



TAMIL NADU STATE COUNCIL FOR HIGHER EDUCATION

CHENNAI 600 005

Report of the Workshop on 'Mathematics Education in the 21st Century'

August 2006

A Note on curriculum in Mathematics

Education plays an important role in building an enlightened, strong and prosperous nation. It has been the torch bearer of humanity's most noble ideals. It is education that determines the level of prosperity, welfare and security of the people. Hence education needs to be intimately linked with the different life-skills, the abilities for adaptive and positive behaviour that enable individuals to deal effectively with the demands and challenges of everyday life, by developing in them generic skills related to a wide variety of areas such as health and social needs.

Our education system while taking advantage of the process of globalisation has to prepare the youth to meet this challenge. The task of higher education is to create clear and practical linkages between the education provided on the one hand and the opportunities for employment on the other. Education should impart knowledge and wisdom and bring in the latent skills and talent of the students.

Qualitative improvement in education in response to the changes taking place in the society can be made only through proper curriculum development. In education curriculum renewal and development is an ongoing process and it must meet the learner's needs, societal expectations, community aspirations and international comparisons. While framing curriculum and syllabus, relevance and applicability to career prospect are to be ensured.

The changing social, educational and economic environment are the important determinants of curricular options. To meet the challenges, it is necessary that the students should be equipped with besides theoretical knowledge, adequate skill to enable their full participation in the emerging social, economic and cultural environment. The operative part of this paradigm shift is the need for a continuous upgradation of curriculum in order to introduce the latest development relating to various disciplines in the curriculum and its transactional technique.

The number of teachers playing an active role in designing the curriculum is obviously very small, even though they are the ones implementing the curriculum. Teacher involvement in curriculum development is desirable particularly because it can be a motivating factor for teachers in their profession, give them a sense of ownership of the curriculum they have to transact. As such teachers should be an integral part of curriculum.

The curriculum and syllabus designed by the teachers should develop the skills such as creative thinking, communication, self awareness, coping with stress, decision thinking, interpersonal relationships and empathy. It should also emphasise on value-based education so as to help the nation fight against all kinds of fanaticism, ill will, violence, fatalism, dishonesty, avarice, corruption, exploitation and drug abuse.

Curriculum should be developed in such a way as to make education a forceful tool for the cultivation of essential values, good qualities, self-confidence, skill development and intelligence. It should focus on the following

- Skill development and employment orientation
- Inter-departmental linkage
- Inter-disciplinary approach
- Internal and continuous assessment
- Remedy the existing deficiency in the curriculum
- Keep pace with global standards
- Value education
- Knowledge based education
- Include fieldwork, problem solving, case-studies, projects etc
- Assignments and group discussion

To develop such a curriculum with the active participation of teachers who teach the subject, Tamil Nadu State Council for Higher Education organizes workshops in various subjects. “Mathematics Education in the 21st Century” is considered in this workshop.

One of the outstanding characteristics of scientific culture is quantification. Mathematics therefore assumes a prominent position in modern education. The advent of automation and cybernetics in this century makes the beginning of the new scientific industrial revolution and makes it all the more imperative to devote special attention to the study of mathematics.

Mathematics helps in the process of decision-making through its application to real life situations in familiar as well as non-familiar situations. It contributes in the development of precision, rational and analytical thinking, reasoning, positive attitudes and aesthetic sense. Apart from being a distinct area of learning, it helps enormously in the development of other disciplines which involve analysis, reasoning and quantification of ideas. Study of mathematics also provides ample opportunities for making conjectures, testing and building arguments about their validity and also in asking new questions.

**TAMIL NADU STATE COUNCIL FOR HIGHER EDUCATION,
CHENNAI 600 005**

Workshop on “Mathematics Education in the 21st Century”

24th and 25th August 2006

PROGRAMME

24-08-2006

- 10.00 a.m. - Registration
- 10.30 a.m. - Inauguration
- Inaugural Address : Dr. A. Ramasamy,
Vice-Chairman,
TANSCHE
- Special Address : Dr. S. Bhaskaran,
Member-Secretary,
TANSCHE
- Resource Person : Prof. S. Swaminatha Pillai
- 11.30 a.m. - Tea
- 11.45 a.m. - Framing the Structure of the Curriculum
- 1.00 p.m. - Lunch
- 2.00 p.m. – 5.00 p.m. - Generation of Model Syllabi in groups

25-08-2006

- 10.00 a.m. – 11.15 a.m. - Generation of Model Syllabi in groups
- 11.15 a.m. – 11.30 a.m. - Tea
- 11.30 a.m. - Generation of Model Syllabi in groups
- 1.00 p.m. - Lunch
- 2.00 – 4.00 p.m. - Finalizing the Syllabi and Valediction
- Vote of Thanks - Dr. S. Padmavathy,
Research Officer, TANSCHE

CURRICULUM DEVELOPMENT PROCESS

S. SWAMINATHA PILLAI

COMPETENCIES TO BE DEVELOPED:

Knowing the form and function of a curriculum.
Understanding the need for a curriculum.
Following several steps in developing a curriculum.
Evaluating a curriculum.
Appreciating the role of curriculum in the social process of education.

ABSTRACT:

Curriculum is a contact document between the stakeholders of the educational process. It fulfils the need for directing, implementing and satisfying their role performance in the society. Being scientific in its approach a curriculum specifies all the required conditions for effective learning and teaching including testing, besides leading to continuous individual and social development. The philosophical foundations of an society is the basis for a curriculum; the practical and successful living is the result of well-developed curriculum. Economy of efforts, materials, manpower, time and money is achieved in the otherwise long, unwieldy and indirect process of education.

INTRODUCTION

The long and continuous social process of education is often offered in terms of specified periods. These periods are identified as stages of education viz., early childhood to university education. In each stage there may be several parallel forms or structures like general, special or professional education depending on the needs of the pursuers of education at that stage. To make them ready and interested in their direction of learning and teaching, it is required that both the teachers and the learners should have a clear idea about their plans and activities. This can be set by them if they are mature enough to draw the plan. Very often there arises a situation that quantitative expansion like population increase and transfer of persons like social mobility requiring some sort of uniformity or equality paving way for easy movement and comfort and confidence. Hence there is a need for a common source and plan to enable the younger generation to get the required education assuring a

sort of commonly recognized competencies at each stage of human development. This requirement is fulfilled by what is called curriculum.

WHAT IS A CURRICULUM?

A curriculum seeks to answer questions like ‘What shall I teach or learn?’, ‘Why should I teach or learn?’, ‘How will I teach or learn?’, ‘What resources do I have at my disposal?’, and ‘How do I know if I have succeeded in my learning or teaching?’ Thus a curriculum is **a conceptual scheme** for joint implementation by teachers and learners in core, observed and appreciated by parents and users of the product/ learners in effect and valued and admired by other stakeholders as a result. It is in fact **a changing and living entity** in view of its need for continuous modification as demanded by the members of the society in view of the fast and dynamic changes around. It is obtained from **three sources** such as replacing the familiar environment of **family and friends to school and college**, moving from the **present scenario** to a predicted or even unpredicted **future situation** and making the implementers or beneficiaries **dependent or independent**, or balancing between **individuality and conformity**.

A curriculum is in fact **a programme of studies** or activities (curricular, co-curricular and extra curricular) and guidance. It can function as a scale of values providing a set of criteria. Arising from the **basic needs** and moving on to **social, cultural, individual and traditional needs**, the curriculum very often attempts to fulfil **the ideal needs also**, such as intellectual, moral, aesthetic and religious needs. Curriculum is frequently viewed as **a school/college/university function** for preserving and transmitting traditional cultures, for the transformation of culture, and primarily **for individual development** of the participants.

PRESSURES AND PRINCIPLES OF CURRICULUM DEVELOPMENT

Curriculum is developed under **economic and social pressures**, caused by **knowledge explosion** and utilizing **research findings**. The principles of governing the development of a curriculum can be stated as follows:

*Curriculum should be **dynamic** enough to accommodate the changes in social environment; it should be specifically **goal-oriented** to move towards the accepted direction causing success; **scientific** method needs to be adopted in*

*developing a curriculum to make it reliable and successful; and curriculum has to be **evaluative** with a built-in mechanism of evaluation; and however it should be **comprehensive** enough to bring in clarity, brevity and surety in its success.*

Specifying the **objectives** in observable terms, describing a variety of alternative **learning experiences**, selecting the most appropriate **content** from the vast store of human knowledge, **organizing and integrating** the items into a homogeneous whole and providing for adequate and accurate measures of **evaluation** of the achievement of the state objectives so as to minimize, if not avoid, any loss or distortion of human development.

STAGES OF CURRICULUM DEVELOPMENT:

There are several stages in the development of a curriculum. The following are the most identifiable and adoptable stages as practiced by the curriculum developers:

PLANNING: Observing the gaps, if any, between the educational achievements and the social development there should be a systematic attempt to identify the new needs of the society by adopting the techniques of need analysis. Considering the social forces, needs, goals and objectives, knowledge has to be treated for human development on the philosophical tenets of the society incorporating the learning process with the selection of proper instructional procedure decision is to be taken on the proposed curriculum.

PREPARING: Collecting the available data, identifying the relevant sources, organizing adequate and suitable manpower, debating several styles of learning and strategies of teaching, arranging for several materials useful to cull out specific content from, a curriculum developer has to be prepared for the process. Following a systemic approach the constituent subsystems need to be integrated to deal with the collected data yielding the relevant content to be selected, organized and assessment pattern to be specified.

DESIGNING: Levels, types and structure of educational institutions which are to adopt the proposed curriculum, precepts and practices of educational

technology, humanistic approach, vocational possibilities and social reconstruction contribute to the design of a curriculum. Even the concept of de-schooling or out-of-school or distance or on-line education will have a bearing process. The popular and prominent curriculum models of Tyler and Taba offer potentials of the curriculum development.

DEVELOPMENT: Curriculum development considers instructional development, learning materials and instructional media development besides strategies of teaching and techniques of testing. It is an integrated process taking into account all possible educational practices. Three different diagrammatic approaches are presented in the next section of this paper.

IMPLEMENTATION: The chief implementers of a curriculum are teachers and learners although other educational managers have assigned roles to play. Policy-makers, system managers, auxiliary manpower like technicians and other personnel and evaluators along with users like higher education system and employment organizations definitely play a secondary role in this regard.

