Teaching Plan (Jan 2022-April 2022)
DCC 1D: NETWORK MODELS AND SCHEDULING TECHNIQUES
(THEORY AND PRACTICAL)

Course Objectives:

The objective of this course is to make the students understand about the theory and practical application of transportation problems and assignment problems that requires problem solving and analytical skills from Operational Research. The course shall also deal with utility of project scheduling techniques, related network optimization and resource allocation models to handle managerial decision-making problems.

Course Learning Outcomes:
Students completing this course will be able to:

- Understand relevant concepts related to handling of transportation-based problems
- Develop an understanding towards formulating and solving assignment-based problems
- Do analysis of project schedule and analyze the cost-time tradeoffs in context of a project network
- Learn to solve different real-life problems through network optimization tools
- Learn skills to aid management decision making
- Learn basic concepts pertaining to resource allocation

Contents:

Month	Topic
Jan	**Unit 1**: (**Week 1- 3)** Formulation as a linear programming problem, methods to find initial basic feasible solution (NWCM, LCM, VAM) and optimal solution (MODI), Degeneracy, Unbalanced transportation problem, Prohibited transportation problem, Maximization type Transportation problem, Transshipment problem.
Feb	**Unit 2:** (**Week 4-6)** Formulation as a linear programming problem, Hungarian method, Degeneracy, Unbalanced assignment problem, Prohibited assignment problem, Maximization type assignment problem, Travelling salesmen problem: Branch and bound solution algorithm.
March	**Unit 3: (Week 7-10)** Network representation of project, Project scheduling-Critical path method and PERT, Types of Floats, Crashing-Time and cost trade-off.
April	**Unit 4: (Week 11-15)** Basic concepts, Shortest path problem, Minimum spanning tree problem. Resource Allocation Problem**:** Basic definitions and understanding of resource levelling and resource smoothing.

- To make the lectures interesting, use of PPTs and audio visual presentations will be made.
- The students would be encouraged to solve real life OR problems by applying the different methods/concepts learnt in assignments or tests.

- Demonstration of OR computation will be done through application like TORA/QM, MS Excel and other mathematical software like mathematica.

Text Books:

1. Hillier, F.S., Lieberman, G. J., Nag, B., & Basu, P. (2017).*Introduction to operations research- concepts and cases* (10th ed.). New Delhi: Tata McGraw Hill (Indian print).
2. Taha, H. A. (2017). *Operations research-an introduction* (10th ed.). New Delhi: Pearson Prentice Hall (Indian print).
3. Ravindran, A., Phillips, D. T., & Solberg, J. J. (2007). *Operations research- principles and practice* (2nd ed.). New Delhi: Wiley India (Indian print).
4. Wayne, Winston, L. (2003). *Operations research: applications and algorithms,* (4th ed.). Duxbury Press.
5. Wiest, J. D., & Levy, F.K. (1979). *A management guide to PERT/CPM, with GERT/PDM/ DCPM and other networks* (2nd ed.). New Jersey: Prentice-Hall.

Teaching Plan (Jan 2022-April 2022)
SEC-2: Computer Algebra Systems and Related Software

Course Objectives: This course aims at familiarizing students with the usage of computer algebra systems (/Mathematica/MATLAB/Maxima/Maple) and the statistical software **R**. The basic emphasis is on plotting and working with matrices using CAS. Data entry and summary commands will be studied in **R**. Graphical representation of data shall also be explored.

Course Learning Outcomes: This course will enable the students to:

i. Use of computer algebra systems (Mathematica/MATLAB/Maxima/Maple etc.) as a calculator, for plotting functions and animations
ii. Use of CAS for various applications of matrices such as solving system of equations and finding eigenvalues and eigenvectors.
iii. Understand the use of the statistical software **R** as calculator and learn to read and get data into **R.**
iv. Learn the use of **R** in summary calculation, pictorial representation of data and exploring relationship between data.
v. Analyze, test, and interpret technical arguments on the basis of geometry.

Contents:

Month	Topic
Jan	**Unit 1**: (**Weeks 1 to 3)** **C**omputer Algebra System (CAS), Use of a CAS as a calculator, Computing and plotting functions in 2D, Producing tables of values, Working with piecewise defined functions, Combining graphics. Simple programming in a CAS.
Feb	**Unit 2:** (**Weeks 4 and 5)** Plotting functions of two variables using Plot3D and contour plot, Plotting parametric curves surfaces, Customizing plots, Animating plots.
March	**Unit 2: (Weeks 6 to 8)** Working with matrices, Performing Gauss elimination, Operations (Transpose, Determinant, Inverse), Minors and cofactors, Working with large matrices, Solving system of linear equations, Rank and nullity of a matrix, Eigenvalue, Eigenvector and diagonalization.
April	**Unit 3 & 4: (Weeks 9 to 11)** **R** as a calculator, Explore data and relationships in **R.** Reading and getting data into **R:** Combine and scan commands, Types and structure of data items with their properties. Manipulating vectors, Data frames, Matrices and lists. Viewing objects within objects. Constructing data objects and conversions. **(Weeks 12 to 14)** Summary commands**:** Summary statistics for vectors, Data frames, Matrices and lists. Summary tables. Stem and leaf plot, histograms. Plotting in **R:** Box-whisker plots, Scatter plots, Pairs plots, Line charts, Pie charts, Cleveland dot charts and Bar charts. Copy and save graphics to other applications.

- To make the lectures interesting, use of PPTs and audio visual presentations will be made.
- Demonstration of OR computation will be done through application like TORA/QM, MS Excel and other mathematical software like mathematica
- Practical demonstration will be carried out only in **one** of the CAS: Mathematica/MATLAB/Maxima/Scilab and R Software.

Text Books:

1. Bindner, Donald & Erickson, Martin. (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.
2. Torrence, Bruce F., & Torrence, Eve A. (2009). *The Student's Introduction to Mathematica*R: *A Handbook for Precalculus, Calculus, and Linear Algebra* (2nd ed.). Cambridge University Press.
3. Gardener, M. (2012). *Beginning R*: *The Statistical Programming Language*, Wiley.

Additional Reading:

1. Verzani, John (2014). *Using R for Introductory Statistics* (2nd ed.). CRC Press, Taylor & Francis Group.