GOA UNIVERSITY

Taleigao Plateau, Goa 403 206

M I N U T E S

of the 6th Meeting of the

IX ACADEMIC COUNCIL

Day & Date

4th and 13th September 2017

Time

10.30 a.m.

Venue

COUNCIL HALL
Administration Block

	that it was not a good practice to change the eligibility through a Circular/Notification instead of amending the Ordinance. The Academic Council requested the Department to conduct a workshop involving all stakeholders in order to raise awareness of the importance of Mathematics as a branch of learning, a basic life skill and foundation of knowledge in all streams. It was decided to set up a Committee to facilitate developing SWAYAM Courses in the University. **(Action: AR-PG)**
D 3.6	**Minutes of the meeting of Board of Studies in Mathematics held on 10/08/2017.** The Academic Council approved the minutes of the meeting of Board of Studies in Mathematics held on 10/08/2017 with the exception of Part B of the minutes which will be subject to the decision on the Report of the Committee on setting up of common Question Papers under Ordinance OC – 66. It was informed to change the title under Semester III at page 70 of the annexures. **(Action: AR-PG)**
D 3.7	**Minutes of the meeting of Board of Studies in Physical Education held on 18/08/2017.** The Academic Council approved the minutes of the meeting of Board of Studies in Physical Education held on 18/08/2017 with the following observations: 1. Yoga to be indicated as a physical activity instead of a game. 2. Kabaddi and Kho-Kho to be shown as separate games. 3. Volleyball to be written as a single word. **(Action: AR-PG)**
D 3.8	**Minutes of the meeting of Board of Studies in Botany held on 21/08/2017.** The Academic Council approved the minutes of the meeting of Board of Studies in Botany held on 21/08/2017. **(Action: AR-PG)**
D 3.9	**Minutes of the meeting of Board of Studies in Zoology held on 07/08/2017 & 16/08/2017.** The Academic Council approved the minutes of the meeting of Board of Studies in Zoology held on 07/08/2017 & 16/08/2017 except Annexure II on Modifications which require to be referred back to the Board. The Chairperson was informed to identify the practical component and place the same for the approval of the Vice-Chancellor which would be placed as a Reporting item before the Standing Committee of the Academic Council. It was also informed that pending finalization of the minutes, the syllabus to be circulated to all the Colleges. **(Action: AR-PG)**

IX AC- 6
13-9-2017

GOA UNIVERSITY
Taleigao Plateau, Goa 403 206

U P D A T E D F I N A L A G E N D A

For the 6th Adjourned Meeting of the

IX ACADEMIC COUNCIL

Day & Date

13th September 2017

Time

2.30 p.m.

Venue
COUNCIL HALL
Administration Block

ii. The declaration by the chairman that the minutes were readout by the Chairman at the meeting itself.

Date: (Dr. V.V. Kamat)
Place: Signature of the Chairman

Part G. The Remarks of the Dean of the Faculty

i) The minutes are in order
ii) The minutes may be placed before the Academic Council with remarks if any.
iii) May be recommended for approval of Academic Council.
iv) Special remarks if any.

Date: (Prof. G.M. Naik)
Place Signature of the Dean

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D 3.6 **Minutes of the meeting of Board of Studies in Mathematics held on 10/08/2017**

Part A

(i) (Recommendations regarding courses of study in the subject or group of subject at the Undergraduate level.)

The syllabi for following courses were discussed and are recommended for approval.

Semester III: DSC 1C: Ordinary Differential Equations and Discrete Mathematics.
SEC 1 : Statistical Methods.
Semester IV: DSC 1D: Analysis and Operations Research.
SEC 2 : Analytical Geometry.

Syllabi for following two Generic courses for non mathematics students were discussed and are recommended for approval.

GE-3 : Mathematics for Competitive Examinations –I
GE-4 : Mathematics for Competitive Examinations –II

(See **Annexure I** for detailed syllabus). **Annexure I (refer page no 70)**

(ii) (Recommendations regarding courses of study in the subject or group of subject at the
Postgraduate level and undergraduate level)

The syllabus for the following elective course was discussed and is recommended for approval.

MATH-122 : Graphs and Networks. (4 Credits Course)

(See **Annexure II** for detailed syllabus)

Part B.

