

Course Outline and References

Course Code/Title JEE 606: Mathematical Techniques: 3 credits
Division: Energy **Semester: 1**
Prerequisite: None
Lecturer: Assoc. Prof. Dr. Prungchan Wongwises
 Dr. Porntip Dechpichai
Contact address: JGSEE
E-Mail address: Prungchan.won@kmutt.ac.th , mobile: 0891178495

Course description:

Numerical solution of ordinary differential equations, difference methods of initial and boundary value problems. Numerical solutions of partial differential equations. Optimization techniques: Lagrange multiplier method, linear programming. Simplex method. Nonlinear programming, steepest-descent method, Newton method, Conjugate gradient method. Introduction to programming using R. Descriptive Statistics with R. Inferential Statistics with R

Commence Date: 10 August 2020

Subject outlines:

| | Hrs. |
|---|-------------|
| 1. Introduction to differential equations (ODE), Euler's method, Heun's method Runge-Kutta method. | 3 |
| 2. Boundary value problems for ordinary differential equations, finite-difference Methods, derivative boundary condition. | 3 |
| 3. Solving system of linear equations, Gaussian elimination, Gauss-Jordan elimination, | 3 |
| 4. Eigenvalue problems, eigenvalue, eigenvector, power method. | 3 |
| 5. Introduction to partial differential equations (PDE), boundary and initial conditions, finite-difference methods. | 3 |
| 6. Elliptic PDE, regular boundaries, irregular boundaries. | 3 |
| 7. Heat equation: Parabolic PDE, Wave equation: Hyperbolic PDE. | 3 |
| 8. Optimization techniques, classical optimization techniques, Multivariable optimization with no constraints, Hessian matrix. | 3 |
| 9. Multivariable optimization with equality constraints, Lagrange multiplier method | 3 |
| 10. Linear programming. Simplex method | 3 |
| 11. Nonlinear programming, steepest descent method, Newton method. | 3 |
| 12. Conjugate gradient method | 3 |
| 13. Introduction to programming using R. Descriptive Statistics with R Graphics with R | 3 |
| 14. Inferential Statistics with R, T-test, Analysis of variance. | 3 |
| 15. Inferential Statistics with R, Chi-squared, Correlation and Regression analysis with R. | 3 |

Total **45 hours**

References/Textbooks

1. Dennis G.Zill, Michael R. Cullen: Differential Equations with Boundary-Value Problems, Fifth Edition, Brooks/Cole. (QA 371,Z69)
2. John H. Mathews: Numerical Methods for Computer Science, Engineering and Mathematics, Prentice-hall Inc. (QA 297, M439)
3. James L. Buchanan, Peter R. Turner: Numerical Methods and analysis, McGraw-Hill Inc. (QA 297, B918)
4. N.S. Asaithambi : Numerical Analysis: Theory and Practice, Saunder College Publishing. (QA 297, A789)
5. Chung-Yau Lam: Applied Numerical Methods for Partial Differential Equations, Prentice-Hall. (QA 297, L213)
6. Shoichiro Nakamura: Applied Numerical Methods with Software, Prentice-Hall. (QA 297, N163)
7. Richard L. Burden, J.Douglas Faires, Numerical Analysis, ITP An International Thomson Publishing Company. (QA 297, B 947)
8. Sidney Yakowitz, Farung Szidarovszky: An Introduction to Numerical Computations, Macmillan Publishing Company. (QA 297, Y15)
9. Peter R. Turner: Guide to Scientific Computing, Macmillan. (QA 297,T951)
10. Francis Scheid, Schaum's Outline of Theory and Problems of Numerical Analysis 2/ed. (QA 297,S 318)
11. Gerald Wheatley: Applied Numerical Analysis, International Edition 2004. (QA 297, G 354)
12. S.S. Rao: Optimization, Theory and Applications, AWiley Interscience Publication,
- 13 Lander, P., Jared. R for Everyone: Advanced Analytics and Graphics. 2 edition, Pearson Education, Inc., 2014.
14. James, G., Witten, D. , Hastie T. & Tibshirani R. An Introduction to Statistical Learning with Applications in R, 8 edition, Springer, 2017.
15. Mark P.J. van der Loo, Edwind de Jonge, Learning R Studio For R Statistical Computing, 2012.
16. <https://www.r-project.org/>
17. <https://www.rstudio.com/>
18. <http://www.r-statistics.com/2009/10/free-statistics-e-book-for-download/>

Approved by.

(Assoc. Prof. Dr. Prungchan Wongwises)

(Dr. Porntip Dechpichai)