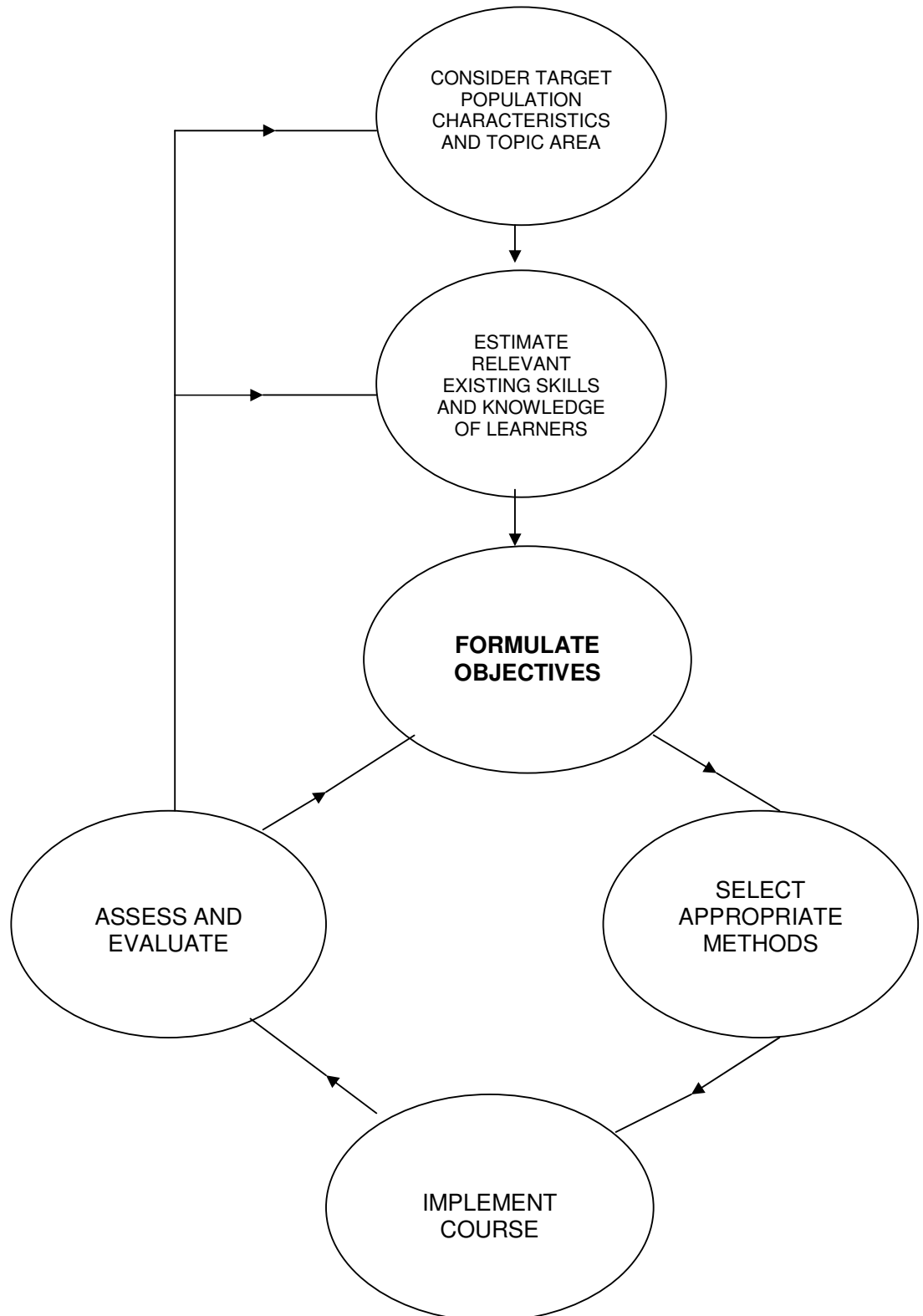
EVALUATION: After implementing a curriculum it is essential to evaluate the same for its effectiveness, deficiencies and mishaps. There are several models of evaluation of a curriculum proposed by experts as in the case of Stufflebeam's model or CIPP model. In any case teacher evaluation of students followed by an analysis of the latter's performance, student evaluation of students followed by their experiences, materials evaluation of all concerned and evaluation of the testing techniques adopted and the examination pattern used form the basis for valid, reliable and acceptable evaluation of a curriculum.

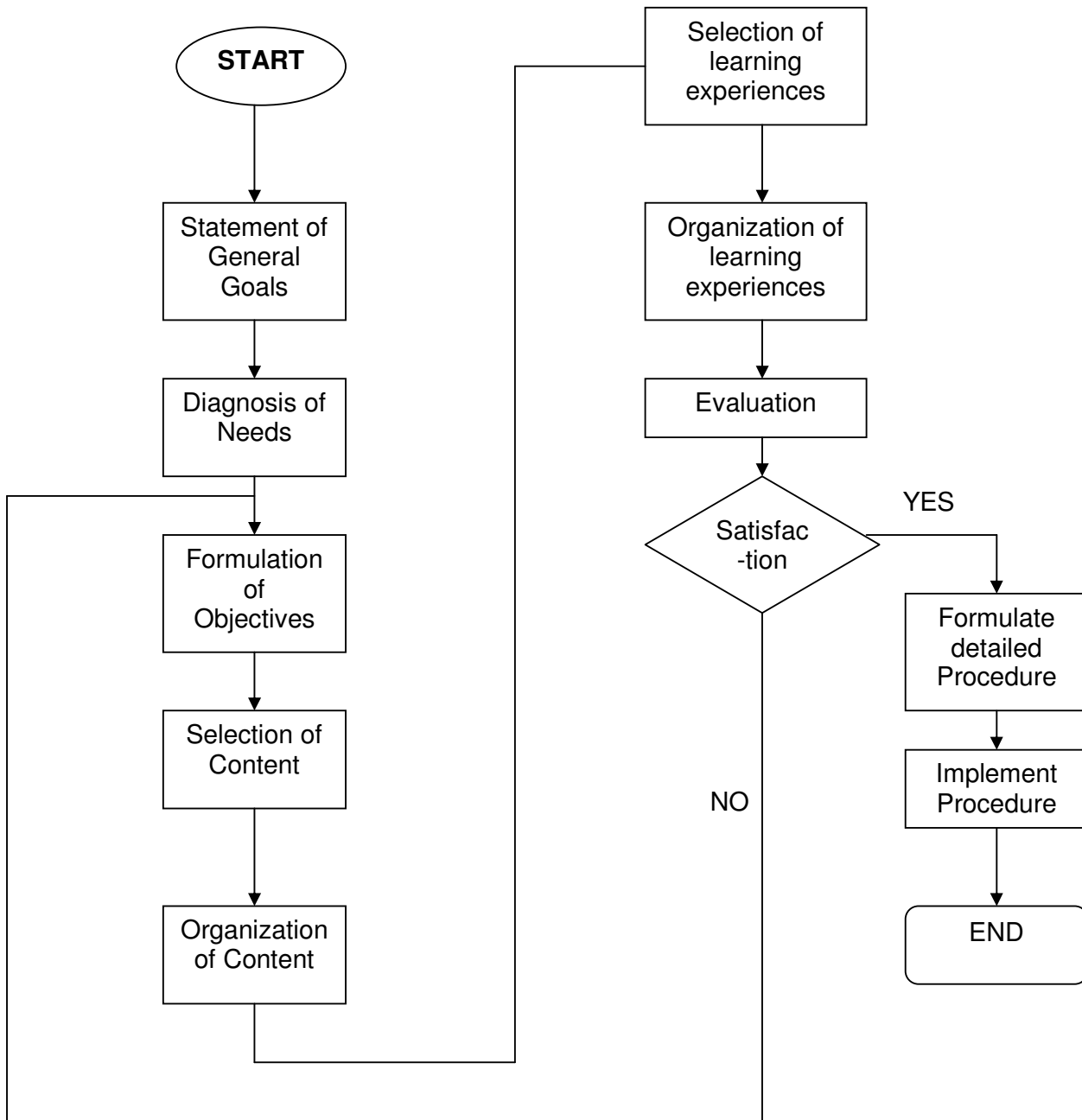
REVIEW: The after-effects of such evaluation will be the need and the mode of reviewing the developed and implemented curriculum periodically so as to make modifications in the relevant aspects of the curriculum. As per the present conditions the life of a curriculum is not even five years unlike in the past. Even annual review for making required changes in the curriculum makes it more dynamic, organizationally difficult though.

IMPROVEMENT: In order to improve a curriculum the process should have a re-look including restart from the scratch. Tinkering with a curriculum makes it lopsided and takes its life away. Total revision is always a must. In view of the fast changes in the social milieu and of the human knowledge and experience the concept of rolling curriculum will yield better results. Anyway every five, or better, three years or period of duration of a course offered there is a need Curriculum improvement or revision or even reconstruction.

CURRICULUM DEVELOPMENT MODELS:

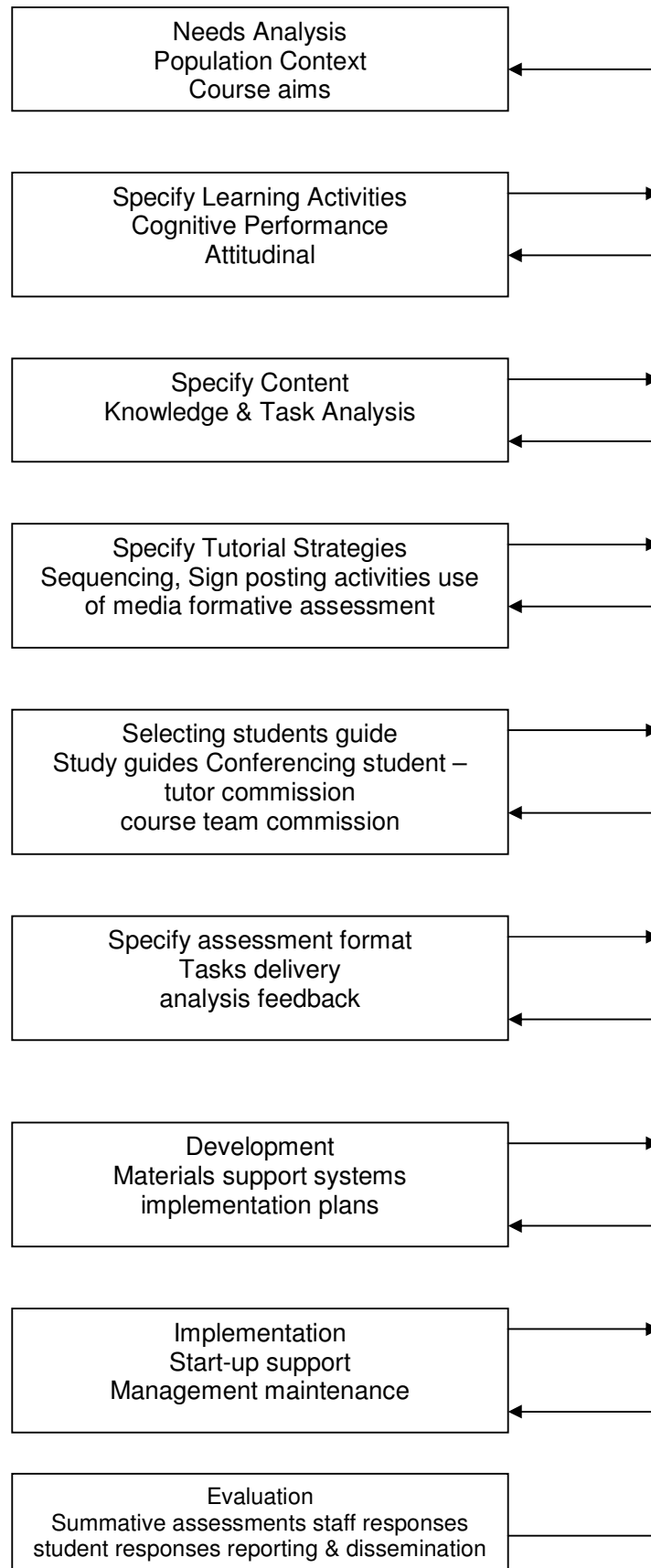
1. A SIMPLIFIED SYSTEMS APPROACH





FLOWCHART REPRESENTATION OF TABA-TYLER CURRICULUM DEVELOPMENT MODEL

3. THE COURSE DESIGN PROCESS



CURRICULUM & SYLLABUS STRUCTURE:

Structure of Curriculum

1. Introduction
2. Scope
3. Aims & Goals
4. Courses of Studies
 - Paper I
 - Paper II
 - Paper III
5. Methodology
6. Materials
7. Media
8. Evaluation
9. Outcome

Structure of Syllabus

1. Linkage
2. Objectives
 - General
 - Specific (Competences)
3. Structured Content
4. Materials
5. Methods & Media
6. Testing

F.N.:-

Objectives

Competencies

Achieve Objectives

Demonstrate Competences

Able to -----

Can do / does -----

'Learning outcome'

'Performance descriptors'

skills

indicators

CURRICULUM CHANGES:

National aspirations and needs, cultural change, social change caused by technological development, economic changes, political variations and changes in values, the value system in vogue, philosophical, sociological and psychological approaches tend to make changes in the curriculum. The National Framework for School Curriculum 2000 has now been revised as the National Framework for School Curriculum 2005. This is an example of curriculum change due to one or more of the above contexts affecting the same.

CONCLUSION:

As an MOU between the participants in the curriculum process, any curriculum is subjected to a variety of pressures, forces and changes. The vital factor involved is the societal need arising then and there in any modern set-up. Speed on the one hand and economy on the other hand provide the essential impetus to the periodical development of different curricula of different stages of education. From a one-month programme to even a five-year programme several curricula need to be developed to supply the specifically needed manpower meeting the demands of a nation.

References

Taba, Hilda (1988) Curriculum Development
Tyler, Robert (1986) Curriculum Development Process
(not available) (1990) The Course Design

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PROPOSED MODEL CURRICULUM

Prepared in the workshop organized at Chennai on the 24th and 25th August 2006 and discussed in the meeting of the Tamil Nadu State Council for Higher Education on 27th June 2007

Recommended to the Universities in Tamilnadu offering B.Sc. Mathematics Degree programmes and all Autonomous Colleges for consideration in their Academic Bodies and consequent implementation from the next academic year.

Co-ordinators

- Core Papers : Dr. K. Thilagavathi,
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- Optional Papers & Allied Papers : Mrs. Geetha Mukund,
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Introduction

A course in B.Sc. Mathematics opens out a whole world of opportunities by introducing Mathematics at the conceptual, analytic and application levels. This enables the development of the innate intelligence level, so as to deviate (if necessary) to any branch of science/arts/technology. The nature of the subject and the growth they undergo during this course facilitates holistic progress.

Scope:

To provide a detailed introduction to the tenets of mathematics and acquaint the learner with intricacies of mathematical models, tools and methods. To provide the students a firm grip on all the facets of pure and applied mathematics and inculcate in the student an ardour for mathematical knowledge. To make the students move towards higher academic ambitions in advanced mathematics, finance, accounting, management, technology, bio-informatics etc. To develop in the students logical, systematic and critical way of thinking to assist in problem solving in their chosen career.

Aims and Goals:

This course facilitates employability prospects and motivates research depending on individual needs and capacity.

Courses of Study

Core Subjects

There are core courses, which are essential for the first level learner of Mathematics. The following are identified for this purpose.

SL.No.	Semester	Title
1.	I	Calculus
2.	I	Algebra, Trigonometry and Fourier Series
3.	II	Vector Calculus and Analytical Geometry
4.	II	Differential Equations and Laplace Transform
5.	III	Mathematical Statistics

6.	III	Statics
7.	IV	Real Analysis - I
8.	IV	Dynamics
9.	V	Abstract Algebra
10.	V	Real Analysis - II
11.	VI	Linear Algebra and the theory of lattices
12.	VI	Complex Analysis

Optional Papers

In addition to these essential aspects of learning Mathematics provisions have to be made for those who volunteer to develop themselves in specific areas.

SL.No.	Optional/ Electives
1.	Graph Theory
2.	Numerical Methods
3.	Operations Research
4.	Discrete mathematics
5.	Programming in C
6.	Object "Oriented" Programming in C++
7.	Data Structures
8.	Design and Analysis of Algorithms
9.	Mathematical Modeling
10.	Astronomy
11.	Fuzzy Mathematics
12.	Fluid Dynamics
13.	Formal Languages and Automata Theory
14.	Stochastic Process
15.	Number Theory

The students should be allowed to opt for atleast six subjects (3 + 3) from the above list.

Allied Subjects

1. Allied Mathematics - I (For B.Sc., Chemistry Major)
2. Allied Mathematics - II (For B.Sc., Chemistry Major)
3. Allied Mathematics - I (For B.Sc., Physics Major)
4. Allied Mathematics - II (For B.Sc., Physics Major)
5. Allied Mathematics - I (For B.Sc., Computer Science and BCA)
6. Allied Mathematics - II (For B.Sc., Computer Science and BCA)
7. Allied Business Mathematics (For Commerce and Management Students)
8. Allied Statistics for Business (For Commerce and Management Students)

For each of the above area, separate syllabi have been prepared and presented below:

I. Linkage

Competencies to be developed

1. Understanding
2. Reasoning and logical skills
3. Problem solving skills
4. Decision making skills
5. Analytical skills
6. Precision in Decision-Making

Evaluation Pattern

External Component

75 marks : 3 hrs

Examination Pattern:

Section A: Consists of 15 questions, each 1 mark of which 10 should be objective type question with four options each and 5 should be definitions/statements. 3 questions from each unit (2 MCQS + 1 definition/statement). [15 x 1 = 15 marks]

Section B: 5 questions – either/ or pattern – one from each unit each question carries 4 marks. [5 x 4 = 20 marks]

Section C: 5 question – either/ or pattern – one from each unit – each question carries 8 marks. [5 x 8 = 40 marks]

[Total: 75 marks]

Internal Component:

Test of 2 hours durations

[25 marks]

1. 3 tests may be conducted of 2 hours duration each. Best two can be considered. [2x5 = 10 marks]
2. Attendance – 5 marks with minimum attendance 75%
3. Home assignment – 5 marks.
4. Seminar/Quiz/Class assignment (tutorials) – 5 marks.

[Total: 25 marks]

Distribution of instruction hours per week:

<u>Semester No</u>	<u>Title</u>	<u>No. of hrs/weeks</u>	
I	Core 1: Calculus	4	
I	Core 2: Algebra, Trigonometry and Fourier Series	4	
I	Foundation Course I	1	Examination at the end of the first year
I	Allied (IDC)	9	
II	Core 3: Vector Calculus and Analytical geometry	4	
II	Core 4: Differential equations and Laplace Transform	4	
II	Foundation Course I	1	Examination at the end of the first year
II	Allied (IDC)	9	
III	Core 5: Mathematical Statistics	4	
III	Core 6: Statics	4	
III	Foundation Course II	1	Examination at the end of the Second year
III	Allied (IDC)	9	
IV	Core 7: Real Analysis I	4	
IV	Core 8: Dynamics	4	
IV	Foundation course II	1	Examination at the end of the Second year
IV	Allied (IDC)	9	
V	Core 9 : Abstract Algebra	6	
V	Core 10: Real Analysis II	6	
V	Optional I	6	
V	Optional II	6	
V	Optional III	6	
During the fifth semester vacation, a compulsory field work / a mini project related to one of the optional papers for a minimum period of 45 hours to be completed. It may be evaluated with viva voce examination and may be graded.			
VI	Core 11: Linear Algebra and the theory of Lattices	6	

VI	Core 12: Complex Analysis	6
VI	Optional IV	6
VI	Optional V	6
VI	Optional VI	6

PROPOSED MODEL SYLLABI FOR CORE PAPERS

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LIST OF PROPOSED CORE SUBJECTS

1. Calculus
2. Algebra, Trigonometry and Fourier Series
3. Vector Calculus and Analytical Geometry
4. Differential Equations and Laplace Transform
5. Mathematical Statistics
6. Statics
7. Real Analysis - I
8. Dynamics
9. Abstract Algebra
10. Real Analysis - II
11. Linear Algebra and the theory of lattices
12. Complex Analysis

CALCULUS

Objectives:

- ✧ This course introduces concepts in differential geometry and integral calculus facilitating a sound base for other courses.

Unit I:

Radius of Curvature in Cartesian and Polar coordinates, Pedal equations, Involutives and Evolutives, Envelopes.

Unit II:

Asymptotes and Singular points (node, cusp and conjugate points) - Tracing of Curves - Folium of Descartes, Cycloid, Cardioid and Lemniscate of Bernoulli.

Unit III:

Properties of definite integrals, Bernoulli's formula and Reduction formulae.

Unit IV:

Double and Triple integrals: Changing the order of integration, Jacobians and change of variables, Applications of double and triple integrals in finding area and volume.

Unit V:

Beta and Gamma functions - Application of Beta and Gamma functions in evaluation of Double and Triple integrals, Improper integrals.

Books for Reference:

1. S. Narayanan and T.K. Manickavasagam Pillai, Volume I (2004), Volume II (2004), S. Viswanathan Printers Pvt. Ltd.,
2. P. Kandasamy and K. Thilagavathi, Mathematics for B.Sc., - Volume II – 2004, S.Chand & Co., New Delhi.

ALGEBRA, TRIGONOMETRY AND FOURIER SERIES

Objectives:

- ✧ To inculcate the habit of problem solving.
- ✧ To expose trigonometry as a tool in solving problem.