(i) (Scheme of examinations at the under-graduate level.)

The following pattern of question paper for Semester End Examination was discussed and approved.

There will be FOUR questions of 20 marks each. In each question there will be Sub-questions and may carry 1/2/3/4/5/8 mark/s. Each sub-question may have sub-sub-

	questions. There can be choice in sub-questions and sub-sub-questions. Paper setter can decide the number of sub-questions and sub-sub-questions. (ii) (Panel of examiners for different examinations at the under-graduate level.) **NIL** (iii) (Scheme of examinations at the post-graduate level.) **NIL** **Part C:** (Recommendations regarding preparation and publication of selection of reading material in any subject or group of subject or group of subjects and names of persons recommended for appointment to make the selection) **NIL** **Part E:** (i) Recommendations of text books for the course of study at the under-graduate level. **NIL** (ii) Recommendations of text books for the course of study at the post-graduate level. **NIL** **Part F**: (i) (The declaration by the Chairman, that the minutes were read out by the Chairman at the meeting itself.) **Important points for the approval of the academic council.** 1. Proposal of UG Courses. (Annexure I) 2. Proposal of PG Course. (Annexure II) 3. Pattern of Question Paper for Semester End Examination. The meeting ended with a formal vote of thanks to the Chair. I hereby declare that the minutes are circulated to the members and decisions are informed to the members in the meeting itself. Place: Goa University Date: 10th August, 2017 (Prof. Y.S. Valualiker) Chairman, Board of Studies in Mathematics. **Part G; The remarks of the Deans, FNS** 1. The minutes are in order. 2. The minutes may be placed before the Academic Council. 3. Important points of the minutes that needs policy decision of the Academic Council to be recorded. Place: Goa University Date: (Prof. G.M. Naik) Dean, Faculty of Natural Sciences (Back to Index)
D 3.7	**Minutes of the meeting of Board of Studies in Physical Education held on 18/08/2017** **Part A** i. Recommendations regarding courses of study in the subject or group of subjects at

D 3.6 Minutes of the meeting of Board of Studies in Mathematics held on 10/08/2017

Annexure I

ANNEXURE I

Discipline Specific Core (Mathematics) Papers for B.Sc.

Sl. No.	Paper Code	Semester	Title	No. Of Credits.
1*	**DSC 1A**	**I**	**Calculus and Numerical Methods**	**4+2**
2.*	**DSC 1B**	**II**	**Matrices and Linear Algebra**	**4+2**
3.	DSC 1C	III	Ordinary Differential Equations and Discrete Mathematics	4+2
4.	DSC 1D	IV	Analysis and Operations Research	4+2

*** Already approved in 2016-17.**

Skilled Enhancement Courses

Sl. No.	Paper Code	Semester	Title	No. Of Credits.
1	SEC 1	III	Statistical Methods	4
2.	SEC 2	IV	Analytical Geometry	4

Generic Courses for Non Mathematics Students

Sl. No.	Paper Code	Semester	Title	No. Of Credits.
1	GE-3	III	Mathematics for Competitive Examination -I	4
2.	GE-4	IV	Mathematics for Competitive Examination -II	4

SYLLABUS OF S. Y.B. Sc. MATHEMATICS UNDER CBCS

Semester – III Credits: 4+2

DSC 1C: Differential Equations and Discrete Mathematics

1. FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS:-

Review of Basic concepts such as order, degree, formation, solution and their types of differential equations. First order first degree differential equation and initial value problem. Method of separation of variables. Homogeneous and Non - homogeneous differential equation. First order linear differential equations. Bernoulli's differential equation. Exact and Non – exact differential equations. Condition for exactness. Integrating factors and rules to find integrating factors. Clairaut's differential equation and differential equations reducible to Clairaut's form. Ricatti's differential equation. Applications of first order differential equations. Modeling with differential equations.

(8 Hours)

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2. SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS:-

General form of second order linear differential equation and its classification. Existence and Uniqueness theorem for solution of second order linear differential (Only statement). Second order homogeneous linear differential equation and its properties. Wronskian of solutions of homogeneous linear differential equation and its properties. Linear dependence and independence of solutions of homogeneous differential equation. Complementary function. Use of known solution to find second linearly independent solution of homogeneous differential equation. Homogeneous linear differential equations with constant coefficients and with variable coefficients. Method of undetermined coefficients. Method of variation of parameters. Applications of second order linear differential equations.

