# NATIONAL COUNCIL FOR HIGHER EDUCATION

## Minimum Standards for courses of study in Mathematics and Economics

*2005*

## Core Mathematics Programmes

**Teaching and Assessment Pattern**

The following were agreed upon:

**Duration of Courses**

The contents of the courses will be covered in one 15-week academic semester with three[1] hours of instruction per week and weekly one-hour problem sessions to go over the assignments or homework or tests.

**Mode of Instruction**

- Most of the instruction will be lecture-oriented, but students can still interrupt the instructor and ask some questions
- Students are encouraged to seek help outside the Lecture Room from fellow students, the course instructor, other mathematics instructors or the web/internet.
- There will be fortnightly assignments.
- There will be at least two major homework assignments and two tests.

**Assessment Pattern**

The following instruments will be used to assess the extent of growth in skills, abilities and understanding acquired:

| **Requirements** | **No. of units** | **Contribution** |
|---|---|---|
| Homework | (3) | 10% |
| Research Assignment | (2) | 20% |
| Tests | (2) | 20% |
| Final examination | (1) | 50% |
| **Total** | | **100%** |

[1] Some courses could, however, be covered in less than 15 weeks or 2 hours per week spread over the semester.

All scores will then be converted to letter grades using the system shown below:

| Marks % | Letter Grade | Grade Point |
|---|---|---|
| 80 - 100 | A | 4.4-5.0 |
| 70 - 79 | B+ | 4.0-4.3 |
| 60 - 69 | B | 3.0-3.9 |
| 50 - 59 | C | 2.0-2.9 |
| 0 - 49 | D | 0 -1.9 |

**Responsibility of the Student**

Regular attendance; do all assignments, homework, and tests

**Responsibility of the Course Lecturer**

- Regular and punctual teaching;
- Accurate and prompt grading of assignments, homework, tests and examinations and
- Available to assist students after formal lectures.

**Programme Content**

The following were the suggested core courses:

1. Calculus 1
2. Calculus II
3. Elements of probability and Statistics
4. Linear Algebra
5. Differential Equations I
6. Differential Equations II
7. Numerical Analysis I
8. Real Analysis
9. Linear Programming
10. Abstract Variable
11. Complex Variables I

The following were the suggested Electives:

1. Calculus III
2. Graph Theory
3. Number Theory
4. History of Mathematics
5. Classical Mechanics
6. Discrete Mathematics
7. Graph Theory
8. Statistical inference

**Suggested Core Courses for the Mathematics Programmes**

**Calculus I**

**1. Course Name:** Calculus I

**2. Course Code:**

**3. Course Description**

This is an introductory course that is divided into the following six major topics:

- Functions
- Limits
- Differentiation
- Applications of differentiation
- Integration
- Applications of the definite integral

The content of the course is selected in such way that it assumes no prior knowledge of the subject by the student.

**4. Course Objectives**

This course is intended

- To impart basic competence in the concepts, principles, procedures and applications of calculus
- To encourage orderliness, speed and accuracy in the presentation of mathematics
- To assist students to express themselves in proper mathematical language and using mathematical symbols correctly
- To help students apply their knowledge of calculus to find solutions to real–life problems.

**5. Course Outline**

**Review of Functions and Graphs**

**Limits**

The concept of the Limit, Computation of Limits, Continuity and its consequences, Limits involving infinity, Formal definition of the Limit and Applications.

**Differentiation**

Tangent Lines and Velocity, the Derivative, Computation of Derivatives: The Power Rule, the Product and Quotient Rules, Derivatives of Trigonometric Functions, Derivatives of Exponential and Logarithmic Functions, The Chain Rule, Implicit Differentiation, The Mean Value Theorem, Rolles' Theorem.

**Applications of Differentiation**

Linear Approximation and Newton's method, Maximum and Minimum Values, Increasing and Decreasing Functions, Concavity, Overview of Curve Sketching, Optimization, Rates of Change and Applications.

**Integration**

Anti-derivatives, Riemann Sums and Sigma Notation, Area, The Definite Integral, The Fundamental Theorem of Calculus, Techniques of Integration.

**Applications of the Definite Integral**

Area between Curves, Volume, Disc**,** Shell**,** Arc Length and Surface Area,

**Introduction** **(3 Hrs)**

- Functions of one variable (domain and range)
- Roots, quadratic formula, factor/remainder theorems and synthetic division
- Linear equations: general form, slope-intercept, formulating equation, parallel/perpendicular, distance and mid-point
- Trigonometric Functions
- Simplification of algebraic fractions
- Composite functions
- Absolute value functions

Limits and their properties (3Hrs)

- Introduction
- Techniques for evaluating limits
- Continuity and one-sided limits

**Basic Differentiation** **(3Hrs)**

- Definition
- Proof of differentiability
- Distinguish between continuous and differentiable
- Differentiation: Polynomials, constant functions, and sine/cosine functions

**Differentiation Extended** **(6Hrs)**

- Product Rule
- Quotient Rule
- Chain Rule
- Trigonometric Functions
- Implicit

**Application of Differentiation** **(6 Hrs)**

- Related Rates
- Curve Sketching
  - Extrema on an interval
  - Mean Value Theorem
  - Increasing/decreasing functions and 1st Derivative Test
  - Concavity and 2rd Derivative Test (points of inflection)
  - Limits at Infinity: horizontal asymptotes, oblique asymptotes and vertical asymptotes
- Optimisation (applied minimization/maximization problems: sum, distance, area and volume)

**Integration** **(3Hrs)**

- Antiderivatives and indefinite integration
- Integration by substitution ⇒ change of variable
- Area, Remain Sums and the Definite Integral
- The Fundamental Theorem of Calculus

**Inverse Functions (differentiation/integration)** **(3 Hrs)**

- Exponential ($f(x) = e^u$)
- Logarithmic
- Exponential ($f(x) = a^u$)

- Inverse Trigonometric (arcsin, arctan, arcsec)

**Application of Integration (6 Hrs)**

- Area of a region between two curves (points of intersection, sketch, and representative)
- Volume: Disc/Washer Method
- Volume: Shell Method
- Arc Length and Surfaces of Revolution

**Integration Techniques (6 Hrs)**

- Review of elementary integration formulae and techniques
- Integration by parts $\int u\,dv - \int v\,du$
- Trigonometric Integrals
- Trigonometric Substitution
- Partial fractions

## 6. Reading List

The reading list will include but not limited to the following texts.

Text: recommended by the course lecturer

Notes prepared by the lecturer

Edwards, C.H. Jr. and Penney, David E. *Calculus with Analytical Geometry*, 4th Edition, Englewood Cliffs: Prentice Hall Inc., 1994.

Larson, Roland E., Hostetler, Robert P., and Edwards, Bruce H. *Calculus with Analytical Geometry*, Alt.5th Ed., and Lexington: D.C. Heath and Company, 1994.

Howard Anton, Calculus. A New Horizon, John Wiley & Sons, 1999

D. D. Berkey and P. Blanchard, Calculus, Saunders College Publishing, 1992.

## Calculus II

**1. Course Name:** Calculus II

**2. Course Code:** (This is a level 2 course – extension of Calculus I)

**3. Course Description**

This is an introductory course to Calculus that is divided into the following eight major topics:

- Conics and Polar Equations
- Parametric Curves
- Vectors in the Plane and Space
- Lines and Planes in Space
- Motion and Vector – Valued Function
- Partial Differentiation
- Multiple Integrals
- Vector Analysis

The content of the course is selected in such way that it is a continuation of differentiation and integration taught in Calculus I.

**4. Course Objectives**

This course is intended

- To impart basic competence in the concepts, principles, procedures and applications of calculus
- To encourage orderliness, speed and accuracy in the presentation of mathematics
- To assist students to express themselves in proper mathematical language and using mathematical symbols correctly
- To help students apply their knowledge of calculus to find solutions to real–life problems.

**5. Course Description**

**Analytical Geometry**

The four conics (parabola, ellipse, circle and hyperbola) and their equivalent representation as polar equations.

**Parametric Curves and Vectors in a Plane/Space**

Parametric Curve used to find: area, volume, arc length and area of surface of revolution for smooth parametric curves. The arithmetic of vectors and their use in finding area, volume and angles.

**Lines and Planes in Space**

Determine the equation of a line, a plane and the angle between lines and planes.

**Motion and Vector – Valued Functions**

Define and use position vector, velocity vector and acceleration vector. Fine the derivatives/integrals of vector – valued function. Discuss curature of plane curve and curves in space. Determine: arc length of curves, unit tangent vector, curvature, principal unit normal vector normal/tangential components of acceleration.