Unit I:

Theory of Equations - Formation of Equations - Relations between roots and coefficients - Sum of the powers of the roots - Newton's theorem - Reciprocal Equations.

Unit II:

Transformation of Equations - Multiple Roots, Nature and position of roots - Cubic Equations solution by Cardon's method - Biquadratic Equations - solution by Ferrari's method, Horner's method.

Unit III:

Expansion of $\sin nx$, $\cos nx$, $\tan nx$, $\sin^n x$, $\cos^n x$ - Expansion of $\sin \theta$, $\cos \theta$ and $\tan \theta$ in ascending powers of θ . Application of these to limits and approximations.

Unit IV:

Hyperbolic functions - Definition, Relation between Hyperbolic functions, Inverse Hyperbolic functions, Logarithm of complex quantities.

Unit V:

Fourier Series: Definition – Finding Fourier Co-efficients for a given periodic function with period $2l$ and $2l$ – Odd and even function – Half range series.

Books for Reference:

1. P. Kandasamy and K. Thilagavathi – Mathematics for B.Sc., - 2004, Vol I and Vol IV, S.Chand and Co., New Delhi.
2. T.K. Manickavasagam Pillai and S. Narayanan - Algebra - Viswanathan Publishers and Printers Pvt Ltd., - 2004.
3. S. Arumugam, Thangapandi Issac, - Classical Algebra, New Gamma Publishing House, Palayamkottai.
4. T.K. Manichavasagam - Pillai and S.Narayanan, Trigonometry - Viswanathan Publishers and Printers Pvt. Ltd.

VECTOR CALCULUS AND ANALYTICAL GEOMETRY

Objectives:

- ✧ To expose the students to the concepts three dimensional geometry and highlight an alternative to two dimensional Cartesian geometry and to introduce the idea of surface and volume integrals.

Unit I Vector Calculus:

Vector point function - Scalar point function - Derivative of a vector and derivative of a sum of vectors - Derivative of a product of a scalar and a vector point function - Derivative of a scalar product and vector product - The vector operator 'del' - Gradient of a scalar point function - Divergence of a vector - Curl of a vector - Definitions of solenoidal and irrotational vectors - Laplacian operator.

Unit II

Line integral - Surface integral - Volume integral-Stokes Theorem, Gauss-divergence Theorem, Green's Theorem in two dimensions - Problems on Applications.

Unit III Two Dimensional Analytical Geometry:

Polar Co-ordinates: Distance between the points - Area of Triangles - Equation of Straight Line, Circle and Conic - Simple Problems involving Chords, tangents and normals.

Unit IV Three Dimensional Analytical Geometry:

Sphere: Tangent Plane - Circle of intersections - Tangency of Spheres - Coaxial System of Spheres - Radical Planes - Orthogonal Spheres.

Unit V

Cone and Cylinder: Equation of a Cone - Cone with Vertex at the origin - Quadric cone with the vertex at the origin - Right circular cone - Cylinder - Right circular cylinder.

Books for Reference:

1. P. Duraipandian, Laxmiduraipandian - Vector Analysis (Revised Edition- Reprint 2005) Emerald Publishers.
2. P. Duraipandian, Laxmi DuraiPandian and D.Muhilan (Revised Edition Reprint - 1997) Analytical Geometry (Two Dimensions) Emerald Publishers.
3. P. Duraipandian, Laxmi Duraipandian and D.Muhilan (Revised Edition - Reprint - 2003) Analytical Geometry (Three Dimensions) Emerald Publishers.
4. P. Kandasamy and K. Thilagavathi – Mathematics for B.Sc., Vol IV - 2004, S.Chand and Co., New Delhi.

DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORM

Objectives:

- ✧ To expose differential equations as a powerful tool in solving problems in Physical, Social and Managerial Sciences.

Unit I

ODE: Second Order Linear differential equations with constant coefficients, finding the PI for functions of the form xe^{mx} , higher order equations where $f(D)$ is factorisable - Linear equations with variable coefficients - Method of variation of parameters.

Unit II

ODE: First order higher degree equations, solvable for x , y , p and Clairaut's form - Simultaneous differential equations of the form $f_1(D)x + g_1(D)y = h_1(t)$, $f_2(D)x + g_2(D)y = h_2(t)$.

Unit III

PDE: Formation of equations by elimination of arbitrary constants and functions. Definition of general, particular and complete solutions, solving standard forms 1. $f(p, q) = 0$ 2. $f(x, p, q) = 0$, $f(y, p, q) = 0$, $f(z, p, q) = 0$ 3. $f(x, p) = f(y, q)$ 4. $z = px + qy + f(p, q)$.

Unit IV

PDE: Lagrange's Differential equations $Pp + Qq = R$ - Charpit's Method - Equations reducible to standard forms.

Unit V

Laplace Transform - Inverse Laplace Transform - Solving linear differential equations with constant coefficients using Laplace Transform.

Books for Reference:

1. S. Narayanan and T.K. Manicavachagam Pillai – Differential equations and its application, 2003, S.Viswanathan Printers.
2. P.Kandasamy and K. Thilagavathi, Mathematics for B.Sc., Vol III – 2004 – S.Chand and Co., New Delhi.

MATHEMATICAL STATISTICS

Objectives:

- ✧ To develop the statistical concepts and introduce the techniques of analysis and inference used for research in social and life sciences.

Unit I

Probability: Definitions of various terms - Axiomatic Probability - Random Event - Mathematical Probability - Addition and Multiplication Laws of Probability - Independent events - Conditional Probability – Baye's theorem - Simple applications.

Unit II

Random Variables: Distribution functions - Discrete random variable - Continuous random variable - Joint Probability mass function Joint Probability distribution function - Marginal distribution function - Joint density function - conditional distribution function.

Unit III

Mathematical Expectation: Addition and Multiplication theorem - Covariance Expectation and variance of linear combination of random variables - Moment generating function - Characteristic function - Probability generating function.

Unit IV

Sampling Distributions: Students t-distribution, F-distribution - χ^2 - distribution (Definition and derivation only). Testing statistical hypothesis: Null and alternate hypothesis – Type I and Type II errors – Powers of a test – Critical region – Level of significance – One/two tailed tests critical value. Large sample test: Test of significance for mean and difference of means.

Unit V

Small sample test based on t, F and χ^2 distributions.

Books for Reference:

1. P. Kandasamy, K.Thilagavathi and K. Gunavathi, Probability, Statistics and Queueing theory – (2007) S.Chand and Co., New Delhi.
2. P.R. Vittal – Mathematical Statistics – 2004 – Maragatham Publishers.
3. S.C. Gupta & V.K. Kapoor – Fundamentals of Mathematical statistics – 2002 Sultan Chand & Sons, New Delhi – Eleventh thoroughly revised edition.

STATICS

Objectives:

- ✧ To develop the ability to describe forces and moments, to select suitable reference co-ordinate axes and understand the relation between constraints imposed by supportive forces.

Unit I Forces acting on a particle:

Forces, types of forces, triangle law of forces, equilibrium of forces acting on a particle, Lami's theorem, Polygon law of forces, moment of a force about a point and a line, parallel forces, couple, varignon's theorem.

Unit II Forces acting on a rigid body:

Reduction of a system of forces, Equilibrium of three forces acting on a rigid body.

Unit III Friction:

Friction, Laws of friction, angle of friction, Cone of friction, conditions for sliding and toppling.

Unit IV: Centre of Gravity:

Location of the centre of gravity - Methods of Symmetry and methods by integration.

Unit V Equilibrium of Strings and Chains:

Equilibrium of strings and chains, common catenary suspension bridge.

Books for Reference:

1. Dr.M.K.Venkataraman, 'Statics' – Agastiar Publications 2002, Trichy.
2. K. Viswanatha Naik and M.S. Kasi – Statics – Emeral Publishers.
3. P. Duraipandian, Laxmi Duraipandian and Muthamizh Jayapragasm - "Mechanics". 2003. S.Chand and company.

REAL ANALYSIS - I

Objectives:

- ✧ To understand the basic principles of Analysis in particular the limits, convergence of sequences and series and re-arrangement of series.
- ✧ Essential for learning higher mathematics

Unit I

The field axioms, the order axioms, the rational numbers, the irrational numbers, upper bounds, maximum element, least upper bound (supremum). The completeness axiom, some properties of the supremum, absolute values and the triangle inequality, the Cauchy-Schwarz's inequality.

Unit II

Sequences - Bounded, Convergent, Divergent and oscillating sequences, Algebra of limits - Behaviour of Monotonic sequences

Unit III

Cauchy's first limit Theorem, Cauchy's second limit Theorem, subsequences, Cauchy sequence, upper and lower limit of sequences.

Unit IV

Infinite series - comparison test, Kummer's test, Root test, condensation, Integral test.

Unit V

Alternating series, Absolute convergence Tests for convergence of series of arbitrary terms - Rearrangement of series - Multiplication of series, Power series.

Books for Reference:

1. Dr.S.Arumugam and Thangapandi Issac - "Sequences and Series", New Gamma, Publishing House, Palayamkottai - 627 002. (1997).
2. Tom M. Apostol - Mathematical Analysis, II Edition, Narosa Publishing House, New Delhi (Unit I), (1997).

DYNAMICS

Objectives:

- ✧ Enable students to apply Laws, Principles, Postulates governing the Dynamics in physical reality.

Unit I

Laws of Motion - Principles of Work, Power and Energy, Projectiles: Equation of Path - Range - Maximum height - Time of flight - Range on an inclined plane - Motion on inclined Plane.

Unit II

Impulsive forces - Collision of elastic bodies - Laws of Impact - Direct and oblique impact - Impact on a fixed plane.

Unit III

Simple harmonic motion in a straight line - Geometrical representation - Composition of S.H.M's of same period in the same line and along two perpendicular direction - Particles suspended in a spring - S.H.M. as a curve - Simple pendulum - Simple equivalent pendulum. The seconds pendulum.

Unit IV

Motion under the action of Central Forces - Velocity and acceleration in Polar co-ordinates - Differential equation of Central Orbit - Pedal equation of Central Orbit - Inverse Square Law.

Unit V

Motion of a rigid body about fixed axis - Angular momentum of a rigid body about an axis of rotation - Conservation of angular momentum.

Books for Reference:

1. M.K. Venkatraman – A text book on Dynamics – 2001, Agasthiar Publication, Trichy.
2. S. Narayanan - "Dynamics", S.Chand and Company, 16th Edition, 1986, New Delhi.

ABSTRACT ALGEBRA

Objectives:

- ✧ To acquaint the students with the basic concepts of some of the fundamental algebraic structures.

