```
% ME 564 HW7 Q5 c & d

% Define A(t)
A = @(t) [-4/t -2/t^2; 1 0];

% Define the state transition matrix function
% This is a numerical approximation, as MATLAB does not have a built-in
% symbolic matrix exponential for TVS
Phi = @(t, tau) expm(integral(@(s) A(s), tau, t, 'ArrayValued', true));

% Define the time vector (random)
tspan = [1 10];

% Define the initial condition
x0 = [1; 1];

% Solve the system using ode45
[t_out, x_out] = ode45(@(t, x) A(t)*x, tspan, x0);

% Display the solution at each time step
disp('Time and corresponding solution:')
disp([t_out, x_out])

% Compute and display the state transition matrix at a specific time
t = 10;
tau = 1;
Phi_t_tau = Phi(t, tau);

disp(['State transition matrix Phi(' num2str(t) ', ' num2str(tau) '):'])
disp(Phi_t_tau)

% Compute and display the solution phi(t) using the state transition matrix
% This is the solution at time t starting from the initial condition x0 at
 time tau
phi_t = Phi_t_tau * x0;

disp(['Solution phi(' num2str(t) ') with initial condition x(1) = [1; 1]:'])
disp(phi_t)
```

```
Time and corresponding solution:
    1.0000    1.0000    1.0000
    1.0084    0.9508    1.0082
    1.0167    0.9036    1.0159
    1.0251    0.8583    1.0233
    1.0335    0.8149    1.0303
    1.0754    0.6223    1.0603
    1.1172    0.4649    1.0829
    1.1591    0.3357    1.0996
    1.2010    0.2293    1.1113
    1.2537    0.1211    1.1205
    1.3065    0.0360    1.1245
    1.3593   -0.0310    1.1246
```

1.4121	-0.0839	1.1215
1.4653	-0.1258	1.1159
1.5185	-0.1586	1.1083
1.5717	-0.1842	1.0991
1.6249	-0.2039	1.0888
1.6935	-0.2225	1.0741
1.7621	-0.2351	1.0584
1.8307	-0.2432	1.0420
1.8993	-0.2478	1.0251
1.9916	-0.2500	1.0021
2.0840	-0.2488	0.9790
2.1763	-0.2453	0.9562
2.2686	-0.2403	0.9338
2.3934	-0.2320	0.9043
2.5183	-0.2226	0.8759
2.6431	-0.2128	0.8487
2.7679	-0.2029	0.8228
2.9485	-0.1890	0.7874
3.1292	-0.1758	0.7545
3.3098	-0.1635	0.7238
3.4904	-0.1522	0.6953
3.7154	-0.1393	0.6626
3.9404	-0.1278	0.6325
4.1654	-0.1176	0.6049
4.3904	-0.1084	0.5796
4.6154	-0.1001	0.5561
4.8404	-0.0928	0.5344
5.0654	-0.0861	0.5143
5.2904	-0.0802	0.4956
5.5154	-0.0748	0.4782
5.7404	-0.0699	0.4619
5.9654	-0.0655	0.4467
6.1904	-0.0614	0.4324
6.4154	-0.0577	0.4190
6.6404	-0.0544	0.4064
6.8654	-0.0513	0.3945
7.0904	-0.0485	0.3833
7.3154	-0.0458	0.3727
7.5404	-0.0434	0.3627
7.7654	-0.0412	0.3532
7.9904	-0.0391	0.3441
8.2154	-0.0372	0.3355
8.4404	-0.0355	0.3274
8.6654	-0.0338	0.3196
8.8904	-0.0323	0.3121
9.1154	-0.0308	0.3050
9.3404	-0.0295	0.2983
9.5654	-0.0282	0.2918
9.7904	-0.0270	0.2856
9.8428	-0.0268	0.2841
9.8952	-0.0265	0.2828
9.9476	-0.0263	0.2814
10.0000	-0.0260	0.2800

```
State transition matrix Phi(10, 1):
   -0.0479   -0.0373
    0.1863    0.1427

Solution phi(10) with initial condition x(1) = [1; 1]:
   -0.0852
    0.3291
```

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