**Partial Differentiation**

All the main ingredients of single – valued differential calculus (limits, derivatives and rates of change, chain rule computations, and max/min techniques) can be generalized to functions of two or more variables. Determining the gradient at a point on a surface in any direction. Finding the extreme of functions of variables.

**Application of the Definite Multiple Integrals (Double and Triple)**

Area between Curves, Volume, Arc Length and surface Area.

Given the density functions of a solid: mass, centroid and moments of inertia.

**Vector Analysis**

Application of vector fields, line integrals, independence of path, Fundamental Theorem of Line Integrals Green's Theorem and its corollary, surface and integrals, Divergence Theorem, outward normal vectors to a surface, and Stoke's Theorem (giving the relationship between a surface integral over an oriented surface S, and a line integral over a closed space curve C forming the boundary of S )

**6. Suggested Teaching Program**

**Assignment 1**

**Conic Section, Polar Coordinates and Surfaces (Chap 10 and 13.6)**

**(6Hrs)**

- Define and determine loci of points
- Define and sketch each of the conic sections (circle, parabola, ellipse and hyperbola)
- Define polar coordinates
- Convert from rectangular coordinates/equations to polar coordinates/equations
- Given an equation of a surface in space to be able to write in standard form, name, give axis and traces.

**Parametric Curve (Chap. 12: 1-2)** **TEST 1**

**Assignment 2**

**(3Hrs)**

- Define parametric curve
- Use polar curve as parametric curves
- Determine tangent line to parametric curves
- Find area, volume arc length and area of surface of revolution for smooth parametric curves.

**Vectors in the Plane and Space (12:3, 13: 1-2)**

**Assignment 3**

Define vectors, position vector, equality of, addition of, multiplication by a secular, unit vector, length

- Define dot product and its interpretation
- Test for perpendicular vectors
- Determine direction angles
- Define and use vector products, scalar triple products (area, volume, angles)

**Lines and Planes in Space (Chap 13:3)**

**Assignment 4**

**(3Hrs)**

- Write parametric and symmetric equations of straight lines space
- Write the equation of a plane
- Find the angle between planes

**Motion and Vector – Valued functions (Chap 12:4, 13:4-5)**

**Assignment 5**

- Define position vector=r(t); velocity vector=v(t)=r'(t); and acceleration vector=a(t)=r''(t)
- Find the derivatives and integrals of vector-valued functions in 2- and 3-dimensions.
- Discuss curvature of plane curves, and curves in space
- Determine: arc length of curves, unit tangent vector, curvature, principal unit normal unit vector, normal vector, normal and tangential components of acceleration.

**Partial Differentiation (Chap 14) Test 2, Assignment 6 (9 Hrs)**

(All the main ingredients of single-valued differential calculus {limits, derivatives, rates of change, chain rule computations and max/min techniques} can be generalized to functions to two or more variables).

- Determine partial derivatives in general at a point and tangent planes to a surface
- Find the maxima and minima of functions of several variables in general and over a closed region
- Determine incrementals and differentials
- Use the chain rule for the derivative of functions of functions
- Define and use implicit partial differentiation
- Determine directional derivatives and the gradient at points on a surface in any given direction
- Determine the relative extrema of functions of two variables.

**Multiple integrals (Chap 15) Assignment 7 (6 Hrs)**

1. Double Integrals (15:1-2)

- Determine double integrals over a rectangle
- Determine double integrals over more generalized region
- Sketch the region given a double integral and then reverse the limits of integration

2. Area and Volume (15:3)

- Use double integrals to find the area between two curves
- Use double integrals to find the volume below a surface and above a specified bounded region and surface area

3. Triple Integral (15:6)

- Find the volume of a solid, or volume between two surfaces
- Find the mass given the density function of a solid
- Find the coordinates of a masses centroid
- Find the moments of inertia about the 3 coordinate axes
- Use of cylindrical and spherical where appropriate

**Test 3**

**Vector Analysis (Chap 16) Assignment 8**

**(12 Hrs)**

1. Vector Field (16:1)

- Study functions that assign a vector to a point in the plane or a point in space
- Sketch the force field with representative vector
- Determine whether a vector field is conservative
- Determine the divergence of a vector field

2. Line Integrals (16:2)

- Determine the length of a curve in the plane or space
- Determine the line integral of a vector field

3. Independence of Path (16:3)

- Show that the line integral is independent of path if the vector field is conservative
- Determine and use the Fundamental Theorem of Line Integrals

4. Green's Theorem in a Plane (16:4)

- Use Green's Theorem to evaluate line integrals
- Use the corollary to Green's Theorem to evaluate area of a region bounded by piecewise closed curve

5. Surface Integrals (16:5)

- Sketch and determine the surfaces of a solid
- Determine the surface area of a solid using its projections

6. The Divergence Theorem (16:6)

- Discuss the extension of Green's Theorem to three-dimensions
- Use and verify the Divergence Theorem given solids and a force field

- Find outward normal vectors to a surface

7. Stokes Theorem (16:7)
   - Illustrate the a Theorem as an analogue of Green's Theorem
   - Show that the line integral over a closed space is equal to the surface integral over an oriented surface

**6. Reading List**

The reading list will include but not limited to the following texts.

Text: recommended by the course lecturer

Notes prepared by the lecturer

Edwards, C.H. Jr. and Penney, David E. *Calculus with Analytical Geometry*, 4th Edition, Englewood Cliffs: Prentice Hall Inc., 1994.

Larson, Roland E., Hostetler, Robert P., and Edwards, Bruce H. *Calculus with Analytical Geometry*, Alt.5th Ed., Lexington: D.C. Heath and Company, 1994.

Any other relevant textbooks, website and resources in the library or else where.

**Elements of Probability and Statistics**

**1. Course Name:** Elements of Probability and Statistics

**2. Course Code:** (this is a level 1 course)

**3. Course Description**

Probability is measured in the scale from 0(=impossible) to 1(=certainty). If two events are equally likely to occur, the probability assigned to each event is 0.5. Statistics on the hand has no single definition. Statistical techniques provide descriptive procedures for classifying and converting a mass of quantitative data into a comprehensible form. Statistics also provides inductive techniques for using principles of mathematical probability to obtain generalizations from sample data that may be applied to the lager population. Probability and statistics have wide application in virtually all aspects of human endeavour such as industrial processes, telecommunication, aviation industry, commerce, politics, environment, health and demography just to cite a few examples.

**4. Course Objectives**

The purpose of this course is to introduce students at an early stage in a university program to many of the important concepts and procedures they are likely to need in order to:

- Improve their ability to make better decisions over a wide range of topics
- Improve their ability to measure and cope with changing conditions both at home and on the job
- Explain statistical procedures and interpret the resulting conclusions
- Help students apply their knowledge of statistics to find solutions to real life problems.

**6. Detailed Course Curriculum**

**1 Descriptive Statistics (3Hrs)**

Definition: data, statistics, elements, variables etc.

Data representing tabular and graphical i.e bar graph, pie chart, frequency distribution, relative frequency, histogram, cumulative distribution, ogive – explanatory data analysis: stem and leaf plot measures of location: mean media mode, percentiles quartiles.

**2. Introduction to Probability (6Hrs)**

- Experiment, sample space and counting rule

- Events and their probabilities
- Relationship of probability: component, addition law
- Conditional probability: independent events, multiplication law

**3. Probability Distributions (6Hrs)**

- Random variables
- Discrete probability distribution binominal, poisson
- Expected value, variance, permutation and combinations
- Continuous probability distributions
- Uniform probability, Normal probability distribution

**4. Estimation and Sampling Theory Distribution (6Hrs)**

- Definitions: population, sample
- Simple random sampling: finite and infinite populations
- Point estimation
- Interval estimation: population mean

**5. Hypothesis Tests (9 Hrs)**

- Development of null and alternative hypothesis
- Type I and II errors
- One tailed test about a population mean
- Two tailed test about population mean
- Hypothesis testing and decision making

**6. Regression and Correlation (9 Hrs)**

- Scatter plots
- Regression line and regression equation
- Correlation: Spearman's rank of correlation
- Kendal's rank of correlation

**7. Reading List**

The reading list will include but not limited to the following texts

Wapole, R.E, and Myers, R.H, (1989). Probability and Statistics for Engineers and Scientists. Macmillan

Fruend ,J.E (1992). Mathematical Statistics. Prentice Hall

Text recommended by the course lecturer

Notes prepared by the lecturer

Any other relevant textbooks, website and resources in the library or else where

## Linear Algebra

**1. Course Name:** Linear Algebra

**2. Course Code:**

**3. Course Description**

Linear Algebra is an essential part of the mathematical background required of mathematicians, economists, engineers, physicists and other scientists.