Unit I

{Groups - Definition and Examples - Simple Properties of Groups (not for examination)} - Subgroups - Necessary and sufficient condition for a subset to be a subgroup - Order of the Group - Order of an element - Centre of a group - Normalizer and Centralizer, Product of two subgroups - Order of HK - Necessary and sufficient condition for HK to be of a cyclic group a subgroup - Intersection and union of subgroups.

Unit II

Cyclic groups - subgroups, generators of a cyclic group - Number of generators of a cyclic groups - Co-sets - left Co-sets and right Co-sets - Partitioning of a group by Co-sets - Langrange's theorem - Euler's theorem - Fermat's theorem.

Unit III

Normal subgroups - Quotient groups - Group Homomorphisms - Canonical Homomorphism - Kernel of a homomorphism - Isomorphism - Automorphism - Inner Automorphism - Carley's Theorem - Permutation groups.

Unit IV

Rings - Definition and examples - Types of rings - Elementary properties of a ring - Integral Domain - Field - Sub rings - Sub fields - Ideals - Left ideal - Right ideal - Principal ideal - quotient ring - Maximal and prime Ideals - Characteristic of a ring - PID - UFD.

Unit V

Homomorphisms - Isomorphism - Kernel of a Homomorphism - Fundamental theorem of Homomorphism - Field of quotients of an Integral domain - Polynomial rings - Division algorithm - Polynomial rings over a UFD - Gauss lemma - Polynomials over the rational field - Eisenstein's criterion.

Books for Reference:

1. Dr. S. Arumugam and Others - Modern Algebra
2. T.K. Manicavasagam. Pillai and others - Modern Algebra, S.Viswanathan Publishers, Chennai 1993.
3. IN Herstein, - Topics in Algebra, Vikas Publishing house Pvt. Ltd., 1975, New Delhi.

REAL ANALYSIS - II

Objectives:

- ✧ To introduce the concepts which provide a strong base to understand and analysis mathematics.

Unit I

Limit and Metric Spaces - Metric Spaces - Limit in Metric Spaces.

Unit II

Continuous functions on metric spaces - Functions continuous at a point on the real line - Functions continuous in a metric space - Open sets, Closed sets - Discontinuous function on \mathbb{R}^1

Unit III

Connected, Completeness and Compactness - Connectedness - Bounded sets and totally bounded sets - Complete metric spaces - Continuous functions on compact metric spaces continuity of the inverse function uniform continuity.

Unit IV

Sets of Measure zero, definition of the Riemann integral, Existence of the Riemann integral.

Unit V

Derivatives, Rolle's theorem - Fundamental theorem of Calculus - Taylor's Theorem

Books for Reference:

1. R.Goldberg - Methods of Real Analysis Oxford and IBH Publishing Co. New Delhi (2000).
2. Malik SC and Savitha Arora (1991) - Mathematical Analysis Wiley Eastern Limited New Delhi.
3. K. Viswanath Naik - Real Analysis, Emerald Publishers, Chennai.

LINEAR ALGEBRA AND THE THEORY OF LATTICES

Objectives:

The objective of this course is to enable the students to understand the basic ideas of vector spaces, Linear transformations and their relation to matrices. It helps the students to appreciate the significance of Boolean Algebra.

Unit I

Vector Spaces - Definition and Examples - Subspaces - Linear Transformation - Fundamental Theorem of Homomorphism.

Unit II

Span of a set - Linear Independence - Basis and Dimension - Rank and Nullity - Matrix and Linear transformation.

Unit III

Inner Product space - Definition and Examples - Orthogonality - Orthogonal Complement - Gram Schmidt orthogonalization process.

Unit IV

Matrices - Elementary transformation - Inverse - Rank - Test for consistency - Solving Linear Equations - Cayley Hamilton's theorem - Eigen values and Eigen vectors.

Unit V

Partially ordered set - Lattices - Modular Lattice - Distributive Lattice - Boolean Algebra – Simple application to switching circuits.

Books for Reference:

1. S. Arumugam and A. Thangapandi Issac - "Modern Algebra", Scitech Publications (India) Pvt. Ltd., Chapters 5,6,7& 9
2. J.N. Sharma and A.R. Vashistha - "Linear Algebra", Krishna Prakash Nandir 1981.
3. Boolean Algebra and Lattices - Schaum Series 1996 - Lipschultz.
4. M.K. Venkataraman and others – Discrete Mathematics – 2000, National Publishing Company.
5. I.N.Herstein – Topics in Algebra, Vikas Publishing House Pvt Ltd., 1975, New Delhi.
6. P. R. Halmos- Finite Dimensional Vector Space.

COMPLEX ANALYSIS

Objectives:

To expose a fertile area of pure mathematics as a source of powerful techniques that are widely applied in sciences.

Unit I Analytic Functions:

Functions of a complex variable - Derivatives - Cauchy Riemann Equations - Sufficient conditions - Polar form - Analytic functions - Harmonic functions.

Unit II Integrals:

Definite integrals - Contours - Cauchy - Goursat Theorem - antiderivatives and independence of path - Cauchy Integral formula - Morera's Theorem.

Unit III Series:

Convergence of Sequence and Series: Taylor's series - Examples – Laurent's Series - Zeros of analytic functions - Residues - Residue Theorem - Principal part of a functions - Residues at poles - Quotients of Analytic functions.

Unit IV Evaluation of Integrals:

Evaluation of Improper Real Integrals - Improper Integrals involving sines and cosines - Definite Integrals involving sines and cosines.

Unit V: Transformations:

Conformal mappings basic properties – Basic Properties – Mappings $w= 1/z$, z^2 , e^z , $\sin z$, $\cos z$, $z+1/z$ and Bilinear maps – Fixed Points – Applications.

Book for Reference:

1. R.V. Churchill and J.W. Brown - "Complex variables and Applications" - Fourth Edition - McGraw Hill International Editions.
2. Arumugam, T. Issaic - "Complex Analysis" - Sci-tech Publishing House - Chennai.
3. S. Ponnuswamy - "Foundations of complex Analysis", Narose Publication House New Delhi, 2nd edition 2005.
4. P.DuraiPandian and Lakshmi DuraiPandian - "Complex Analysis" - Emerald Publications Chennai (2001).

PROPOSED MODEL SYLLABI FOR OPTIONAL PAPERS

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List of Proposed Optional Papers

1. Graph Theory
2. Numerical Methods
3. Operations Research
4. Discrete mathematics
5. Programming in C
6. Object "Oriented" Programming in C++
7. Data Structures
8. Design and Analysis of Algorithms
9. Mathematical Modeling
10. Astronomy
11. Fuzzy Mathematics
12. Fluid Dynamics
13. Formal Languages and Automata Theory
14. Stochastic Process
15. Number Theory

GRAPH THEORY

Objectives:

- ✧ To understand the concept of graph theory as an application of mathematics in real information technology related fields.

Unit I

Introduction: Finite and Infinite graphs - Incidence and degree - Isolated vertex - Pendent vertex and null graphs - Paths and Circuits - Isomorphism - Sub graph - walks paths and circuits - Connected and disconnected graphs - Euler graphs - Hamiltonian paths and circuits.

Unit II

Trees and fundamental circuits: Trees - Some properties of trees - Pendent vertices in a Tree - Distance and Centres in a tree - Rooted and Binary Trees - Spanning trees.

Unit III

Cut Sets and Cut Vertices: Cutsets in a graphs - Properties of a cut set - all cut sets in a graph - Fundamental circuits and cut sets - Connectivity and separability.

Unit IV

Planar and dual graphs: Combinatoinal versus Geometric Graphs - Planar graphs - Kuratowskis' graphs - Difference representations of a planar graph - Detection of Planarity – Geometric dual.

Unit V

Matrix representation of graphs: Incidence Matrix, sub matrices – Circuit matrix – Fundamental Circuit matrix and rank – Cut set matrix – Relations – Path matrix – Adjacency matrix.

Books for Reference:

1. Narasing Deo - "Graph Theory with Application to Engineering and Computer Science" Prentice - Hall of India Pvt. Ltd, New Delhi - 110 001, 2001 Edition.
2. M.K. Venkataraman and Others – Discrete mathematics, National Publishing Company, 2000.
3. Dr. S. Arumugam and Dr. S. Ramachandran, - Invitation to Graph Theory, Scitech Publications India Pvt. Limited, Chennai - [2001, Edition].

NUMERICAL METHODS

Objectives:

- ✧ To expose the students to standard numerical techniques as a powerful tool in scientific computing.

Unit I Solution of Numerical Algebraic and Transcendental Equations:

The bisection method - Newton's method - Criterion of order of convergence of Newton's method - Regula false method - Gauss elimination - Gauss Jacobi - Gauss Seidal method.

Unit II Finite Differences:

First and higher order differences - Forward and backward differences - Properties of operator - Differences of a polynomial - Factorial polynomial - Error propagation Operator E and E^{-1} Relation among Δ , E, δ and D - summation of series.

Unit III Interpolation:

With equal intervals: Newton's forward - backward interpolation formula - Gauss forward - backward interpolation formula - Bessel's formula.

Unequal intervals: Divided differences - Newton's divided difference formula - Lagrange's interpolation formula - Inverse interpolation.

Unit IV Numerical Differentiation and Integration:

Newton's forward and backward differences to compute derivatives - Derivatives using Bessel's formula - Newton - Cote's formula - Trapezoidal rule - Simpson's $1/3$ and $3/8$ th rule - Weddle's rule.

Unit V Difference Equations:

Definition - Order and degree of difference equation - Linear difference equation - Finding complementary function - Particular integral - Simple applications.

Books for Reference:

1. P. Kandasamy, K. Thilagavathy, K. Gunavathy - "Numerical Methods", S.Chand & Company Ltd., Edn. 2006.
2. M.K. Venkataraman, - Numerical Methods in Science and Engineering - National Publishing company V Edition 1999.

OPERATIONS RESEARCH

Objectives:

- ✧ To expose the mathematical tools applied to social and managerial sciences.

Unit I

Mathematical formulation of LPP - Simplex Method - Artificial variable technique - Concept of Duality - Primal and Dual Problems - Duality - Dual Simplex Method.

Unit II

Transportation Problem: North-West Corner Rule - Matrix Minima method - Vogel's Approximation Method - MODI Method - Degeneracy and Unbalanced Transportation Problem.

Assignment Problem: Hungarian Method - Unbalance Assignment Problem - Travelling Salesman Problem.

Unit III

Games and Strategies: Two Person Zero sum Games - The Maximin - Minimax Principle - Games without Saddle Points - Mixed Strategies - Graphical Solution of $2 \times n$ and $m \times 2$ games - Dominance Property.

