle equilibrium problem.
7	• Solve for unknowns in a 2-D particle equilibrium problem. (repeat) • Explain the difference between analysis and design. • Define factor of safety.
8	• Identify reaction forces and moments associated with different idealized support conditions. • Construct a free body diagram for a rigid body.
9	• Solve for unknowns in a 2-D rigid body equilibrium problem.
10	• Solve for unknowns in a 2-D rigid body equilibrium problem. (repeat) • Classify a rigid body as statically determinate, statically indeterminate, partially constrained, or improperly constrained. • Recognize a two- or three-force body and identify the lines of action of all forces on such a body. • Identify the assumptions used for analysis and design of trusses.
11	• Identify zero force members in a truss by inspection. • Solve for unknown forces in a truss using the method of joints.
12	• Solve for unknown forces in a truss using the method of sections.
13	• Calculate the average normal stress acting on a cross-section. • Calculate the average shear stress acting on a cross-section.
14	• Identify key components of an open web steel joist. • Solve for unknown forces in a truss using the method of joints. (repeat) • Solve for unknown forces in a truss using the method of sections. (repeat) • Calculate the average normal stress acting on a cross-section. (repeat) • Compute actual factors of safety and/or stress ratios. • Predict the maximum design capacity and failure load of a simple structure given allowable stresses and factors of safety.
15	• Determine the load capacity of a simple connection given a set of allowable normal, shear, and/or bearing stresses. • Design a simple connection for a given load and set of allowable normal, shear, and/or bearing stresses.
16	• Calculate the average normal strain acting on a cross-section. • Calculate the average shear strain acting on a cross-section.
17	• Explain the methodology for determining stress and strain experimentally. • Identify the important elements of a stress-strain diagram. • Identify and apply Hooke's Law. • Compute the modulus of elasticity, yield stress, and ultimate stress from a stress-strain curve. • Characterize the difference between ductile and brittle behavior. • Calculate the percent area reduction and percent elongation from a tension test.
18	• Compute the following from experimental tension test data: strain energy, modulus of resilience, modulus of toughness, Poisson's ratio, and modulus of rigidity.

19	• Identify the six steps related to the production of steel. • Identify the methodology for manufacturing steel using a Basic Oxygen Furnace. • Describe the difference between a Basic Oxygen and an Electric Arc Furnace. • Define the terms “slag” and “mini-mill”.
20	• Calculate the elastic displacement of an axially loaded member.
21	• Apply data from a tension test to solve an engineering problem. • Identify the structural layout of the Brandywine bridge. • Conduct a Charpy impact test and analyze data to determine the impact energy of a steel alloy. • Identify the effect of temperature on the impact energy. • Characterize relative ductility from failed Charpy specimens.
22	• Solve for unknowns in a statically indeterminate problem involving axial displacements.
23	• Solve for unknowns in a statically indeterminate problem using superposition and the Force Method.
24	• Solve for unknowns in a problem involving thermal effects.
25	Overarching problem: see previous lecture learning outcomes
26	• Solve for unknown forces and residual stresses in a problem involving elastic-perfectly plastic material behavior.
27	• Determine kinematic properties (acceleration, velocity, distance, or time) for a particle or system of particles using the equations of motion in rectangular coordinates.
28	• Explain graphically the relationship between, static friction, maximum static friction, and kinetic friction. • Determine whether or not an object remains in static equilibrium under a given set of loads. • Determine kinematic properties (acceleration, velocity, distance, or time) for a particle or system of particles using the equations of motion in rectangular coordinates. (repeat)
29	• Determine whether or not an object remains in static equilibrium under a given set of loads. (repeat) • Determine kinematic properties (acceleration, velocity, distance, or time) for a particle or system of particles using the equations of motion in rectangular coordinates. (repeat) • Design a simple experiment to determine unknown quantities.
30	• Solve for unknown parameters in a problem involving the impending motion of a body. • Identify the basic characteristics of a gravity dam.
31	• Develop force and couple resultants to represent a system of forces and couples.
32	• Determine the magnitude, direction, and location of a single force to represent a system of coplanar forces and couples. • Determine the magnitude and location of a single force to represent a system of parallel forces.
33	• Determine the magnitude and location of an equivalent concentrated force to represent a simple distributed force pattern.
34	• Define the terms center of gravity, center of mass, and centroid. • Determine the centroid of an area by integration.
35	• Determine the centroid of a line segment by integration. • Determine the centroid of a volume of revolution by integration. • Determine centroidal axes of a shape by symmetry.
36	• Determine the magnitude(s) and location(s) of an equivalent concentrated force(s) to represent a fluid pressure.
37	• Determine the centroid of a composite area.
38	• Determine the centroid of a composite area. (repeat) • Determine the centroid of a composite line segment. • Determine the centroid of a composite volume. • Determine the center of gravity of a non-homogeneous composite body.
39	• Determine the moment of inertia of an area about a specified axis by direct integration.
40	Overarching problem: see previous lecture learning outcomes

41	• Determine the moment of inertia of an area about a specified axis by direct integration. (repeat) • Determine the moment of inertia of an area about a specified axis using the Parallel Axis Theorem.
42	• Determine the moment inertia of a composite area about a specified axis.
43	• Identify the basic design characteristics for a water tower.
44	• Calculate the critical buckling load for a simple pin-connected structure using an equilibrium analysis. • Explain the relationship between length and critical buckling load for a pin-ended compression member.
45	• Explain the relationship between section properties and critical buckling load for a pin-ended compression member. • Explain the relationship between material properties and critical buckling load for a pin-ended compression member. • Calculate the critical buckling load for a pin-ended compression member using the Euler buckling formula.
46	• Explain the relationship between end conditions and critical buckling load for a compression member. • Determine the effective length for a compression member with specified end conditions. • Calculate the critical buckling load for a compression member using the Euler buckling formula and appropriate effective slenderness ratio.
47	• Explain the difference between elastic buckling and inelastic buckling. • Calculate the critical buckling load for a compression member using the modified Euler buckling formula with a tangent modulus.
48	Overarching problem: see previous lecture learning outcomes
49	• Construct a position vector of one point relative to another using the coordinates of the two points in space. • Express a force as a Cartesian vector using a position vector along the line of action of the force.
50	• Calculate the moment of a force about a point by vector methods. • Calculate the moment of a force about a specified axis by vector methods.
51	• Solve for unknowns in a 3-D particle equilibrium problem.
52	• Identify reaction forces and moments associated with different 3-D idealized support conditions. • Solve for unknowns in a 3-D rigid body equilibrium problem.
53	• Solve for unknowns in a 3-D particle equilibrium problem. (repeat)

Green = Secondary Outcome (tools, intermediate calculations, and concepts)
Red = Primary Outcome (application problems)

Primary Outcomes are more comprehensive and build upon the secondary learning outcomes. *Exam questions will be based on the primary outcomes, with secondary outcomes incorporated as appropriate.*