- Systems of Linear Equations and Matrices
- Determinants
- Vector Spaces
- Linear Transformations
- Orthogonality

4. **Course Objectives**

By the end of this course, students should be able to

- find solutions to systems of linear equations using a number of methods
- explain the concept of vector spaces and their properties
- translate appropriate real-life problems into a suitable form to be solved using the knowledge of linear systems, vector spaces, linear transformations, etc.

**5. Detailed Course Outline**

**Matrices and systems of equations** ***(6 Hrs)***

- Systems of Linear Equations
- Row Echelon Form
- Matrix Algebra
- Elementary Matrices
- Partitioned Matrices

**Assign 1**

**Determinants** ***(3Hrs)***

The Determinant of a Matrix

- Properties of Determinants
- Cramer's Rule

Assign 2

**Test 1**

***Vector spaces***

***(9 Hrs)***

- Definition and Examples
- Subspaces
- Linear Independence
- Basis and Dimension
- Change of Basis
- Row Space and Column Space

Assign 3

**Linear transformations** **(6Hrs)**

- Definition and Examples
- Matrix Representations of Linear Transformations
- Similarity **Assign 4**

**Test 2**

**Orthogonality**

***(9Hrs)***

- The Scalar Product in Rn
- Orthogonal Subspaces
- Inner Product Spaces
- Least Squares Problems
- Orthonormal Sets
- The Gram-Schmidt Orthogonalisation Process **Assign 5**

**Eigen Values** ***(6Hr)***

- Eigenvalues and Eigenvectors
- Systems of Linear Differential Equations
- Diagonalisation **Assign 6**

### *6. Suggested Reading List*

The reading list will include but not limited to the following texts.

Lipschutz, S. (1968), Theory and Problems of Linear Algebra: Schaum's Outline Series, McGraw Hill Company, New York, London, Toronto.

Anton, H. and Rorres, C. (1987), Elementary Linear Algebra with Applications, John Wiley & Sons, Inc., New York, Singapore, Toronto.

Georgi E. Shilov (1977), Linear Algebra, …

Steven J. Leon, (1998), Linear Algebra with Applications, …

**Differential Equations 1**

1. **Course Name:** Differential Equations 1

2. **Course Code:**

3. **Course Description**

Pre-requisite: Calculus I

This is an introductory course to ordinary differential equations including related topics.

It is divided into the following 5 major topics:

- First Order Differential Equations
- Second Order Differential Equations
- Higher Order Differential Equations
- Power series & its Applications
- Introduction to Systems of Linear Differential Equations

The content of the course is selected in such way that it assumes no prior knowledge of the subject by the student.

4. **Course Objectives**

This course is intended to enable students;

- Engage in logical and critical thinking
- Acquire a proficiency in the topics covered in the course
- Translate written languages into mathematical statements, interpret information, analyze given information and formulate appropriate mathematical statements.

5. **Detailed Course Curriculum**

**First Order Differential Equations & their Applications (9Hrs)** Classification of DE; exact, separable, Homogeneous

Linear & Non linear differential equations

Integrating factors.

Examples include; physical process,

Chemical process like radioactive process and Biological process

**Second Order Differential Equations & their Applications (9 Hrs)**

Real roots, Complex roots, Uniqueness and Existence Theorem.

Undetermined Coefficients; Difference Equations.

**Higher Order Differential Equations (9Hrs)**

Constant coefficients, Method of under determinant co-efficiency,

Variation of parameters. Linear independence and the wronskian method of order reduction

**Power series & its applications (9 Hrs)**

Power series solutions of first and Second order equations.

Linear equations of nth order.

**Introduction to Systems of Differential Equations; (9Hrs)**

Theory of Systems of differential Equations.

Homogeneous systems of differential equations.

Application to Eigen Values

## 6. Suggested Reading List

The reading list will include but not limited to the following texts.

Richard. K. Miller (1991). Introduction to Differential Equations 2nd Edition, Prentice Hall New Jersey USA

Martin Braun (1993). Differential Equations and their applications 4th Edition Verlay New York

**Differential Equations 2**

1. **Course Name:** Differential Equations 2

2. **Course Code:**

3. **Course Description**

**Pre-requisite: Differential Equations 1**

This course is an extension of the first course in Ordinary Differential Equations to Partial Differential Equations:

It is divided into the following 5 major topics:

- Power series & Lap lace Transform
- First Order Partial Differential Equations
- Second Order Partial Differential Equations
- Application of Partial Differential Equations
- Boundary Value Problems

The content of the course is selected in such way that it assumes no prior knowledge of the subject by the student.

4. **Course Objectives**

This course is intended to enable students;

- Identify methods for finding particular solutions to PDEs that are needed in physical applications.
- Choose the right initial conditions and boundary conditions required to obtain a particular solution to a PDE.

5. **Detailed Course Curriculum**

**Introduction (1 week)**

- Definitions
- Remarks on PDEs.
- Classification of PDEs.

**Power series & Lap lace Transform; (6Hrs)**

- Fourier Series & Applications
- Orthogonal polynomials
- Lap lace transform and application to solving differential equations.

**First Order Partial Differential Equations; (9 Hrs)**

- Characteristic/ Auxiliary equations
- Boundary conditions and Formation of PDE.
- Non-linear first order PDEs
- Separation of variables

**Second Order Partial Differential Equations; (9 Hrs)**

- Characteristic Equations
- Constant coefficients
- Boundary conditions
- Separation of variables
- Hyperbolic, Parabolic, and Elliptic Equations.

**Application of Partial Differential Equations; (9 Hrs)**

- Wave Equation
- Heat/Diffusion equation.
- Lap lace equation

**Boundary Value Problems; (3 weeks)**

- Solutions by Fourier Series
- Solutions by Bessel/Legendary functions

**6. Reading List**

The reading list will include but not limited to the following texts.

Richard. K. Miller (1991). Introduction to Differential Equations $2^{nd}$ Edition, Prentice Hall New Jersey USA

Nagle,R. Kent. Staff. Fundamentals of D.E and boundary value problems

Lawrence. C. Evans. Partial Differential Equations

**Numerical Analysis I**

1. **Course Name:** Numerical Analysis I
2. **Course Code:**
3. **Course Description**

This is an introductory course that is divided into seven major topics:

- Errors
- Solution of Nonlinear Equations
- Finite Difference Operations
- Polynomial Interpolation
- Numerical Differentiation
- Numerical Integration
- Solution of Systems of Linear Equations

4. **Course Objectives**

This course is intended:

- To impart basic competence in numerical methods of solving mathematical problems
- To enable students to determine the level of accuracy of numerical approximations
- To help students appreciate the complexity of numerical computations

5. **Course outline**

**Errors** **(3 Hrs)**

- Sources of errors
- Round-off errors
- Absolute errors
- Percentage errors

**Solution of Nonlinear Equations** **(9 Hrs)**

- Need for numerical solution
- Definition and location of root
- Methods of solution: Bisection method, Newton's method, Secant method, Method of False Position.
- Order of convergence of the iterative methods

**Finite Difference Operations** **(6 Hrs)**

- Definition and properties of Forward, Backward and Shift operators.
- Construction of Difference Tables
- Use of Difference Tables to detect/correct errors

**Polynomial Interpolation** **(6 Hrs)**

- Lagrange interpolating polynomial
- Finite difference interpolating polynomials: Newton forward difference formula, Newton backward-difference formula, Centered-difference formulas e.g. Stirling's formula.

**Numerical Differentiation** **(6 Hrs)**

- Forward/Backward-difference formula
- Derivatives from Lagrange's interpolating polynomials: Three-point formulas, Five-point formulas

**Numerical Integration** **(9 Hrs)**

- Newton-Cotes formulas
- Trapezoidal rule
- Simpson's rule
- Simpson's three-eights rule
- Composite trapezoidal rule
- Composite Simpson's rule

**Solution of Systems of Linear Equations** **(9Hrs)**

- Gaussian Elimination
- Triangular decomposition
- Jacobi iteration
- Gauss-Seidel iteration

## 6. Suggested reading List

Richard L. Burden, J. Dauglas Faires, Albert C. Reynolds (1981) Numerical Analysis, Weber & Schmidt, Boston Massachusetts

B.D. Gupta (1992) Numerical Analysis, New York, USA.