Unit IV

Network scheduling by PERT / CPM: Network and basic components - Rules of Network Construction - Time Calculation in network - Critical Path Method - PERT Calculation.

Unit V

Inventory Control: Introductions - Types of Inventories - Inventory decisions - Deterministic inventory Problems - EOQ Problems with no shortages - Production Problems with no shortages - EOQ problems with shortages - Production Problems with shortages.

Books for Reference:

1. Kanti Swarup, P.K. Gupta and Manmohan - Operations Research - Sultan Chand & Sons – 2006, 12th edition.
2. P.K. Gupta and D.S. Hira – S.Chand and Company.

DISCRETE MATHEMATICS

Objectives:

- ✧ To expose the students to the application of mathematics in computer science and to provide sound base in fundamentals of logic.

Unit I

Statement and Notation - Connectives - Negation - Conjunction - Disjunctions - Statement Formula and Truth Table - Conditional and Biconditional - Well defined formulas - Tautologies - Equivalence of formulas - Duality Laws - Normal forms.

Unit II

Algebraic Structures - Groups and Monoids - Simple Properties - Group Codes.

Unit III

Lattices and Boolean Algebra - Lattices and Posets - Properties of Lattices - Special Lattices - Boolean Algebra - Gating Networks - Minimal sums of Products - Karnaugh maps.

Unit IV

Languages: Finite State Machines Language - The set Theory and Strings - Finite State Machine - A first encounter - Finite State machine - a Second encounter.

Unit V

Number system and codes - Decimal, Binary, Octal, Hexadecimal - Conversion from one to another - Binary addition, subtraction multiplication and division - BCD - Weighted excess time - Gray Code - ASCII code, Error Detecting Code.

Books for Reference:

1. Trembley and Manohar - Discrete Mathematical structures with application to Computer Science, (Tata McGraw Hill, New Delhi) 1997.
2. Ralph P. Grumaldi Pearson Edelen - Discrete and Combinational Mathematics - an Applied Introduction (IV Edn.).
3. Maluino A and Leech - Digital Principles and Application McGraw Hill.
4. M.K. Venkataraman and others – Discrete Mathematics – 2000, The National Publishing Company.

PROGRAMMING IN C

Objectives:

- ✧ To enable the students to learn a high level language and help them to write programs.

Unit I

Variable name - Data types and sizes - Constants - Declarations - Arithmetic operators relational operators - Logical operators - bitwise operators - Assignment operators and expressions - Conditional expressions - Standard Input and Output - Formatted input and output.

Unit II

Statements and blocks - if-else, else-if, switch, while, do-while and for-break - continue - GOTO - labels. External variable - static variables - Register variables - Scope and rules.

Unit III

Pointers and Addresses - Pointers and function arguments - Pointer and arrays - Pointers and functions - Pointer arrays - Pointer and multi-dimensional arrays, command line arguments, pointer to functions.

Unit IV

Structure and Functions - Array of structures - Pointers to structures - Unions.

Unit V

Files in C - Compilation Directives - File Management.

Books for Reference:

1. E.Balagurusamy - "Programming in ANSI C", Tata McGraw Hill 2004, New Delhi.
2. C. Gottfried, "Programming with C", Tata McGraw Hill, 1990, New Delhi.
3. B.W.Kernighan and D.M.Ritchie, "The C Programming Language", Tata McGraw Hill 1996.

Practical Objectives:

1. Two hours practical in each unit to demonstrate the concepts involved in that unit.

OBJECT ORIENTED PROGRAMMING IN C++

Objectives:

- ✧ To introduce the students to the concepts in C++

Unit I

Introduction to object oriented approach - Characteristics of OOP - Classes, objects, inheritance and overloading.

Unit II

C++ console I/O - Conditional statements - Looping statements - Function overloading - Constructors and destructors - Friend and inline functions - Static variables and functions.

Unit III

Using pointers to objects, this pointer - New and delete operators - Operator overloading - Overloading unary and binary operators using friend functions and member functions.

Unit IV

Inheritance - Levels of inheritance - Multiple inheritance - Multilevel inheritance - Virtual base classes - Pointers to derived classes - Virtual functions - Polymorphism.

Unit V

Files - Templates - Exception handling.

Books for Reference:

1. OOP with C++, E. Balagurusamy, Tata McGraw Hill, 2002, New Delhi.
2. H.Schildt, Teach yourself C++, McGraw Hill.

Practicals - 2 hr/week

1. Two Practical in each unit demonstrating the concepts involved in that unit.

DATA STRUCTURES

Objectives:

- ✧ To introduce various data structures used for imputing data in Computer programs in a suitable form.

Unit I

Built in data structures - One and two dimensional arrays - Packed structures - Stacks - Operations on stacks - Implementation - Queue - Operations on Queues - Implementation - Another queue design - Application - Expression Evaluation, Simulation, Playing maze.

Unit II

Linked lists - Operations - Get node and Free node - Implementation as an array of records - Implementing list operations - Inserting in an ordered list - Deleting from ordered list - Implementation - Stacks and queues as linked lists - Circular linked lists - Application - Magazine circulation.

Unit III

Pointer variables - Up arrow syntax - Debugging hints - Recursion - Function sum - Reverse print - NFACT - Application - Quick Sort - Dynamic Storage Allocation.

Unit IV

Binary Search trees - Searching - Insertion - Deletion - Implementations - Traversals - Binary expression trees - A non-linked representation - Heap sort - Application - Creating Index.

Unit V

Sorting Algorithm - Analysing Quick Sort - Analyzing heap sort - Sequential searching - Binary Search - Hashing.

Books for Reference:

1. Nell Dale and Susan C.Lilly - Pascal Plus Data Structures Algorithms and Advanced Programming, Tata McGraw Hill Pvt. Company Ltd, 16th edition 2001, New Delhi.
2. Radha Ganesan, - "C and Data Structures" - Scitech Publications Chennai 2nd edition 2002.
3. Ellis Horowitz, - "Fundamentals of Data Structures", Sartaj Sahani Galgotia Publishers, 1983, New Delhi.
4. Seymour Lipschutz, - "Theory and Problems of Data Structures" Schaum's Series, Tata McGraw Hill Pvt. Company.

DESIGN AND ANALYSIS OF ALGORITHMS

Objectives:

- ✧ To introduce the students to the different design techniques and methods used in solving problems and to enable the students to analyse, compare, apply suitable algorithms to solve specific problems in computer programming.

Unit I

Introduction to algorithms - Algorithm specifications - Recursive algorithms - Performance Analysis - Space complexity - Time Complexity - Asymptotic notation - Practical complexities - Performance measurement.

Unit II

Divide and Conquer Method - General method - Binary search - Finding the Maximum and Minimum - Mergesort - Quick sort - Performance Measurement.

Unit III

Greedy method - General method - Job sequencing with deadlines - Minimum cost spanning tree - Prim's algorithm - Kruskal's algorithms - Single source shortest paths.

Unit IV

Dynamic programming - General method - Multistage graphs - All pairs shortest paths - Single source shortest paths - General weights - The travelling salesman problem.

Unit V

Basic traversal and search techniques - Techniques for binary trees - Techniques for graphs - Breadth first search and traversal - Depth first search and traversal - Connected components and spanning trees.

Books for Reference:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, - Galgotia Publications Pvt. Limited – 2001, New Delhi.
2. Wirth Ni Claus - Algorithm + Datastructure = Programs, Prentice Hall of India Private Ltd., 1994, New Delhi.
3. Schaum's series Seymour Lipchutz - Theory and Problems in Datastructures, Tata McGraw Hill Publishing Company 2000.

MATHEMATICAL MODELING

Objectives:

- ✧ To formulate physical problems using mathematical concepts and solving them by using differential equations / graphs.

Unit I Mathematical Modeling through O.D.E. (First Order)

Linear growth and Decay Models - Non linear growth and Decay Models - Compartment Models - Dynamics Problems - Geometrical Problems.

Unit II

Population Dynamics - Epidemics - Compartment Models - Economics, Medicine, Arms Race, Battles and International Trade.

Unit III Mathematical Modeling through O.D.E. (Second Order)

Planetary Motion - Circular Motion - Motion of Satellites - Modeling through Linear difference equations of Second Order.

Unit IV Mathematical Modeling through Difference Equations

Basic theory of difference equation with Constant Coefficients - Economics and Finance - Population Dynamics and Genetics - Probability Theory.

Unit V Modeling through Graphs

Solutions that can be Modelled through graphs - Models in terms of directed graphs, signed graphs, weighted digraphs and unoriented graphs.

Books for Reference:

1. J.N.Kapur - Treatment as in "Mathematical Modeling" by J.N.Kapur - New Age International Publishers, 2004.
2. J.N.Kapur, - Mathematical Modeling in Biology and Medicine - East West Press - 1985.
3. Singh, - Mathematical Modeling, International Book House - 2003.

ASTRONOMY

Objectives:

- ✧ To introduce the students to space science and to encourage them to become astronomers.

Unit I

Spherical Trigonometry - Spherical Triangle - The fundamental formulae of Spherical Trigonometry, the sine, cosine, four parts and Napier formulae (without proof).

The Celestial Sphere: Celestial coordinators - Diurnal motion - Rising and setting of a star - Sidereal time - Circumpolar star - Morning and Evening stars - Twilight - Earth - Length of the day.

Unit II

Refraction - Tangent Formula – Cassini's formula - Effects of Refraction - Geocentric Parallax - Effects of Geocentric Parallax - Heliocentric Parallax - Effects of Heliocentric Parallax - Aberration - Its Effects.

Unit III

Kepler's Laws - Verification of Kepler's Laws - True anomaly, Mean Anomaly - Eccentric Anomaly, Relation between them - Time - Equation of Time - Seasons - Conversion of Time.

Unit IV

Moon - Sidereal Month, Lunation and Relation between them - Phases of the Moon - Lunar Libration - Surface of the Moon - Metonic Cycle - Tides - Eclipses - Shadow Cone - Minimum and Maximum number of Eclipses.

Unit V

Planetary Phenomena - Bodes law - Elongation - Sidereal Period, Synodic period and the relation between them - Phase - Stationary Points - Solar System - Stellar Universe - A brief history of Astronomy - Astronomical Instruments.

Books for Reference:

1. Prof. S. Kumaravelu and Prof. Susheela Kumaravelu – Astronomy for degree classes, Rainbow printers, Nagarcoil (2005).
2. G.V. Ramachandran - Astronomy
3. George.O.Abell - Exploration of the Universe (Second Edition)

Observational Astronomy:

1. System of Coordinates - A practical Study
2. Observation of Moon - Different phases
3. Observation of Planets, Galaxies.
4. Identification of Constellations.

