36. The roots of a cubic equation $a_3x^3 + a_2x^2 + a_1x + a_0 = 0$ can be calculated using the following procedure:

    Set: $A = a_2/a_3$, $B = a_1/a_3$, and $C = a_0/a_3$.

    Calculate: $D = Q^3 + R^2$,

    where $Q = (3B - A^2)/9$ and $R = (9AB - 27C - 2A^3)/54$.

    If $D > 0$ the equation has complex roots.

    If $D = 0$ all roots are real and at least two are equal. The roots are given by:

    $x_1 = 2\sqrt[3]{R} - A/3$, $x_2 = -\sqrt[3]{R} - A/3$, and $x_3 = -\sqrt[3]{R} - A/3$.

    If $D < 0$ all roots are real and are given by:

    $x_1 = 2\sqrt{-Q}\cos(\theta/3) - A/3$, $x_2 = 2\sqrt{-Q}\cos(\theta/3 + 120°) - A/3$, and

    $x_3 = 2\sqrt{-Q}\cos(\theta/3 + 240°) - A/3$, where $\cos\theta = R/\sqrt{-Q^3}$.

    Write a MATLAB program that determines the real roots of a cubic equation. As input the program asks the user to enter the values of a_3, a_2, a_1, and a_0 as a vector. The program then calculates the value of D. If the equations has complex roots the message "The equation has complex roots" is displayed. Otherwise the real roots are calculated and displayed. Use the program to solve the following equations:

    (a) $5x^3 + -34.5x^2 + 36.9x + 8.8 = 0$ (b) $2x^3 + -10x^2 + 24x - 15 = 0$

    (c) $2x^3 + -1.4x^2 - 20.58x + 30.87 = 0$

Solution

Script File:

```
v=input('Enter the values of a3, a2, a1, and a0 as a
vector:  ');
a=v(2)/v(1);  b=v(3)/v(1);  c=v(4)/v(1);
Q=(3*b-a^2)/9;
R=(9*a*b-27*c-2*a^3)/54;
D=Q^3+R^2;
if abs(D)<0.01
    D=0;
end
if D > 0
    disp('The equation has complex roots.')
elseif D ==0
    S=nthroot(R,3);
    x1=2*S-a/3;
    x2=-S-a/3;
```

Matlab Solutions For Chapter 5

Dale E. Seborg,Thomas F. Edgar,Duncan A. Mellichamp,Francis J. Doyle, III

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A Guide to MATLAB Brian R. Hunt,Ronald L. Lipsman,Jonathan M. Rosenberg,Kevin R. Coombes,John E. Osborn,Garrett J. Stuck,2006-06-08 This is a short focused introduction to MATLAB a comprehensive software system for mathematical and technical computing It contains concise explanations of essential MATLAB commands as well as easily understood instructions for using MATLAB s programming features graphical capabilities simulation models and rich desktop interface Written for MATLAB 7 it can also be used with earlier and later versions of MATLAB This book teaches how to graph functions solve equations manipulate images and much more It contains explicit instructions for using MATLAB s companion software Simulink which allows graphical models to be built for dynamical systems MATLAB s new publish feature is discussed which allows mathematical computations to be combined with text and graphics to produce polished integrated interactive documents For the beginner it explains everything needed to start using MATLAB while experienced users making the switch to MATLAB 7 from an earlier version will also find much useful information here **Biosignal and Medical Image Processing** John L. Semmlow,Benjamin Griffel,2021-09-30 Written specifically for biomedical engineers Biosignal and Medical Image Processing Third Edition provides a complete set of signal and image processing tools including diagnostic decision making tools and classification methods Thoroughly revised and updated it supplies important new material on nonlinear methods for describing and classify Process Control B. Wayne Bequette,2023-07-24 Master Process Control Hands On through Updated Practical Examples and MATLAB Simulations Process Control Modeling Design and Simulation Second Edition is a complete introduction to process control and has been fully updated integrating current software tools to enable professionals and students to master critical techniques hands on through simulations based on modern versions of MATLAB This revised edition teaches the field s most important techniques behaviors and control problems with even more practical examples and exercises Wide ranging enhancements include safety considerations an expanded discussion of digital control additional process examples and updates throughout for newer versions of MATLAB and SIMULINK Fundamentals of process control and instrumentation including objectives variables block diagrams and process flowsheets Methodologies for developing dynamic models of chemical processes including compartmental models Dynamic behavior of linear systems state space models transfer function based models including conversion to state space and more Empirical and discrete time models including relationships among types of discrete models Feedback control proportional integral and derivative PID controllers and closed loop stability analysis Frequency response analysis techniques for evaluating the robustness of control systems Improving control loop performance internal model control IMC automatic tuning gain scheduling and enhanced disturbance rejection Split range selective and override strategies for switching among inputs or outputs Control loop interactions and multivariable controllers An introduction to model predictive control MPC with a new discrete state space model derivation exercise Bequette walks step by step through developing control

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Continuous System Simulation François E. Cellier,Ernesto Kofman,2006-03-15 Highly computer oriented text introducing numerical methods and algorithms along with the applications and conceptual tools Includes homework problems suggestions for research projects and open ended questions at the end of each chapter Written by our successful author who also wrote Continuous System Modeling a best selling Springer book first published in the 1991 sold about 1500 copies   *Proceedings of the 2024 3rd International Conference on Educational Science and Social Culture (ESSC 2024)* Yongjun Feng,Wei Cui,Ye Dong,Guiyun Guan,2025-05-04 This is an open access book 2024 3rd International Conference on Educational Science and Social Culture ESSC 2024 is scheduled to be held in Chengdu China during December 27 29 2024 The 3rd International Conference on Educational Science and Social Culture ESSC 2024 aims to unite scholars educators and practitioners to foster a deeper understanding of educational sciences and social culture The conference will address emerging trends innovative practices and critical issues affecting education and society in today s complex global environment ESSC 2024 focuses on promoting interdisciplinary research and collaborative efforts to explore and solve contemporary challenges in education and social culture The conference serves as a platform for disseminating cutting edge research sharing practical solutions and fostering dialogues that can translate into actionable policies and strategies ESSC 2024 will feature extended workshops keynote speeches from globally renowned experts and enhanced networking opportunities Unlike previous editions this year s conference will incorporate more interactive sessions and digital platforms

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