**Real Analysis I**

**1. Course Name:** Real Analysis I

**2. Course Code:**

**3. Course Description**

This is an introductory course that is divided into the following six major topics:

- Real Numbers
- Sequences of Real Numbers
- Limits and Continuity
- Differentiation
- Series of Real Numbers
- Sequence and Series of Functions

The content of the course is selected in such way that it assumes prior knowledge of an introductory course in calculus.

**4. Course Objectives**

This course is intended

- To impart basic competence in the concepts, principles, procedures and applications of real analysis
- To assist students to use mathematical language and mathematical symbols correctly in formulating abstract concepts
- To help students apply their knowledge of analysis to find solutions to real–life problems.

**5. Course Outline**

**Real Numbers**

- What is a real number?
- Absolute values, intervals, inequalities
- The Completeness Axiom
- Countable and Uncountable sets
- Real valued functions
- Subsets of R – open, closed, bounded

- Neighborhoods
- Limit points

**Sequences of Real Numbers**

- Convergent sequences
- Limit theorems
- Monotone sequences
- Cauchy sequences
- Subsequences

**Limits and Continuity**

- Formal definition of a limit
- Continuous functions
- Intermediate and extreme value theorems
- Uniform continuity
- Monotone functions and inverses

**Differentiation**

- The derivative of a function
- Mean value theorems
- L'Hospital's rule
- Derivatives of higher order
- Taylors's theorem

**Series of Real Numbers**

- Convergence of infinite sequences
- Convergence tests
- Absolute and conditional convergence
- Rearrangements and products
- Square summable sequences

**Sequence and Series of functions**

- Pointwise convergence
- Uniform convergence

- Uniform convergence and continuity
- Uniform convergence and integration
- Uniform convergence and differentiation
- Power series
- Differentiation and Integration of Power series
- Taylor and Maclaurin series

**6. Reading List**

The reading list will include but not limited to the following texts.


Main Text: recommended by the course lecturer

Notes prepared by the lecturer

Russell Gordon, Real Analysis: A First Course, Addison-Wesley, 2002

Manfred Stoll, Introduction to Real Analysis, Addison- Wesley, 2000

K. G. Binmore, Introduction to Mathematical Analysis, Cambridge University Press,

R. Haggarty, Fundamentals of Mathematical Analysis, Addison- Wesley, 1993

C. Clark, Elementary Mathematical Analysis, Wadsworth,

S. H. Nsubuga, Lecture Notes: Analysis I Handbook, 1995

Walter Rudin, Principles of Mathematical Analysis, McGraw-Hill, 1976.

F. Mary Hart, Guide to Analysis, Macmillan, 1988.

**Linear Programming**

**1. Course Name:** Linear Programming

**2. Course Code:**

**3. Course Description**

Linear Programming deals with the allocation limited resources to competing activities. This introductory course covers mathematical formulation of Linear Programming models, solving of the Linear Programming models, and Post Optimality Analysis. The content is divided into six major topics:

- Introduction
- The Algebra of Linear Programming Models
- The Simplex Method
- Starting Solution and Convergence
- Duality
- Post Optimality Analysis

**4. Course Objectives**

This course is intended

- To impart basic competence in formulating Linear Programming models
- To help students solve Linear Programming Problems
- To enable student to carry out Post Optimality Analysis

**5. Course Outline**

**Introduction** **(6 Hrs)**

- The Linear Programming (LP)
- Problem Linear Programming Modeling and Examples

**Geometric Solution** **(6 Hrs)**

- Solution Space
- Unique finite optimal solution
- Bounded region

- Unbounded region
- Basic and optimal solutions to an LP problem

**The Algebra of LP models** **(6 Hrs)**

- Convex Sets and convex functions
- Polyhedral sets
- Polyhedral cones
- Extreme points
- Connection between basic solutions and Extreme points

**The Simplex Method** **(9 Hrs)**

- Extreme Points and Optimality
- Basic Feasible Solutions
- The Simplex Method
- Derivation of conditions for existence and optimality of the solution
- The Simplex Method in Tableau format

**Starting Solution and Convergence** **(6 Hrs)**

- The Initial Basic Feasible Solution
- The Big-M Method
- Degeneracy, Cycling and Stalling

**Duality** **(6 Hrs)**

- Formulation of the Dual Problem
- Primal-Dual Relationships
- Economic Interpretation of the Dual
- The Dual Simplex Method
- The Primal-Dual Method

**Post Optimality Analysis** **(6 Hrs)**

Investigation of how changes in the objective function and the constraint sets of an LP problem would affect the current solution

- Changes in Objective Function
- Changes in Constraint Sets

- Changes in right hand side vector
- Addition of new constraint

**6. Suggested reading List**

The reading list may include

Mokhtar S. Bazaraa, John J. Davis, Hanif D. Sherali(1990) Linear Programming and Network Flows, John Wiley & Sons, New York, USA

Saul I. Gass (1985) Linear Programming, McGraw-Hill Inc, Singapore

**Abstract Algebra I**

**1. Course Name:** Abstract Algebra I

**2. Course Code:**

**3. Course Description**

This is an introductory course that is divided into the following major topics:

- The Basics of Sets and Logic
- Introduction to Group Theory
- Homomorphisms of Groups
- Introduction to the Classification of Finite Groups
- Introduction to Rings and Fields

The content of the course is selected in such way that it assumes no prior knowledge of the subject matter by the student.

**4. Course Objectives**

This course introduces the student to the basic ideas that form the foundations of modern abstract algebra. The key ideas in group theory, rings and fields are introduced, illustrated and applied to develop basic competencies in the concepts, principles, and applications of algebra.

This course seeks:

- To impart basic competence in the concepts, principles, procedures and applications of abstract algebra
- To train students to express themselves in abstract mathematical language and using mathematical symbols correctly

- To help students apply their knowledge of abstract algebra to find solutions to problems in mathematics and related subjects.

**5. Course Outline**

**The Basics of Sets and Logic**

Elementary, Set Theory; Sets, relations, equivalence relations, mappings. Logic Methods of Proof.

**Introduction to Group Theory**

Group Theory: binary operations, groups, order of a group and order of an element, Subgroups, Cyclic groups, lattice diagrams, Cosets, Lagrange's Theorem. Permutations: cycles, transpositions, even and odd permutations, symmetric and alternating groups, dihedral groups.

**Homomorphisms of Groups**

Normal subgroups and Homomorphisms: Conjugacy, Centralisers, Centre, Normalisers, normal subgroup, Homomorphisms, kernel, image.

Quotient groups: Fundamental Homomorphism Theorem, The isomorphism Theorems.

**Introduction to the Classification of Finite Groups**

Cauchy's Theorem. Sylow's Theorems. Fundamental Theorem of Finite Abelian Groups. Simple and solvable groups. Applications

**Introduction to Rings and Fields**

Rings with examples. Fields with examples. Integral Domains. Basic Theorems.
Applications in Number Theory e.g Fermat and Euler Theorems. Field of Quotients. Polynomial Rings. Factorization Theorems.

**6. Reading List**

The reading list will include but not limited to the following texts:
Main Text: recommended by the course lecturer
Notes prepared by the lecturer
M. A. Armstrong, Groups and Symmetry (Undergraduate Texts in Mathematics), Springer
J. B. Fraleigh, A First Course in Abstract Algebra, Addison-Wesley, 1988

J. A. Green, Sets and Groups, A First Course in Algebra, 1988

W. Lederman, Introduction to Group Theory, Longman Scientific & Technical, 1973

**Complex Variables I**

1. **Course Name:** Complex Variables I
2. **Course Code:**
3. **Course Description**

Complex Variables I is a course basically on complex variables and their properties. This is another useful and delightful field of mathematics. It is intended for prospective teachers of secondary mathematics and laboratory and non-physical scientists.

The course is divided into the following five major topics:

- Complex Numbers and their Geometrical Representation
  Point Sets, Sequences, and Mappings
  Single-Valued Analytic Functions of a Complex Variable
  Elementary Functions
  Integration

**4. Course Objectives**

This course is intended:

- To introduce to the students to yet another exciting field, of Complex Variables,
- To assist students develop the habit to express themselves in proper mathematical languages and in using mathematical
  symbols correctly,
- To provide a solid mathematical background for students majoring in Mathematics,
- To guide students in how to apply their knowledge of Complex Variables to find solutions to real-life problems.