FUZZY MATHEMATICS

Objectives:

- ✧ To enable the students to have better application of uncertainty through Fuzzy Mathematics for problems in Physical and Social Sciences.

Unit I

Crisp Sets - Fuzzy Sets - Basic Types - Basic Concepts - Characteristics and Significance of the Paradigm shift.

Unit II

Additional properties of α -cuts - representations of fuzzy sets - Extension principle for fuzzy sets.

Unit III

Fuzzy set operations - Fuzzy complements - Fuzzy intersections: t-norms - Fuzzy Unions: t-conorms - Combinations of operations - Aggregation operations.

Unit IV

Fuzzy Numbers - Linguistic variables - Arithmetic operations on intervals - Arithmetic operations on fuzzy numbers - Lattice of fuzzy numbers - Fuzzy Equations.

Unit V

Fuzzy Decision Making - Individual Decision Making - Multi-person decision making - Fuzzy linear Programming.

Books for Reference:

1. George J. Klir and Bo Yuan, - Fuzzy Sets and Fuzzy Logic Theory and Applications, Prentice Hall of India, 2002, New Delhi.
2. George J.Klir, Tina. A. Folger - Fuzzy Sets, Uncertainty and Informations - Prentice Hall of India, 2003.

FLUID DYNAMICS

Objectives:

- ✧ Apply, appreciate the abstract concepts and concretize them through abstract mathematics.

Unit I

Classification of Fluids - Eulers and Lagrange's descriptions of Flow - Material Derivative - Continuity Equation - Irrotational and Solenoidal Velocity fields - Boundary conditions for a material surface - Circulation - Kelvin's theorem on Circulation - Euler's equation of motion.

Unit II

Bernoulli's theorem, Vorticity - Helmholtz vorticity theorem - Two dimensional motion - Stream function - complex Potentials - Complex potentials of sources - sinks - Doublets - Circle theorem.

Unit III

Blasion Theorem - Image of source and doublet on circular cylinder - Uniform stream past the circular cylinder - Axisymmetric flow - Stokes stream function.

Unit VI

Butler's sphere theorem - Sphere in a uniform stream - Joukowski transformation - Theorem of Kutta - Joukowski - Aerofoil - Lift on an aerofoil.

Unit V

Navier - Stokes equation of Motion - Some exact solutions of Navier-stokes equations - Flow between parallel planes:- Flow through a circular tube flow between concentric cylinders - Flow through a Pipe of elliptical cross section.

Books for Reference:

1. F. Chorlton - Text book of Fluid Dynamics - CBS Publications, 1985, New Delhi.
2. L.M. Milne Thomson - Theoretical Hydro dynamics – Dover Publications, V edition, New York.
3. C.K. Batchelor, - An introduction to Fluid Mechanics, Cambridge University Press, 2005, U.K.

FORMAL LANGUAGES AND AUTOMATA THEORY

Objectives:

- ✧ To make the students understand the technique of computers accepting/rejecting words and checking the syntax.

Unit I Finite Automata and Regular Expressions:

Finite state system, Non-Deterministic and Deterministic finite state automation. Finite automation with E-Moves. Regular expressions.

Unit II Properties of Regular Expressions:

Pumping Lemma for Regular sets - Closure and other properties of Regular sets.

Unit III Context Free Grammars:

Context free Grammar - Derivation tree - Simple properties Normal forms chemistry and Greibach - Normal forms.

Unit IV Pushdown Automata:

Informal description, Definition and examples - Pushdown Automata and Context free languages.

Unit V Properties of Context Free Languages:

Pumping lemma for context free languages - Closure and other properties of context free languages.

Books for Reference:

1. John, Hopcroft and Jeffrey D. Ullman, - Formal Languages, Automata Theory as Computations, Narosa Publications, Indian Student Edition 1994 (10th reprint), New Delhi.
2. Rani Sironmoney, Formal Languages, CLS Publications
3. Dr.M.K. Venkatraman, Dr. N. Sridharan & Dr.N.Chandrasekaran, - Discrete Mathematics, National Publishing & Co., (2000).
4. K.L.P. Mishra & N. Chandrasekaran – Theory of Computer Science, Prentice Hall of India – 2001, 2nd edition.

STOCHASTIC PROCESS

Objectives: This paper enables the learners to

- ✧ Understand the notion of differential difference equations to learn
- ✧ To learn Markov Chain & Queuing theory
- ✧ Apply the theory to several real life problems

Unit I

Generating function - Laplace Transforms - Laplace transforms of a probability distribution function - Difference Equation - Differential difference Equation.

Unit II

Stochastic Processes - Notion - Specification - Stationery Processes - Markov Chains - Definition and example and higher transition probability.

Unit III

Classification of States and Chains - Determination of higher transition probabilities - Stability of a Markov System - Limiting behaviour.

Unit IV

Poisson Process and related distribution - Generalization of Poisson Process - Birth and Death Process.

Unit V

Stochastic Process in queuing and reliability - Queuing system - M/M/1 Models - Birth and Death process in queuing theory - Multi Channel models.

Books for Reference:

1. J. Medhi, - Stochastic Process, Wiley Eastern Limited, New Delhi, 1987.
2. Samuel Karlin and Taylor - First Course in Stochastic Processes.
3. Srinivasan and Mehta - Stochastic Processes, Tata McGraw Hill Publishing Company, New Delhi.
4. V. Narayanan - Elements of Applied Stochastic Processes.

NUMBER THEORY

Objectives:

- ✧ To expose the student to understand the order, beauty and logic in the study of numbers.

Unit I

Peano's Axiom - Mathematical Induction - The Binomial Theorem - Early Number Theory.

Unit II

Divisibility Theory in Integers - The Division Algorithm - The g.c.d. - Euclidean Algorithm - The Diophantine Equation $ax + by = c$

Unit III

Primes and their Distributions - The fundamental Theorem of Arithmetic - The sieve of Eratosthenes - The Gold Conjecture.

Unit IV

The Theory of Congruence - Basic Properties of Congruence - Special Divisibility test - Linear Congruence.

Unit V

Fermat's Theorem - Fermat's factorization method - The little theorem - Wilson's theorem.

Books for Reference:

1. David M. Burton - Elementary Number theory.
2. Ivan Niven and H. Zuckerman - An Introduction to theory of Numbers.
3. S. Kumaravelu and Susheela Kumaravelu – Elements of Number Theory, Nagarcoil, 2002.

PROPOSED MODEL SYLLABI FOR ALLIED PAPERS

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List of Proposed Allied Papers

1. Allied Mathematics - I (For B.Sc., Chemistry Major)
2. Allied Mathematics - II (For B.Sc., Chemistry Major)
3. Allied Mathematics - I (For B.Sc., Physics Major)
4. Allied Mathematics - II (For B.Sc., Physics Major)
5. Allied Mathematics - I (For B.Sc., Computer Science and BCA)
6. Allied Mathematics - II (For B.Sc., Computer Science and BCA)
7. Allied Business Mathematics (For Commerce and Management Students)
8. Allied Statistics for Business (For Commerce and Management Students)

ALLIED MATHEMATICS I (For B.Sc., Chemistry Major)

Objectives:

- ✧ To acquaint the students with the tools in Mathematics to understand and solve problems.

Unit I

Matrices: Characteristic Roots and Characteristic Vectors - Properties (Statements only), Cayley Hamilton Theorem (Statement only) - Verification - To find the inverse using the above theorem - Diagonalisation of a matrix and using it to find the powers of a matrix.

Unit II

Group Theory - Review of the set theory and Equivalence Relations - Group - Properties - Order of an Element - Subgroups - Cyclic groups - Theorems - Permutation group - Symmetric group S_n

Unit III

Theory of equations - Roots of an equation - Relation between Roots and Coefficients - Transformation of Equations - Increasing and Decreasing the Roots of an Equations - Reciprocal Equations - Horner's Method - Newton's Method of finding roots of a given equation.

Unit IV

Trigonometry - Expansions of $\cos n\theta$, $\sin n\theta$ - Expressions of $\cos \theta$, $\sin \theta$, $\tan \theta$ in powers of θ - Hyperbolic functions - Inverse Hyperbolic function - Real and imaginary parts of $\sin(\alpha + i\beta)$, $\cos(\alpha + i\beta)$, $\tan(\alpha + i\beta)$, $\tan^{-1}(\alpha + i\beta)$.

Unit V

Laplace transformation - Definition - Laplace transforms of e^{at} , $\cos at$, $\sin at$, $\cos h at$, $\sin h at$, t^n (n is a positive integer) - $e^{at} f(t)$, $t^n f(t)$, $f^l(t)$, $f^{l1}(t)$. Inverse Laplace transform of standard functions. Solving differential equations of second order with constant coefficients and simultaneous equations, using Laplace transform.

Books for Reference:

1. S. Narayan and T.K. Manicavachagam Pillay Treatment as in Ancillary Mathematics.
2. P.Kandasamy and K. Thilagavathy - Mathematics for B.Sc., Volume II, S.Chand & Company, New Delhi.
3. P. Kandasamy and K. Thilagavathi – Allied Mathematics Volume I and Volume II – 2004, S.Chand and Company, New Delhi.

ALLIED MATHEMATICS II (For B.Sc. Chemistry Major)

Objectives:

- ✧ To acquaint the students with tools in Mathematics to understand and solve problems.

Unit I

Calculus: Curvature and radius of curvature in Cartesian and polar form - Evolutes - Involute - Pedal equations integration - Multiple integrals - Evaluation of double integrals - Changing the order of integration - Double integrals in polar coordinates.

Unit II

Integration - Application of double integral in evaluating area between curves - Evaluation of triple integrals - Jacobian of two and three variables - Beta and gamma functions - Relation - Evaluation of double and triple integrals using Beta and gamma functions.

Unit III

Differential equation of the form $(aD^2 + bD + C)y = e^{ax}\theta(x)$ where a, b, c are constants, $\theta(x) = \sin mx$ or $\cos mx$ or x^m . Solution of homogeneous linear differential equation's of the form $(ax^2D^2 + bxD + C)y = x$ where x is a function of x - variation of parameters.

Unit IV

Formation of partial differential equations by eliminating arbitrary constants and arbitrary function - Solutions of standard types of first order equations - $f(p,q)=0$; $f(x,p,q)=0$, $f(y,p,q) = 0$, $f(z,p,q) = 0$; $z = px+qy + f(p,q)$ - Charpits's method (Problem only). Lagrange method of solving linear partial differential equation $P_p + Q_q = R$.

Unit V

Fourier Series - Definition - Finding Fourier co-efficients for a given periodic function with period 2π . Odd and Even Functions - Half Range Series - Change of Interval.

