***Solutions Section* 6.2 – Basic Theory of Linear Systems**

***Exercise***

Write the given system of equations in matrix-form then show that the given vector is a solution to the system



***Solution***

***Exercise***

Write the given system of equations in matrix-form then show that the given vector is a solution to the system



***Solution***

***Exercise***

Verify by substitution that  and  are solutions of the given homogenous equation. Show also that the solutions  and  are linearly independent. Find the solution of the given homogeneous equation with the initial condition 



***Solution***

***Exercise***

Verify by substitution that  and  are solutions of the given homogenous equation. Show also that the solutions  and  are linearly independent. Find the solution of the given homogeneous equation with the initial condition 



***Solution***

***Exercise***

Verify by substitution that  and  are solutions of the given homogenous equation. Show also that the solutions  and  are linearly independent. Find the solution of the given homogeneous equation with the initial condition 



***Solution***

***Exercise***

Consider the RLC parallel circuit below. Let V represent the voltage drop across the capacitor and I represent the current across the inductor.



***Solution***

***Exercise***

Consider the RLC parallel circuit below. Let V represent the voltage drop across the capacitor and I represent the current across the inductor.

Show that:



***Solution***

***Exercise***

Consider the RLC parallel circuit below. Let V represent the voltage drop across the capacitor and I represent the current across the inductor.



Show that:



***Solution***

***Exercise***

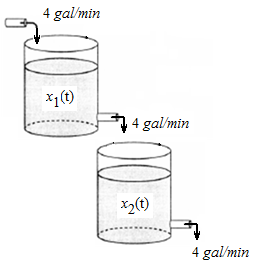
Two tanks are connected by two pipes. Each tank contains 500 gallons of a salt solution. Through on pipe solution is pumped from the first tank to the second at 1 *gal/min*. Through the other pipe, solution is pumped at the same rate from the second to the first tank. Show the salt content in each tank varies with time.



***Solution***

***Exercise***

Each tank contains 100 gallons of a salt solution.Pure water flows into the upper tank at a rate of 4 *gal/min*. Salt solution drains from the upper tank into the lower tank at a rate of 4 *gal/min*. Finally, salt solution drains from the lower tank at a rate of 4 *gal/min*, effectively keeping the volume of solution in each tank at a constant 100 *gal*. If the initial salt content of the upper and lower tanks is 10 and 20 pounds, respectively. Set up an initial value problem that models the amount of salt in each tank over time (do not solve).Write the model in matrix-vector form. Is the system homogeneous or inhomogeneous?



***Solution***

***Exercise***

Two masses on a frictionless tabletop are connected with a spring having spring constant . The first mass is connected to a vertical support with a spring having spring constant . The second mass is shaken harmonically via a force equaling . Let  and  measure the displacements of the masses and ., respectively, from their equilibrium positions as a function of time. If both masses start from rest at their equilibrium positions at time .



Set up an initial value problem that models the position of the masses over time (do not solve).Write the model in matrix-vector form. Is the system homogeneous or inhomogeneous?

***Solution***

***Solutions Section* 6.3 – Linear Systems with Constant Coefficients**

***Exercise***

Find the eigenvalues and the eigenvectors for each of the matrices.



***Solution***

***Exercise***

Find the eigenvalues and the eigenvectors for each of the matrices.



***Solution***

***Exercise***

Find the eigenvalues and the eigenvectors for each of the matrices.



***Solution***

***Exercise***

Find the eigenvalues and the eigenvectors for each of the matrices.



***Solution***

***Exercise***

Find the eigenvalues and the eigenvectors for each of the matrices.



***Solution***

***Exercise***

Find the eigenvalues and the eigenvectors for each of the matrices.



***Solution***

***Exercise***

Find a fundamental set of solutions for the system  , where *A* is the given matrices.



***Solution***

***Exercise***

Find a fundamental set of solutions for the system  , where *A* is the given matrices.



***Solution***

***Solutions Section* 6.4 – Planar Systems – *Distinct, Complex, and Repeated Eigenvalues***

***Exercise***

Find the general solution of the system 



***Solution***

***Exercise***

Find the general solution of the system 



***Solution***

***Exercise***

Find the general solution of the system 



***Solution***

***Exercise***

Find the general solution of the system 



***Solution***

***Exercise***

Find the general solution of the system 



***Solution***

***Exercise***

Find the general solution of the system 



***Solution***

***Exercise***

Find the general solution of the system 



***Solution***

***Exercise***

Find the general solution of the system 



***Solution***

***Exercise***

Find the real and imaginary part of 

***Solution***

***Solutions Section* 6.5 – Phase Plane Portraits**

***Exercise***

Sketch a rough approximation of a solution in each region determined by the half-line solutions. Use arrows to indicate the direction of motion on all solutions. Determine the behavior of the equilibrium point and the stability.



***Solution***

***Exercise***

Sketch a rough approximation of a solution in each region determined by the half-line solutions. Use arrows to indicate the direction of motion on all solutions. Determine the behavior of the equilibrium point and the stability.



***Solution***

***Exercise***

Sketch a rough approximation of a solution in each region determined by the half-line solutions. Use arrows to indicate the direction of motion on all solutions. Determine the behavior of the equilibrium point and the stability.



***Solution***

***Exercise***

Sketch a rough approximation of the given system. Use arrows to indicate the direction of motion on all solutions. Determine the behavior of the equilibrium point and the stability.



***Solution***

***Exercise***

Sketch a rough approximation of the given system. Use arrows to indicate the direction of motion on all solutions. Determine the behavior of the equilibrium point and the stability.



***Solution***

***Exercise***

Sketch a rough approximation of the given system. Use arrows to indicate the direction of motion on all solutions. Determine the behavior of the equilibrium point and the stability.



***Solution***

***Exercise***

Sketch a rough approximation of the given system. Use arrows to indicate the direction of motion on all solutions. Determine the behavior of the equilibrium point and the stability.



***Solution***

***Exercise***

Sketch a rough approximation of the given system. Use arrows to indicate the direction of motion on all solutions. Determine the behavior of the equilibrium point and the stability.



***Solution***

***Exercise***

Sketch a rough approximation of the given system. Use arrows to indicate the direction of motion on all solutions. Determine the behavior of the equilibrium point and the stability.



***Solution***

***Exercise***

Sketch a rough approximation of the given system. Use arrows to indicate the direction of motion on all solutions. Determine the behavior of the equilibrium point and the stability.



***Solution***