**5. Detailed Schedule/ Course Outline**

**Complex Numbers and Their Geometrical Representation Series**

- Complex Numbers
- Subtraction and Division of Complex Numbers
- Conjugate and Absolute Value of a Complex Numbers
- Geometric Representation of Complex Numbers
- Polar Form of Complex Numbers

- Products and Quotients of Complex Numbers
- Powers and Roots of Complex Numbers
- The nth Root of Unity

**Points Sets, Sequences, and Mappings**

- Points Sets on the Real Line and in the Complex Plane
- Open, Closed, and Connected Sets
- Sequences
- Some Fundamental Properties of the Real and Complex
- Numbers System
- Compact Sets
- Algebraic Operation with Sequences
- Series of Complex Numbers
- Upper and Lower Limits
- Continuous Mappings
- Continuous Curves
- Sets of Points in k-dimensional Euclidean Space
- Stereographic Projection
- Stereographic Projection from the Point S(0,0,0)

**Single –Valued Analytic Functions of a Complex Variable**

- Functions of a Complex Variables
- Limits of Functions
- Continuity
- The Derivative of a Function
- The Cauchy-Riemann Condition
- The Laplace Partial Differential Equation
- Level Curves

**Elementary Functions**

- The Exponential Function
- The Trigonometric Functions
- The Logarithmic Function
- Multiple-Valued Functions

- The Inverse Trigonometric Functions
- The Elementary Operation and Elementary Functions

**Integration**

- Definition
- Contour Integration
- Variation of the Logarithm along the Contour
- The Winding Number
- Simple Closed Contours
- The Positive Direction along a Simple Closed Contour
- Simply Connected Domains
- Cauchy's Integral Theorem for the Interior of a Circle
- Integrals around Closed Contours in a General Domain
- The Cauchy Integral Theorems
- Indefinite Integrals
- The Cauchy Integral Formula
- Derivatives of Analytic Functions

***6. Suggested Reading List***

The reading list will include but not limited to the following texts.

Hamilton, Hugh J., (1989), A Primer of Complex Variables with and Introduction to Advanced Techniques, Brooks/ Cole
Publishing Company, Belmont, California.

Pennisi, Louis L., (1983), Elements of Complex Variables, , Holt, Rinehart and Winston, New York.

**Electives For The Mathematics Programme**

**Graph Theory**

1. **Course Name**: Graph Theory

2. **Course code:**

3. **Course Objectives:**

This course is intended

- To impart students with basic competence in graph theory
- To help students to solve graph theoretic problems
- To teach students the usability and importance of graphs

4. **Course Description**

This course deals with following major topics

- The Basics Of Graphs
- Paths
- Trees, Spanning Trees and connectivity
- Rooted Trees
- Planner Graphs and Graph colouring

**5. Detailed Course Outlines**

**The Basics: (9 Hrs)**

- Introduction to Graphs, multigraphs ,the koeinsberg bridges ,bipartite graphs
- Terminology; directed and undirected graphs, graph representation
- Matrices of graphs: incidence matrix, circuit matrix, adjacency matrix, cut matrices ,isomorphism

**Paths (9 Hrs)**

- walks, paths and circuits
- Euler paths and circuits, Eulerian graphs
- Hamiltonian paths and circuits, directed Hamiltonian graphs,
- Directed graphs; graphs and relations, directed trees,
- Shortest paths and transitive closure

**Trees ,Spanning Trees and connectivity (12 Hrs)**

- Introduction to trees, application of trees, trees traversal,
- Spanning trees; introduction, depth first search, breadth-first search, minimum cost spanning trees and forests, cuts sets and cuts, cycle basis,
- Connectivity, connectedness and components of a graph, operations on graphs, cut vertices and separable graphs, special graphs

**Rooted Trees (6 Hrs)**

- terminology
- properties
- The number of binary trees

**Planer Graphs, homomorphic graphs, colouring and chromatic number**

**(9 Hrs)**

Planar graphs; introduction, Euler's formula, Kuratowski's Theorem,
Graph coloring; introduction, the four color theorem,
the chromatic number application of graph coloring
matchings cliques and independent sets

**6. Suggested Readings**

Graph Theory F Hararay reading Massachusetts
concepts in Discrete Mathematics second edition Sartaj Sahni
Kenneth H. Rosen Discrete Mathematics and its applications
Fundamentals of computer algorithms, by E,Horowitz and s sahni, computer science press, Maryland

**Number Theory**

1. **Course Name**: Number Theory
2. **Course code:**
3. **Course Objectives:**

By the end of this course, students should be able to discover and prove;

Some of the simple rules regarding numbers.

- Solve real-life problems using rules from number theory, such as the Chinese remainder theorem.
- Apply the theory of numbers o9f games, that leads to finding pleasure out of mathematics.
- Appreciate the contribution of both mathematicians and amateurs towards the area of number theory.

**4. Course Description**

Number Theory deals with the properties of the series of natural numbers, one of the basic and most essential concepts of Mathematics. In this correct one finds that there exists many simple rules regarding numbers that are quite easy to discover and not too difficult to prove. Topics covered include: the natural numbers, divisors of a number, Fermat's Theorem, Congruence, Diophantine equations, etc.

**5. Detailed Contents**

**The factorization of integers**

- Divisibility
- Prime numbers
- The greatest common divisor
- Unique factorization
- Linear Diophantine Equation
- Perfect numbers
- Mersenne numbers and Fermat's numbers

**Congruences**

- Definition
- Reduced residue system
- Euler φ-function

- Congruences
- Chinese remainder theorem
- Congruences module a prime power

**Quadratic residues**

- Legendre symbol
- Quadratic Reciprocity
- Jacobi's Symbol
- The order of an integer
- Primitive roots

**Continued Fractions**

- Simple continued fractions

**6. Suggested Reading List**

Uspensky, J.V., and Heaslet, M.A., Elementary Number Theory. New York: Mc-Graw-Hill, 1989.

Hardy, G. H., and Wright, E. M., An Introduction to the Theory of Numbers. Third Edition, New York: Oxford University Press, 1974

Any other relevant material form the library, Internet, study notes by lecturer.

**History of Mathematics**

1**. Course Name**: History of Mathematics

2. **Course code:**

**3. Course Objectives**:

The course is intended

- To make the students familiar with the History of Mathematics in ancient cultures and pre –modern era
- To make the students familiar with the history of various fields in Mathematics
- To introduce the students with the names of great mathematicians of the world

**4. Course Description:**

This course is historical course without going into much details of Mathematical formulas.

We subdivide the course into four major topics

Regional mathematics

History of various fields in mathematics

List of mathematicians

Chronology

5. **Detailed Course Outlines**:

**Regional Mathematics** **(12Hrs)**

| | | |
|---|---|---|
| Babylonia | - | bibliography |
| Egypt | - | maps and bibliography |
| China | - | Timeline, chronology of Mathematics and mathematical works. |
| Greece | - | Chronology, maps and bibliography |
| Arab sphere | - | Chronology and bibliography |
| Japan | - | Chronology and bibliography |
| India | - | Chronology and bibliography |
| Europe | - | Chronology and bibliography |

**Subjects:** **(24 Hrs)**

- The history of numerals and counting
- The history of Algebra

- The history of Geometry
- The history of Arithmetic and Number theory
- The history of Mathematical Analysis
- The history of Probability and statistics

**Chronology: (9 Hrs)**

List of Mathematicians: 1700BCE, 700BCE,600BCE, 500BCE,400BCE, 300BCE,200BCE,100BCE, 1CE,100CE, 200CE,300CE, 400CE, 500CE, 600CE,700CE, 800ce, 900CE, 1000CE,110CE, 1200CE,1300CE, 1400CE, 1500cCE, 1600CE, 1700CE,1800CE,1900CE,1970CE.

**6. Suggested Reading:**

Cajori Floria A History of Mathematical Notations Two Volumes Chelsea New York

A History of Algebra, from Alkhwarzmi to Emmy Noether ,Springenverlag, Berlin New York 1988

Braumuhl, Anton Von, Verlesungen uber Gdt Two Volumes Leipzig 1900-1903

On the Web. Mathematical Archives, Index to Number Theory, Fermat's Last Theorem, History of Fermat's Last Theorem

Baron Margaret, E. The Origin Infinitesimal Calculus, Pergmamon Press Oxford-New York1969

**Probability Theory/Mathematical Statistics**

1. **Course Name:** Probability Theory /Mathematical Statistics
2. **Course Code:**
3. **Course Description**

**Pre-requisite: Element of probability and statistics**

This course continues and concretizes concepts pf probability including a more systematic treatment of the concepts using both mathematical and statistical methods.