(10 Hours)

3. D – OPERATORS:-

D – Operator method to solve n^{th} order homogeneous linear differential equation with constant coefficients. Properties of D – Operator. Inverse D – operator and it properties. Inverse D – operator method to solve n^{th} order Non - homogeneous linear differential equation with constant coefficients **f(D) = R(x)**, where **R(x) = e^{ax} , cosax, sin ax**, polynomial in '**x**' and their products. **(8 Hours)**

4. SYSTEM OF 1^{ST} ORDER DIFFERENTIAL EQUATIONS:-

Conversion of n^{th} order differential equation to first order system of differential equations. Existence and uniqueness of solution (statement only). " 2×2 " homogeneous linear first order system of differential equations and their solution. Wronskian of " 2×2 " homogeneous linear first order system of differential equations and its properties. Linear dependence and independence of solutions of " 2×2 " homogeneous linear first order system of differential equations. Matrix method to solve " 2×2 " homogeneous linear first order system of differential equations with constant coefficients. Method of solving " 2×2 " Non - homogeneous linear first order system of differential equations with constant coefficients. **(10 Hours)**

5. GRAPH THEORY:-

Introduction. Basic terminology. Types of Graphs. Multigraphs and Weighted graphs. Isomorphism of graphs. Paths and circuits. Shortest path in weighted graphs. Eulerian paths and circuits. Hamiltonian paths and circuits. Factors of graphs. planar graphs.

(12 Hours)

6. TREES AND CUT-SETS:-

Trees. Rooted trees. Path lengths in rooted trees. Prefix codes. Binary search trees. Spanning trees and cut- sets. Minimum spanning tree. Kruskal's algorithm. Prim's algorithm. Transport network. **(12 Hours)**

List of practical sessions (4 hours each):

1. General solution of $\frac{dy}{dx}=\frac{a_1x+b_1y+c_1}{a_2x+b_2y+c_2}$.

2. General solution of M(x, y)dx + N(x, y)dy = 0.

3. Method of undetermined coefficients.

4. Method of variation of parameters.

5. Inverse D – operator method to solve f(D) = R(x).

6. Matrix method to solve " 2×2 " homogeneous linear first order system of differential equations.

7. Shortest path using Dijkstra's algorithm for weighted graphs.

8. Eulerian paths and circuits in graphs.

9. Hamiltonian paths and circuits in graphs.

10. Prefix Codes in trees.

11. Minimum Spanning tree using Kruskal's algorithm.

12. Minimum Spanning tree using Prim's algorithm.

Principal texts:

1. Differential Equations and Their Applications: Martin Braun (Springer)

2. Elements of Discrete Mathematics: C. L. Liu and D. P. Mohapatra
(Tata Mcgraw Hill)

References:

1. Differential Equations with Applications and with Historical Notes:
G. F. Simmons (Tata Mcgraw Hill)

2. Ordinary Differential Equations: E. A. Coddington (PHI Learning Pvt. Ltd.)

3. Shaum's Outline on Differential Equations: Richard Brownson
(Tata Mcgraw Hill)
4. Discrete Mathematical Structures: Kolman, Busby and Ross
(PHI Learning Pvt. Ltd.)
5. Discrete Mathematics and Applications: Kenneth Rosen (TMH)

6. Shaum's Outline on Discrete Mathematics: Seymour Lipschutz and Marc Lipson
(Tata Mcgraw Hill)

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Semester – IV Credits: 4+2

DSC 1D: Analysis and Operations Research

1. Infinte Series [Ajit kumar, Chapter 5]:

Convergence of infnite series, absolute convergence, Conditional convergence, Geometric series, Cauchy criterion for convergence, Algebra of convergent series, Comparision test, Convergence of Harmonic P-series, D'Alembert ratio test,Cauchy nth root test,Leibniz test or alternating series test**.** **[10 hours]**

2. Riemann Integration [Ajit kumar, Chapter 6]:

Darboux Integrability, Criterion for integrability, Properties of integrabilities. First fundamental theorem of calculus, Second fundamental theorem of calculus, integration by parts, Mean value theorems for integrals, First mean value theorem for integrals, Second mean value theorem I, Second mean value theorem II, Riemann original definition**.**

