DEPARTMENT OF MATHEMATICS

The following Courses having focus on Employability/Entrepreneurship/Skill Development:

Courses:

1.Differential equations since 2016

2.Operation Research since 2016

3.Discrete Mathematics since 2016

4.Mathematical Modelling since 2021

Attachment:

Attached Syllabus copy of the above mentioned courses or papers

Sign of the Head, Dept.

DIFFERENTIAL EQUATIONS

(w.e.f. academic year 2019-20)

DSC-1B **BS-101**

Objective: The main aim of this course is to introduce the students to the techniques of solving differential equations and to train to apply their skills in solving some of the problems of engineering and science.

Outcome: After learning the course the students will be equipped with the various tools to solve few types differential equations that arise in several branches of science.

Unit- I

Differential Equations of first order and first degree: Introduction - Equations in which Variables are Separable - Homogeneous Differential Equations - Differential Equations Reducible to Homogeneous Form - Linear Differential Equations - Differential Equations Reducible to Linear Form - Exact differential equations - Integrating Factors - Change in variables - Total Differential Equations - Simultaneous Total Differential Equations - Equations of the form $dx = dy = dz$. P Q R

Unit- II

Differential Equations first order but not of first degree: Equations Solvable for p - Equations Solvable for y - Equations Solvable for x - Equations that do not contain x (or y)- Equations Homogeneous in x and y - Equations of the First Degree in x and y - Clairaut's equation. Applications of First Order Differential Equations : Growth and Decay - Dynamics of Tumour Growth - Radioactivity and Carbon Dating - Compound Interest - Orthogonal Trajectories .

Unit- III

Higher order Linear Differential Equations: Solution of homogeneous linear differential equations with constant coefficients - Solution of non-homogeneous differential equations $P(D)y = Q(x)$ with constant coefficients by means of polynomial operators when $Q(x) = be^{ax}$, b sin ax/b cos ax, bx^k, V e^{ax} - Method of undetermined coefficients.

Unit- IV

Method of variation of parameters - Linear differential equations with non constant coefficients - The Cauchy - Euler Equation - Legendre's Linear Equations - Miscellaneous Differential Equations. Partial Differential Equations: Formation and solution- Equations easily integrable - Linear equations of first order.

Paper-IV: **Operations Research**

Unit I

Formulation of Linear Programming problems, Graphical solution of Linear Programming problem, General formulation of Linear Programming problems, Standard and Matrix forms of Linear Programming problems, Simplex Method, Two-phase method, Big-M method, Method to resolve degeneracy in Linear Programming problem, Alternative optimal solutions. Solution of simultaneous equations by simplex Method, Inverse of a Matrix by simplex Method, Concept of Duality in Linear Programming, Comparison of solutions of the Dual and its primal.

Unit II

Mathematical formulation of Assignment problem, Reduction theorem, Hungarian Assignment Method, Travelling salesman problem, Formulation of Travelling Salesman problem as an Assignment problem, Solution procedure.

Mathematical formulation of Transportation problem, Tabular representation, Methods to find initial basic feasible solution, North West corner rule, Lowest cost entry method, Vogel's approximation methods, Optimality test, Method of finding optimal solution, Degeneracy in transportation problem, Method to resolve degeneracy, Unbalanced transportation problem.

Unit III

Concept of Dynamic programming, Bellman's principle of optimality, characteristics of Dynamic programming problem, Backward and Forward recursive approach, Minimum path problem, Single Additive constraint and Multiplicatively separable return, Single Additive constraint and Additively separable return, Single Multiplicatively constraint and Additively separable return.

Unit-IV

Historical development of CPM/PERT Techniques - Basic steps - Network diagram representation - Rules for drawing networks - Forward pass and Backward pass computations - Determination of floats - Determination of critical path - Project evaluation and review techniques.

Paper - V: **Discrete Mathematics**

Unit-I

Mathematical Logic: Propositional logic, Propositional equivalences, Predicates and Quantifiers, Rule of inference, direct proofs, proof by contraposition, proof by contradiction. **Boolean Algebra:** Boolean functions and its representation, logic gates, minimizations of circuits by using Boolean identities and K - map.

Unit-II

Basic Structures: Sets representations, Set operations, Functions, Sequences and Summations. Division algorithm, Modular arithmetic, Solving congruences, applications of congruences. **Recursion:** Proofs by mathematical induction, recursive definitions, structural induction,generalized induction, recursive algorithms.

Unit-III

Counting: Basic counting principle, inclusion - exclusion for two - sets, pigeonhole principle, permutations and combinations, Binomial coefficient and identities, generalized permutations and combinations. **Recurrence Relations:** introduction, solving linear recurrence relations, generating functions, principle of inclusion - exclusion, applications of inclusion - exclusion. **Relations:** relations and their properties, representing relations, closures of relations, equivalence relations, partial orderings.

Unit-IV

Graphs: Graphs definitions, graph terminology, types of graphs, representing graphs, graph isomorphism, connectivity of graphs, Euler and Hamilton paths and circuits, Dijkstras algorithm to find shortest path, planar graphs Eulers formula and its applications, graph coloring and its applications. **Trees:** Trees definitions properties of trees, applications of trees BST, Haffman Coding, tree traversals: pre - order, in - order, post - order, prefix, infix, postfix notations, spanning tress DFS, BFS, Prims, Kruskals algorithms.

Mathematical Modeling

Project/ Optional – VI **BS:602**

Objective: This topic is aims to provide the student with some basic modeling skills that will have application to a wide variety of problems.

Outcome: The focus is on those mathematical techniques that are applicable to models involving differential equations, andwhich describe rates of change. Student realizessome beautiful problems can be modeled by using differential equations. The students also learn howto use the mathematical technique in solving differential equations.

Unit- I

Introduction toMathematical Modeling : Mathematical Models-Modeling for decision making. Compartmental Models:-Exponential decay and radioactivity – Case Study: Detecting art forgeries – Lake Pollution Models - First order Linear Differential Equations – Equilibrium points and stability.

Unit- II

Models of Single Populations: Exponential growth – Density-dependent growth – Limited growth with harvesting. Interacting Population Models: Model for an influenza outbreak – Case Study: Cholera – Predators and prey – Competing Species.

Unit- III

Formulating Heat and Mass Transport Models: Some basic physical laws-Model for a hot water heater- Heat conduction and Fourier's Law - Heat conduction through a wall – Radioactive heat conduction - Diffusion.

Unit- IV

Boundary Value Problems – Heat loss through a wall – Insulating a water pipe –