It is divided into the following 4 major topics:

- Review of basic concepts of probability
- Probability & moment general functions
- Multi dimension random variables
- Distribution of functions of random variable

The content of the course is selected in such way that it assumes no prior knowledge of the subject by the student.

4. **Course Objectives**

This course is intended to enable students;

- Engage in logical problem solving
- Acquire a proficiency in the topics covered in the course

5. **Detailed Course Curriculum**

**Review of the basic concepts of probability theory (6 Hrs)**

- General Multiplicative rule, Boole's inequality & Bayes theorem
- Mathematical expectations; mean, variance & other moments.

**Probability and moment generating functions (12 Hrs)**

- Markov and Chebychev inequalities
- Derivation of common moments (third moment, fourth moment)
- Illustration of common distribution; Binomial, Bernoulli, Poisson, Normal, Geometric, Exponential, Weibull, Hyper geometric, gamma, and beta distributions.

**Multi dimensional random variable** **(15Hrs)**

- Bivariate & Trivariate random variables
- Joint marginal & Conditional distribution
- Independence of random variable
- Covariance & Correlation
- Conditional expectations, Variance.

**Distribution of functions of random variables** **(12 Hrs)**

- Using the definition of a distribution function.
- Change of variable technique.
- Jacobean technique.
- Limitations of the Jacobean methods.
- Mgf Technique
- Central limit theorem

## 6. Reading List

The reading list will include but not limited to the following texts.

Mathematical statistic by John E Freund

An Introduction to Mathematical Statistics and its Application by Richard J. Larsen, Morris L Marx 2nd edition 1986 Prentice –Hall

**Classical Mechanics**

1. **Course Name:** Classical mechanics
2. **Course Code:**
3. **Course Description**

This is an introductory course divided into six topics

- Rectilinear Motion
- Forces and Energy
- Newton's Law of Motion
- Two Dimensional Problems
- Projectiles
- Kinematics of assembles of particles and rigid bodies

**4. Course Objectives**

The course is intended:-

To provide the student with the basic concepts and principles in mechanics

- To enable students apply their knowledge of elementary mechanics to solve solutions to real life problems

**5. Suggested Teaching Programme**

- Rectilinear Motion

Uniformly accelerated motion **(3 Hrs)**

- Force, energy, momentum, conservative force, impulsive forces **(6 Hrs)**
- Newton's law of motion

  Resisted motion under gravity **(9 Hrs)**
- Hookes law, Simple Harmonic motion **(9 Hrs)**
- Projectiles **(6 Hrs)**
- Kinematics of assemblies of particles and rigid bodies **(6 Hrs)**
- Problems in 2 dimensions **(6 Hrs)**

**6. Suggested Reading List**

Lecturer will recommend their textbooks. This will vary from one institution to another. Possible texts are:-

Murray R. Spiegel (1992). Theoretical mechanics, Schaum outline series, New York, USA

Anwar Kamal (1995). Mechanics of particles, waves and Oscillation, New Delhi, India

Hans H.S & Puri S.P (1997). Mechanics. New Delhi, India

## Economics Programmes

**Microeconomics 1**

**1. Course Name:** Microeconomics 1

**2. Course Code:** This is a level I course for first students

**3. Course Description**

The course presents in a systematic way, some of the basic analytical techniques or "tools of analysis" of economics. This course is divided into the following topics:

Introduction to concepts and definitions

- Demand and Supply
- Theory of consumer behaviour
- Theory of production
- Theory of costs
- Market structures

**4. Course Objectives**

This course is intended to:

- **Provide a good treatment of modern introductory economics. The students will be facilitated to build a firm background upon which to learn and understand the modern economic principals.**
- **Expose the student to the basic understanding of the operation of the economic system and explain the roles of demand and supply in determining prices**
- **Help the student to suggest solutions to the economic problems in the real world today.**

**5. Detailed Course outline**

**a) Introduction (6Hrs)**

- An explanation of what Microeconomics is
- Evolution of economic theory
- Purpose and principles of economic theory
- Positive and normative economics
- Scarcity, choice and opportunity cost
- Markets, functions and Equilibrium

- Comparative statistics and dynamics
- Partial and general equilibrium
- Economic systems and economic questions
- Price mechanism and resource allocation

**b) Demand, Supply and Equilibrium (8Hrs)**

- Individual's demand for a commodity
- The law of negativity sloped demand curve
- Shifts in the individual's demand curve
- Analysis of the market demand curve for a commodity
- Types of equilibra
- Elasticities and their measurements: price, arc, point, cross etc

**c) The theory of Consumer Behaviour (15Hrs)**

Cardinal Utility Approach

- Assumptions
- Total and marginal utility analysis
- Consumer equilibrium
- Derivation of an individual's demand curve
- Critique of the cardinal utility approach

Ordinal Utility Approach (Indifference Curve Approach)

- Assumptions
- Properties of indifference curves
- Marginal rate of substitution (MRS) and its application
- Consumer equilibrium
- Income consumption curve, price consumption curve and the Engel curve
- Substitution and price effects
- Separation of substitution and price effects
- Price consumption curve and consumer curve
- Critique of the indifference curve approach

**d) The theory of Production (8Hrs)**

- Production with one variable input: total Production (TP), Average Production (AP), and marginal Production (MP)
- Shapes of the AP and MP curves
- Stages of production
- Production with two variable inputs
- Isoquants – their properties and characteristics
- Marginal rate of technical substitution
- Isocosts and their characteristics
- Production equilibrium
- Expansion path concept and the regions of production
- Factor substitution and the elasticity of technical substitution
- Increasing, constant and decreasing returns to scale

**e) The Theory of Costs (8hrs)**

- Understanding cost functions, implicit and explicit costs
- Short run and long run average cost curves
- Shape of the LAC curve and its link with economies and diseconomies of scale and externalities
- LAC curve as an envelop curve
- Long run MC
- Long run TC
- Tabulation and derivation different cost of production
- Production functions and cost curve i.e. total production and marginal product

**f) Market Structures (15Hrs)**

- Perfect Competition
- Factors for classifying markets
- Price and output under perfect competition
- Characteristics of perfect competition
- Price determination
- Short run equilibrium of a firm
- Short run profit and loss

- Long run equilibrium of a firm
- Firm and industry analysis
- Constant, increasing and decreasing cost industries

**Monopoly**

- Price and operation under pure monopoly
- Basis of monopoly powers
- MR curve and elasticity
- Short run equilibrium
- Regulation of monopoly (price control, lamp sum and per unit taxes)
- Price discrimination

**Monopsony**

Monopolistic competition

- Understanding monopolistic competition
- Conditions necessary for monopolistic competition to succeed
- Short run and long run equilibrium
- Excess capacity analysis

**Oligopoly**

- Understanding oligopoly
- Characteristics of oligopoly
- Equilibrium position
- Kinked demand curve

**6. Suggested Reading List**

The references include but not limited to the following:


- Baumol W.J (1999), Economic Theory and operations Analysis, Third Ed. Prentice Hall
- Leftwich, Richard (1986), The Price System and recourse Allocation, Fifth ed. Dry den Press
- Mansfield Edwin (2000), Microeconomics, Theory and Application, New York
- Thigan M.L.: Advanced Economic theory, Eight Ed.