[20 hours]

3. Sequences and Series of functions[Ajit kumar, chapter 7]:

Pointwise convergence of sequence of functions and examples, Uniform convergence of sequence of functions and examples, Mn-Test,Cauchy Criterion for uniform convergence, Consequences of Uniform convergence, Continuity of limit function, Series of functions, Absolute convergence, Cauchy Criterion for uniform convergence of a series, Weierstrass M-test, Weierstrass Approximation Theorem. **[10 hours]**

4. Operations Research

Fundamentals: Linear Programming problems, Convex sets ,Extreme points of Convex sets, Convex Polyhedron ,hyperplanes, Graphical Method, Simplex Method, Theorems on simplex method ,Big-M method, Two phase method, Unrestricted variables, Duality and solution using duality, Theorems on Duality, Dual Simplex method, Post Optimal Analysis (Discrete changes in cost and requirement vector) Transportation Problems, North west corner method, Vogel's approximation method, Modi Method, Assignment Problems, Hungrian Method, Basics of Inventory control, Inventory model with No shortages and Instantaneous production, Inventory model with Shortages allowed and Instantaneous production. Basics of Queueing theory, Queueing Model (M/M/1):(1/FIFO),
Queueing Model (M/M/1):(N/FIFO). **[20 hours]**

List of Practical sessions [4 hours each]

1. Basics of Linear Programming problems including Formulation.
2. Graphical Method
3. Simplex Method, Unbounded solution, Alternate solution
4. Big-M method, unrestricted variables.
5. Two phase method
6. Duality and solution using duality.
7. Dual Simplex method
8. Post Optimal Analysis (Discrete changes in cost and requirement vector)
9. Transportation Problems, existence of solution (North west corner method, Vogel's approximation method)
10. Transportation Problems (Modi Method,Problems to Minimize/Maximize objective function)
11. Assignment Problems (Hungrian Method)
12. Basics of inventory control, Inventory model with No shortages and Instantaneous production.
13. Inventory model with Shortages allowed and Instantaneous production.
14. Queueing Model (M/M/1):(1/FIFO)
15. Queueing Model (M/M/1):(N/FIFO)

Principal texts:

1. A Basic Course in Real Analysis, Ajit Kumar and S.Kumaresan ; CRC Press.
2. Linear Programming by G. Hadley; Adddison.

References:

1. Mathematical Analysis I, R.D.Bhat, Vipul Prakashan,Mumbai.
2. Mathematical Analysis II, R.D.Bhat,Vipul Prakashan,Mumbai.
3. Introduction to Real analysis ,Robert G.Bartle, Donald R.Sherbert, Third edition, Wiley Publication.
4. Methods of Real analysis , Richard R.Goldberg, Oxford and IBH publishing Co.pvt.ltd.
5. Calculus Vol-I, Tom M.Apostol, Second edition, Wiley Publication.
6. Operations Research, Kanti Swarup and Gupta, S. Chand and company , Delhi.

Semester – III Credits: 4

SEC 1 : Statistical Methods

1. **Introduction- Meaning and Scope**: Definition of Statistics, Importance and scope of Statistics, Limitations of Statistics, Distrust of Statistics. **(2 hours)**
2. **Correlation and Regression Analysis**: Introduction. Karl Pearson's coefficient of Correlation, Rank correlation method. Regression Analysis. **(10 hours)**
3. **Theory of Probability**: Introduction, Mathematical probability, Statistical probability, Axiomatic probability, Addition theorem of probability.(Proof omitted), Multiplication theorem of probability. Pair wise and mutual independence, Inverse probability – Baye's theorem. **(6 hours)**

4. **Random Variables**: Probability Distributions and Mathematical Expectation: Random variable, Probability distribution of a Discrete Random Variable, Probability distribution of a Continuous Random Variable, Mathematical Expectations. **(3 hours)**
5. **Theoretical Distributions**: Binomial distribution, Poisson Distribution, Normal Distribution. **(5 hours)**
6. **Testing of Hypothesis**: Interval Estimation, Testing of Hypothesis. **(3 hours)**
7. **Large sample tests**: Introduction, Sampling of Attributes, Sampling of Variables. **(4 hours)**
8. **Parametric tests**: Student's 't' distribution, ANOVA, Post-hoc analysis. **(10 hours)**
9. **Non-Parametric tests**: Chi Square test, Mann-Whitney test, Kruskal walli's test. **(7hours)**