Books for Reference:

1. S. Narayanan & T.K.Manicavachagam Pillay - Treatment as in Ancillary Mathematics, S.Viswanathan - Printers and Publishers Private Limited.
2. P. Kandasamy and K. Thilagavathi – Allied Mathematics – Volume II – 2004, S.Chand and Co., New Delhi.

ALLIED MATHEMATICS I (For B.Sc. Physics Major)

Objectives:

- ✧ To acquaint the students with the tools in Mathematics to understand and solve problems.

Unit I

Theory of equations - Roots of an equation - Relation between roots and coefficients - Transformation of Equations - increasing and decreasing the roots of an equation - Reciprocal Equations - Horner's method - Newton's method of finding roots.

Unit II

Integration - Multiple integrals - Evaluation of double integrals - Changing the order of integration; Double integrals in Polar co-ordinates - Application of double integral in evaluating area between curves - Evaluation of triple integrals - Jacobians of two and three variables. Beta and gamma functions - Relation (statement only) and simple problems. Evaluation of double and triple integrals using Beta and Gamma functions.

Unit III

Trigonometry - Expansion of $\cos n\theta$, $\sin n\theta$ - Expressions of $\sin \theta$, $\cos \theta$, $\tan \theta$ in powers of θ - Hyperbolic functions - Inverse of Hyperbolic function - Real and Imaginary parts of $\sin(\alpha + i\beta)$, $\cos(\alpha + i\beta)$, $\tan(\alpha + i\beta)$, $\tan^{-1}(\alpha + i\beta)$

Unit IV

Matrices: Eigen values and Eigen vectors - Cayley Hamilton Theorem - Verification - Using this theorem to find the inverse of a matrix.

Unit V

Laplace transformation: Definition - Laplace transform of e^{at} , $\cos at$, $\sin at$, $\cos hat$, $\sin hat$, t^n , n -a positive integer - $e^{at} f(t)$, $t^n f(t)$, $f'(t)$, $f''(t)$, $f^{(n)}(t)$ - Inverse Laplace transform - Solving differential Equation of second order with constant coefficient using Laplace transform solving simultaneous equations, using Laplace transform.

Books for Reference:

1. S. Narayanan and T.K. Manicavachagam Pillay, Allied Mathematics Vol. I & II, S.Viswanathan Printers and Publishers Pvt. Ltd.
2. P.Kandasamy & K. Thilagavthy, Allied Mathematics Vol. I and II – (2004) S.Chand & Company.

ALLIED MATHEMATICS II (For B.Sc., Physics Major)

Objectives:

- ✧ To acquaint the students become familiar with tools in Mathematics to understand problems.

Unit I

Vector Calculus - Scalar and Vector point functions. Differentiation of Vectors, Differential operators, Directional Derivative, Gradient, Divergence and Curl.

Unit II

Integration of Vectors, line, surface and volume integrals. Theorems of Gauss, Green, Stokes (Statements only) - Verification.

Unit III

Differential Equation of the form $(aD^2 + bD + C)y = e^{ax}\theta(x)$ where a,b,c are constants, $\theta(x) = \text{Sin } mx, \text{ Cos } mx$ or x^m . Solution of homogeneous linear differential equations of the form $(ax^2D^2 + bxD + c)y = X$ where X is a function of x.

Unit IV

Formation of partial differential equations by eliminating arbitrary constants and arbitrary function - Solutions of standard types of first order equations - $f(p,q) = 0; f(x,p,q) = 0, f(y, p,q) = 0, f(z, p, q) = 0; f_1(x,p) = f_2(y,q); z = px + qy + f(p,q)$ - Charpit method - Problem only; Lagranges method of solving linear partial differential equation $P_p + Q_q = R$.

Unit V

Fourier Series - Definition - Finding Fourier Coefficients for a given periodic function with period odd and Even function's - Half Range Series .

Books for Reference:

1. S. Narayanan and T.K. Manicavachagam Pillay, Ancillary Mathematics, S. Viswanathan - Printers & Publishers - Private Limited.
2. P. Kandasamy and K. Thilagavathi – Allied Mathematics Volume I and Volume II – 2004, S.Chand & Co.,

ALLIED MATHEMATICS I
(For B.Sc., Computer Science and BCA)

Objectives:

- ✧ To make the students become familiar with the tools in Mathematics to solve problems in different related fields.

Unit I

Theory of equations - Roots of an equation - Relation between roots and coefficients - Transformation of Equations - Increasing and decreasing the roots of an equation - Reciprocal equation - Horner's method - Newtons method of finding roots.

Unit II

Matrices: Characteristic roots and characteristic vectors - Properties (Statements only) Cayley Hamilton theorem (Statement only) verification - To find the inverse using the above theorem - Diagonalization of a matrix and using it to find the powers of a matrix.

Unit III

Trigonometry - Expansions of $\cos n\theta$, $\sin n\theta$ - Expressions of $\cos\theta$, $\sin\theta$, $\tan\theta$, $\cot\theta$ in powers of θ - hyperbolic functions - Inverse hyperbolic function - Real and imaginary parts of $\sin(\alpha + i\beta)$, $\cos(\alpha + i\beta)$, $\tan(\alpha + i\beta)$, $\tan^{-1}(\alpha + i\beta)$

Unit IV

Multiple integrals - Application of double integral - Integral in evaluating area between curves - Evaluation of triple integrals - Jacobian of two and three variables - Beta and Gamma functions - Relation - Evaluation of double and triple integrals using Beta and Gamma functions.

Unit V

Fourier series - Definition - Finding fourier coefficients for a given periodic function with period 2π - odd and even function - Half range series.

Books for Reference:

1. P. Kandasamy and K. Thilagavathi, Allied Mathematics Volume I and Volume II – 2004, S.Chand and Co., New Delhi.
2. S. Narayanan and T.K. Manickavasgam Pillai - Ancillary Mathematics, S.Viswanathan Printers, 1986, Chennai.

ALLIED MATHEMATICS II
(For B.Sc., Computer Science and BCA)

Objectives:

- ◇ To acquaint the students with the tools in Mathematics to understand and solve problems in related fields.

Unit I

Differential equation of the form $(aD^2+bD+C) y = e^{ax} \theta(x)$ where a, b, c are constants, $\theta(x) = \sin mx$ (or) $\cos mx$ (or) x^m . Solution of homogeneous linear differential equations of the form $(ax^2D^2+bxD+C) y = X$, where x is a function of x - variation of parameters.

Unit II

Formation of Partial differential equations by eliminating arbitrary constants and arbitrary function - Solutions of standard types of first order equations - $f(p,q) = 0$; $p(x,p,q) = 0$, $f(y,p,q) = 0$, $f(z,p,q) = 0$, $z = px+qy+f(p,q)$ - Charpit's method (Problem Only) Lagrange method of solving linear partial differential equation P_p+Q_q+R .

Unit III

Vector Calculus - Scalar and Vector point function, Differentiation of Vectors, Differential operators, Directional Derivative, gradient, Divergence and curl.

Unit IV

Integration of Vectors: Line, Surface and Volume Integrals. Theorems of Gauss, Green, Stokes theorems (Statement Only) Verification.

Unit V

Laplace transformation: Definition - Laplace Transform of e^{at} , $\cos at$, $\sin at$, $\cos h at$, $\sin h at$ t^n , n -a Positive integer - $e^{at} f(t)$, $t^n f(t)$, $f'(t)$, $f''(t)$, $f^{(n)}(t)$ - Inverse Laplace Transform - Solving differential equation of second order with constant coefficients using Laplace Transform - Solving simultaneous equations using Laplace Transform.

Books for Reference:

1. S. Narayanan and T.K.Manicavachagam Pillai - Allied Mathematics Vol. I & II, S. Viswanathan Printers and Publishers Pvt.
2. P. Kandasamy and K. Thilagavathy - Allied Mathematics Vol I & II, 2004, S.Chand & Company.

ALLIED BUSINESS MATHEMATICS
(For Commerce and Management Students)

Objectives:

- ✧ To expose a few elementary tools in mathematics to solve problems related to business and to introduce the concept of optimization techniques.

Unit I Matrices:

Rank – Solution of simultaneous linear equations – Cramer's rule – Matrix inverse and augmented matrix methods – Input and output analysis.

Unit II

Arithmetic and geometric series – Simple problems, Calculus: Variables, constants and function – Limits – Differentiation of standard functions from first principles – First and second order derivatives – Maxima and Minima – Application to Business problems.

Unit III

Elementary integral calculus – Determining indefinite and definite integrals using definition – Intergration by parts – Partial fraction method – Applications C, Trigonometric functions not included).

Unit IV

Linear programming problem: Formulation – Solution by graphical method – Simplex method.

Unit V

Transportation problem: Balanced and unbalanced problems – Travelling salesman problem – Assignment problem.

Books for Reference:

1. P.A. Navaneetham, Business Mathematics and Statistics for B.Com., BBM, Jai Publishing house Trichy.
2. Kanthi Swarup, P.K.Gupta and Manmohan – Operations Research, S.Chand and Company, 2006 New Delhi.
3. Sundaresan and Jayaseelan – An introduction to Business Mathematics, S.Chand and Company, New Delhi.

**ALLIED STATISTICS FOR BUSINESS
(For Commerce and Management Students)**

Objectives:

- ✧ To expose the statistical tools in business in order to understand data and arrive at possible inferences relating to population under study.

Unit I

Meaning and Scope of Statistics – Sources of Data – Collection of Data: Primary and Secondary – Methods of Data Collection – Editing Secondary Data – Classification and Tabulation – Presentation of Data by Diagram – Graphic Representation – Frequency Distribution.

Unit II

Averages: Simple and Weighted Mean, Median, Mode, Geometric Mean and Harmonic Mean – Properties and uses – Measures of Dispersion: Range, Quartile Deviation, Standard Deviation and Co-efficient of Variation.

Unit III

Skewness: Meaning – Bowley's and Pearson's Co-efficient of Skewness – Correlation: Meaning and definition – Scatter diagram – Pearson's coefficient of Correlation – Rank Correlation – Regression: Meaning and linear prediction – Difference between correlation and Regression – Regression in 2 variables – Uses.

Unit IV

Interpolation: Newton, Lagrange and Binomial methods – Index numbers: meaning, uses, methods of construction: Aggregative and relative types – Tests of an index number – Cost of living index.

Unit V

Time Series: meaning, components – Methods of estimating trend – Graphic, semi average, moving average, least square method – Seasonal variation: methods – Sampling methods – Sampling and non-sampling errors.

Books for Reference:

1. S.P. Gupta – Statistical Methods, Sultan Chand and Sons Publishers, New Delhi.
2. P.A. Navanitham – Business Mathematics and Business Statistics, Jai Publishers, Trichy – 21.