**Microeconomics Ii**

**1. Course Name:** Microeconomics II

**2. Course Code:** This is a level II course for second year students

**3. Course Description**

This is an extension of Microeconomics I. This course is divided into the following topics: Introduction to concepts and definitions

- Understanding intermediate microeconomics
- Theory of consumer behaviour
- Market demand
- Theory of market demand in the present contex
- Theory of production behaviour
- Theory of costs
- Market structures

**4. Course Objectives**

**The objective of this course is to facilitate the student to have a deeper insight into Microeconomics.**

**5. Detailed Course outline**

**Introduction (4Hrs)**

- Review of basic concepts
- Scarcity, choice and resource optimization
- Choice, benefit and cost
- Review of what equilibrium is, type of equilibra, determinants of equilibrium price and quality and the bizarre situations

**The Theory of Consumer Behaviour (14Hrs)**

The cardinal Utility Approach

- Total and marginal utility analysis
- Review of the equilibrium position of consumer
- Derivation of demend for a consumer

**The Ordinal Utility Approach (Indifference Curve Approach)**

- Analysis of the indifference curve approach and its link to the consumer budget constraint
- Mathematical derivation of consumer equilibrium
- Analysis of substitution, income and total price effects
- The ordinary demand curve
- The Hicksian income – compensated demand curve for a normal good
- Slutsky's income – compensated demand curve for a normal good
- Bandwagon, snob and veblen effects
- Mathematical derivation of the demand curve

**Consumer's Surplus**

- Marshallian surplus
- Determination of the value of consumer surplus using integral calculus
- An alternative measure of consumer's surplus

**Applications of the Indifference Curves Analysis**

- The leisure – income trade off and the need for overtime rates higher than the normal wage rate
- Application of the indifference curves approach to the alternative government policies
- Indifference curves analysis and the theory of exchange (Edgeworth's Contract Curve)
- Indifference curve analysis of the cost of living

**Market Demand (4Hrs)**

- Derivation of market demand
- Determinants of market demand
- Analysis of the elasticity, expenditure and revenue
- Analysis of market demand, total revenue and marginal revenue: relationship between demand and total revenue; relationship between marginal revenue and price elasticity of demand; relationship between total revenue, marginal revenue and price elasticity of demand

**The Theory of Market in the Present Context (6Hrs)**

- The pragmatic approach to demand analysis
- Constant elasticity demand function
- Dynamic versions of demand function: distributed- -lag models of demand (derivation of Nerlove's stock adjustment principle and the Houthakker – Taylor dynamic model)

**The theory of Production Behaviour (10Hrs)**

- Mathematic derivation of total product; average product and marginal product
- Analysis of isoquents: rates of technical substitution, elasticity of substitution, factor intensity and the Cobb – Douglas production function
- Analysis of law of production: law of returns to scale and the law of variable proportions
- Technological progress and the production function: Capital – deepening, labour - deepening and neutral technical progress
- Growth of the firm and the decision to invest: Baumol's model of sales – revenue/profit maximization
- Price fluctuation and their causes, the cobweb cycles – types and the mathematical derivations
- Markets analysis: Walrasian and Marshallian assumptions of market behaviour
- Analysis of economic models: Graphical and mathematical models

**The Theory of Costs (4hrs)**

- Critical minimum cost analysis
- Short run costs of the traditional theory: The U – shapes of the AVC and the ATC curve, relationship between AVC and ATC curves and the relationship between MC and ATC curve

**Market Structures (14Hrs)**

Perfect Competition

- Mathematical analysis of equilibrium
- Losses and the shut down decision
- Calculating the shut down price

**Monopoly**

- Computing the profit maximization price and output for a monopolist
- Diagrammatical illustration of price discrimination (first, second and third degree)
- Allocative inefficiency under monopoly
- Technical inefficiency and rent seeking
- Relevancy of monopoly to the Ugandan context

**Monopolistic Competition**

- Review of profit maximization in the short run and the long run
- Evaluation of monopolistic competition in Uganda

**Oligopoly**

- Oligopoly and strategic behaviour: Decision making under oligopoly (output quantity, product quality and advertising)
- Price leadership model: Cournot model, dominant firm price leadership – the stackelberg model and the hotelling
- Games theory and strategic behaviour

**General equilibrium and welfare economics**

- Cartels
- Formalities for the formation of a cartel
- Organizational difficulties
- Private cartels, government sponsored national cartels and international cartels
- Case study: OPEC

**6. Suggested Reading List**

The references include but not limited to the following:


- *Baumol W.J (1999),* Economic Theory and operations Analysis, Third Ed. Prentice Hall
- *Leftwich, Richard (1986)*, The Price System and recourse Allocation, Fifth ed. Dry den Press
- *Mansfield Edwin (2000),* Microeconomics, Theory and Application, New York
- *Thigan M.L.*: Advanced Economic theory, Eight Ed.
- *Watson and Donald.S (2000),* price theory and Its uses, Houghton Mifflin, Boston
- *Wates C.J*: A Visual Approach to Economics Analysis
- *Varian (2000)*, Intermediate Microeconomics

**Microeconomics Iii**

**1. Course Name:** Microeconomics III

**2. Course Code:** This is a level III course for third year students

**3. Course Description**

This is an extension of the previous microeconomics course taken i.e. Intermediate Microeconomic I. it is divided into the following topics:-

- Theory of consumer behaviour
- Theory of producer behaviour
- Taxes and economic decision making
- Antitrust and regulation
- General equilibrium
- Welfare economics

**4. Course Objectives**

**The objective of this course is to facilitate the student to have a deeper insight into Microeconomics. The course further highlights the fundamental concepts in Microeconomics at a third level.**

**5. Detailed Course outline**

**The theory of Producer Behaviour (16Hrs)**

Analysis of Local and localization of industries

- Market area determination i.e. equal production and equal transport costs as well as unequal production and unequal transport costs.
- Selecting an industrial location i.e. primary and secondary location factors

Pricing and Employment of Factors Production

Perfect competition in the product and factor markets

- Profit maximization and least-cost factor combinations. Equilibrium of the firm: choice of optimal combination of factor of production – maximization of output subject to a cost constraint and minimization of cost for a given level of output.

- The demand curve of the firm for one variable factor
- Demand curve of the firm for one of several variable factors
- The marketing demand curve for a factor
- The market supply curve for a factor
- Pricing and level of employment of a factor
- Rent and quasi-rent

Perfect competition in the factor market and monopoly in the product market

- Profit maximization and least-cost factor combinations
- The demand curve of the firm for one variable factor
- The demand curve of the firm for one of several factors
- The market demand curve and factor pricing

**Monopoly**

- Factor supply curve and marginal factor costs
- Pricing and employment for one variable factor
- Pricing and employment of several variable factors

**Taxes and Economic Decision Making (8Hrs)**

- Profit Maximization and profit taxes
- Revenue and profit taxes
- Taxes on input i.e. cost maximization and input taxes, affluent taxes e.t.c
- Property taxes e.g. fixed property taxes and mobile profit taxes
- Tax preference i.e. interest deductions, tax exempt fringe benefits, investment tax credits e.t.c.

**General Equilibrium (10Hrs)**

- Partial and general equilibrium analysis
- General equilibrium of exchange
- General equilibrium of production
- The transformation curve
- The slope of the transformation
- General equilibrium of production and exchange

**Welfare Economics (14Hrs)**

- Welfare economics defined
- The utility-possibility curve
- The grand utility-possibility curve
- The social welfare function
- The point of maximum social welfare
- Maximum social welfare and perfect competition
- Externalities and market failure

**6. Suggested Reading List**

The references include but not limited to the following:


- *Baumol W.J (1999),* Economic Theory and operations Analysis, Third Ed. Prentice Hall
- *Leftwich, Richard (1986),* The Price System and recourse Allocation, Fifth ed. Dry den Press
- *Mansfield Edwin (2000),* Microeconomics, Theory and Application, New York
- *Thigan M.L.*: Advanced Economic theory, Eight Ed.
- *Watson and Donald.S (2000),* price theory and Its uses, Houghton Mifflin, Boston
- *Wates C.J*: A Visual Approach to Economics Analysis
- *Varian (2000),* Intermediate Microeconomics
- *Kohler. H, (1990)*, Intermediate Microeconomics, third Ed, Scott, Foresman and Company
- *Koutsoyiannis, (1979),* Modern Microeconomics; Macmilan

**Macroeconomics I**

**1. Course Name:** Microeconomics III

**2. Course Code:** This is a level I course for first year students

**3. Course Description**

**4. Course Objectives**

- **To introduce students to basic concepts and theories of Macroeconomics**
- **To help students appreciate how the major Macroeconomics variables influence the economic growth and development of nations**
- **To help students apply their knowledge of Macroeconomics to the challenges of economic growth and development of their country**
- **To equip the learner with Macroeconomics tools that can be used to analyze and appreciate the level at which our countries are in terms of economic growth and development**

## 5. Detailed Course outline

**National Income: Concept and measurement (8Hrs)**

- Introduction to Macroeconomics variables
- Definitions of National Income
- Three Methods of GNP i.e. Income Method of GNP, expenditure method of GNP and product method
- Net national product at market prices
- NNP at factor cost
- Relation between NNP at market price and NNP at factor cost
- Net domestic product at factor cost
- Value added method to GNP
- Personal income
- Disposable income
- Real income
- Per capita income
- Method of measuring national income
- Difficulties in the measurement of national income
- Importance of national income analysis