List of Practicals (Using ***R*** or similar softwares) **(10 hours)**

1. Finding measures of central tendency, namely, mean, median and mode.
2. Finding measures of dispersion, namely, range, quartile deviation, mean deviation and standard deviation.
3. Testing of hypothesis for single mean and difference of means using 't- test' and paired 't-test'.
4. Testing of hypothesis for more than two means using ANOVA.
5. Testing of hypothesis regarding independence of attributes using Chi square test.
6. Testing the hypothesis stating that the k independent samples have been drawn from the populations which have identical distributions using Kruskal Walli's test.

References:

1. Fundamentals of Statistics, S.C Gupta, Himalaya Publishing House, Seventh Edition. (**Principal**

*Reference for purpose of conducting practicals only.

1) Fundamentals of Mathematical Statistics, S.C Gupta, V.K Kapoor, S.Chand Publications.
2) Mathematical Statistics, J.N Kapur, H.C Saxena, S.Chand Publications.
3) Probability, Statistics and Random Processes, T Veerarajan, McGraw Hill Education (India) Private Limited.
4) Probability Theory, B. R. Bhat, New Age International, 2007.

Semester – IV Credits: 4

SEC 2 : Analytical Geometry

1. **Metric Properties on the Plane**. (3 hours)
2. **Straight Lines in the Plane**. (3 hours)
3. **Circles in Plane**. (3 hours)
4. **Conics in the Plane and its plane sections**. (12 hours)
5. **Classification of Conics**. (5 hours)
6. **Polar Co-ordinate System**. (3hours)

7. **Co-ordinates in 3-space**. (3 hours)
8. **Plane in 3-space**. (4 hours)
9. **Lines in 3-space**. (3 hours)
10. **Transformation of Co-ordinates**. (4 hours)
11. **Sphere**. (4 hours)
12. **Cones**. (4 hours)
13. **Cylinder**. (4 hours)
14. **The Conicoid**. (5 hours)

Reference:

1. Analytic Geometry: Two and Three Dimension, D. Chatterjee, Narosa Publishing House, 2009.
2. Analytic Geometry, Shanti Narayan and P. K. Mittal, S. Chand and Company Ltd, 2007.

Remark:

1. Tracing of general second degree conics/conicoids using the mathematical software GEOGEBRA, SAGE, MATH and PYTHON.
2. Properties of pair of lines, circles, parabola, Ellipse etc., may be verified using mathematical softwates lime GEOGEBRA/SAGEMATH.

Generic Courses for Non Mathematics Students

Semester – III Credits: 4

GE-3: Mathematics for Competitive Examination –I

Ratio and proportion; Indices; Logarithms; Linear, Quadratic and cubic equations; Inequalities; Simple & compound interest, annuity & loans

Problem sets on

Time & distance; Time & work; Percentages; Profit & Loss; Boats & Streams; Testing directional sense; Problems on age calculation; Pattern analysis; Data interpretation

Short cut techniques for

Multiplication; Finding squares, square roots; Cubes, cube roots; Magic squares; Digit sum method; Subtraction; solving Linear, Quadratic and cubic equations;

Refrences:

1. Quantitative Aptitude for Common Admission Test by Arun Sharma , Mc Graw Hill (6^{th} edition)
2. Common Proficiency test Quantitative Aptitude, published by The institute of chartered accountants of India

Semester – IV Credits: 4

GE-4: Mathematics for Competitive Examination –II

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Permutation and combinations; Sequences & Series (Arithmetic progression/Geometric progression); Number systems; Sets, relations and functions

Problem sets on

Partnerships; Age; LCM/GCD; simplification of decimal fractions; unitary method; Mensuration (2D/3D); conics; trigonometry; alphabet & number series; Coding & Decoding; Number ranking; stocks & shares; blood relations; surds

Short cut techniques for

Analytical conics; Division; Factorization; Partial fractions

Refrences:

1. Quantitative Aptitude for Common Admission Test by Arun Sharma , Mc Graw Hill (6th edition)

2. Common Proficiency test Quantitative Aptitude, published by The institute of chartered accountants of India.

ANNEXURE II

Elective Course For M.Sc.

COURSE TITLE - MATH- 122 : Graphs & Networks

Number of Credits: 4

Prerequisites: Elementary Algebra and Matrix theory.

SCOPE & OBJECTIVE: Graph theory is a basic course needed in several areas not only in sciences but also in engineering disciplines such as Electrical & Electronics, Networking and data structures in Computer Science, Biotechnology, etc. Objective is not only to present concepts definitions & theorems in a mathematical manner, but also to tell relevance of graphs in different context, ranging from puzzles & games to social science/engineering/ computer science. Relevance of the shortest paths & maximal flows in a network, travelling salesman

problem, relevance of chromatic number to scheduling problem. Problem solving & learning algorithms is also an essential part of graph theory.

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COURSE DESCRIPTION : Course deals with the basics of graph theory, basic definition of simple graphs, types of graph, matrix representation of graphs, isomorphism in graphs, Euler & Hamiltonian graphs, trees & their properties, spanning trees, colouring of graphs, independence number and chromatic number of simple graphs, connectivity, cut-set, directed graphs, directed trees, directed spanning trees, shortest paths & maximal flows in a network.

TEXT BOOKS:

T-1: G. Agnarsson and R. Greenlaw, Graph Theory: Modeling, Applications and algorithms, Pearson , 2011.

T-2: Gary Chartrand and Ping Zhang, Introduction to Graph Theory, Tata Mc-Graw-Hill Edition, 2006.

REFERENCE BOOKS:

R1. F. Harary, Graph Theory, Narosa Publishing House, 2001.

R2. Gary Chartrand and O.R. Oellermann, Applied Algorithmic Graph Theory, McGraw-Hill Inc. 1993.

R3. L.R. Foulds, Graph Theory Applications, Springer Verlag, New York, 2009.

Course Plan:

Lecture No.	Learners Objective	Subject
1-5	To appreciate concept of graphs & simple graphs & their representations	Graphs, Representation of Graphs & Types of Graphs, Degree Sequences,
6-10	Some Graph Theoretic Properties	Subgraphs, Walk, Trail, Path, Cycle, Circuit, Connectedness, Isomorphism on Graphs
11-14	Distinguish clearly between different concepts in graphs & difference between edge traversal & vertex traversal	Operation on Graphs, Euler & Hamiltonian Graphs, Depth First Search & Breadth First Search, Fleury's Algorithm, Traveling Salesman Problems
14-20	Appreciate different equivalent definitions of tree & importance of tree as a structure	Trees, Spanning Trees, Minimal Spanning Trees, Prim's & Kruskal's Algorithms
21-25	Concept of distance between spanning trees, trees and rooted binary trees	Distance, Eccentricity, Centre(s), Radius and Diameter of Trees & Connected Graphs

26-30	How spanning tree is connected with concept of special type of cut set & circuit in a connected graph	Cut-sets & Fundamental Cut-Sets, Edge & Vertex Connectivity, Separability and Menger's Theorem
31-35	How simple concept of planarity of a graph is relevant to several problems as planar maps & electrical circuits	Planar Graphs, Euler's formula, Detection of Planarity, Dual Graphs
36-43	How graph coloring problem is related to independent sets of graph, scheduling problems, planer map, chromatic polynomial as a theoretical tool	Independent Sets, Coloring of Graphs, Chromatic Number, Chromatic Polynomials, Map Coloring, Matching & Covering of Graphs
44-48	How concept of isomorphism is different in digraphs	Directed Graphs (Digraphs), Isomorphism in Digraphs
49 -51	Difference between different type connected digraphs & spanning tree & directed spanning tree	Strongly Connected & Weakly Connected Digraphs, Networks
52-57	Directed weighted network, relevance of maximum flow, searching a graph	Network flows, Max-Min Theorem Ford-Fulkerson Algorithm, Shortest Path Problems & Dijkastara's Algorithm
58-60	Applications to Science and Engineering	Applications of Graph Theory in Social Sciences, Economics, Social Networks, Computer Science, Bioinformatics, Molecular Biology, Chemistry, Electrical Engineering, Industrial Engineering etc.

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