**National Economic Accounting** **(2Hrs)**

- Social accounting
- Presentation of social accounts
- Importance of social accounting
- Difficulties of social accounting

**The Classical Theory of Income, Output and Employment**

**(2Hrs)**

- Introduction and analysis of the classical theory
- Say's law of markets
    - Say's law
    - Propositions and implications of the law
    - Criticism of Say's law

**The Principle of Effective Demand: Aggregated demand and Aggregate Supply**

**(2Hrs)**

- Measuring of the principle
- Aggregate demand price
- Aggregate supply price
- Determination of effective demand
- Importance of effective demand

**The Consumption Function** **(4Hrs)**

- Measuring of consumption function
- Properties of technical attributes of the consumption function
- Significance of MPC
- Keynes' psychological law of consumption
- Implication of Keynes' law of importance of the consumption function
- Determinants of the consumption function
- Measures to rise the propensity of consume

**The Investment Function** **(4Hrs)**

- Measuring of capital and investment
- type of investment

- induced Vs autonomous
- Determinants of the level of investment
- The marginal efficiency of investment (MEI)
- Distinction between MEC and MEI
- Factor other than the interest rate affecting inducement to invest
- Saving and investment equality
- Saving and investment equality i.e. the Keynesian view

**The Concept of Multiplier (4Hrs)**

- Measuring and derivation of investment multiplier
- Working of the multiplier
- Assumption of multiplier
- Leakages of multiplier
- Criticisms of multiplier
- Importance of multiplier
- Multiplier in an underdeveloped country
- The Keynesian theory of income, output and employment i.e. the Keynesian theory of income, output and employment

**Balanced Budget Multiple and Foreign Trade Multiplier**

- Balanced budget multiplier
- Its assumption
- Its criticisms
- Foreign trade multiplier accelerator interaction
- The principle of acceleration and the super-multiplier
    - The principles of acceleration
    - Operation of the acceleration principle
    - Assumption
    - Criticisms
    - The super-multiplier or the multiplier acceleration interaction
    - Use of multiplier accelerator interaction in business cycles

**Income Determination in Closed and Open Economy (4Hrs)**

- Income determination in a closed economy

- Determination of equilibrium level of income-equality of aggregate demand and aggregate supply
- Equality of saving and investment
- Income determination in an open economy
- Its assumption
- Determination of equilibrium level of income

**Wage-Price flexibility and Employment (6Hrs)**

- Introduction
- The classical view
- Keynes' criticisms of the classical view
- The Keynesian view
- The Keynesian view on the money-wage reduction and employment
- The Keynes' effect and its criticism
- The pigou effect and its criticism
- Difference between the pigou effect and real balance effect
- Flexible wage policy Vs flexible monetary policy

**Inflation (8Hrs)**

- Introduction and meaning of inflation
- The inflationary gap
- Demand-pull or monetary theory of inflation
- Cost-push inflation
- Demand-pull Vs cost-push inflation
- Mixed demand-pull cost push inflation
- Sectoral or demand-shift inflation, structural inflation
- Mark-up inflation
- Open and suppressed inflation

**Monetary policy: Instruments and Types (4Hrs)**

- Instrument of monetary policy
- Expansionary monetary policy
- Restrictive monetary policy
- Role of monetary policy in a developing economy

**6. Suggested Reading List**

The references include but not limited to the following:


- *Baumol W.J and Blinder Alan, (2002)*, Macroeconomics Principles and Policy
- *Abel and Bermake 2001*. Macroeconomics. Library of Congress Cataloging in Publication
- *Baily Neil Martin and Fredman (2003),* Macroeconomics: Financial markets and the International Sector, Richard D. Irwin Inc
- *Branson H.W. (1999)*. Macroeconomic Theory and Policy, 2nd Ed. Princeton University, New Delhi
- *Edward Shapiro, 2000*, Macroeconomics Analysis
- *Kohn Meri, 2000* Macroeconomics. Library of Congress. Cataloging in publication data
- *Lindsey and Dolar, 2002* Macroeconomics 8th Ed. Library of Congress. Cataloging in publication
- *Mankilo G.N. 1997*, Macroeconomics 3rd Ed. Harvard University
- *McConnell, Campbell and Brue, 2000*, Macroeconomics principles, Problems and Policies, 14th Ed. New York Mcgrew-hill inc
- *Jingan 2001*, macroeconomics Theory A-18, Rana pratapBagh, Delhi

**Macroeconomics II**

**1. Course Name:** Microeconomics II

**2. Course Code:** This is a level II course for second year students

**3. Course Description**

**4. Course Objectives**

**This course is an extension of Macroeconomics stage I. Therefore the objective is to help the student to understand Macroeconomic theory in detail and how its parts interact before we get into controversies in part III. The course focuses on the contribution of different models to the persisting macroeconomic problems such as unemployment.**

**5. Detailed Course outline**

**Review of the basic Macroeconomic Models (4Hrs)**

- Classical model of income and employment
- Say's law of markets
- Classical savings, investments and interest rates
- Classical quantity theory of money

**The supply of Money (2Hrs)**

- Definition of money supply
- Determinants of money supply
- High-powered money and money multiplier
- Measures of money supply
- Money supply and liquidity
- Derivation of money multipliers
- Velocity of money
- Quantity theory of prices
- Friedman theory of money and their implications

**Keynesian model (4Hrs)**

- Determination of equilibrium income
- Limitations in the Uganda context
- The classical of interest

- The loanable funds theory of interest
- Keynes's liquidity preference theory of interest
- Indeterminacy of the classical, the loanable funds and the Keynesian theories of interest
- Modern theory of interest

**New Classical School of Macroeconomics of Robert Lucas, Thomas Sargent and Robert Barro (2Hrs)**

- Its foundation and practical implications
- Rational expectations hypothesis
- The illusory Phillips curve
- The real business cycle theory

**The Is-LM model (4Hrs)**

- The is Curve
- the money market and LM curve
- Simultaneous equilibrium in the money and commodity markets
- The Is and LM curves as analytical tools to explain the working of the monetary and fiscal policies
- Bop and capital flows

**Budget and Fiscal policy (8Hrs)**

- Definition and types of budget
- Government/public debt and their implication for LDCs
- Government budget policy
    - Discretionary fiscal policy
    - Automatic stabilizers
    - Fiscal deficits structural and cyclical deficits
    - Applications of structural and cyclical budget
- How government debt affect the living standards
- External and internal debt
- Debt servicing

**Growth Models and their Implications (6Hrs)**

- The harrod Domar models and their limitations

- The Kaldor model of distribution
- Pasinetti model of profit and growth
- Assumptions of the models
- The Domar model interpretation and analysis
- The Harrod model interpretation and analysis
- Limitations of these models
- Comparison of the models

**The Solow Model of Long-Run Growth (2Hrs)**

- Assumption s of the model
- Possible growth patterns
- A critical appraisal of the model

**The Model of technical Change (4Hrs)**

- Introduction and interpretation of the technical change concept
- Neutral and non-neutral technical change
- Hicks neutrality
- Harrod neutrality
- Disembodies and embodied technical change
- A critical appraisal and implications od the model
- Its limitations

**6. Suggested Reading List**

The references include but not limited to the following:


- *Baumol W.J and Blinder Alan, (2002),* Macroeconomics Principles and Policy
- *Abel and Bermake 2001*. Macroeconomics. Library of Congress Cataloging in Publication
- *Baily Neil Martin and Fredman (2003)*, Macroeconomics: Financial markets and the International Sector, Richard D. Irwin Inc
- *Branson H.W. (1999)*. Macroeconomic Theory and Policy, 2nd Ed. Princeton University, New Delhi
- *Edward Shapiro, 2000*, Macroeconomics Analysis
- *Kohn Meri, 2000* Macroeconomics. Library of Congress. Cataloging in publication data

- *Lindsey and Dolar, 2002* Macroeconomics 8th Ed. Library of Congress. Cataloging in publication
- *Mankilo G.N. 1997,* Macroeconomics 3rd Ed. Harvard University
- *McConnell, Campbell and Brue, 2000*, Macroeconomics principles, Problems and Policies, 14th Ed. New York Mcgrew-hill inc
- *Jingan 2001,* macroeconomics Theory A-18, Rana pratapBagh, Delhi

**Macroeconomics III**

**1. Course Name:** Microeconomics III

**2. Course Code:** This is a level III course for third year students

**3. Course Description**

**4. Course Objectives**

**This course is designed to give students a consistent way of approaching the full range of contemporary Macroeconomic issue. At this stage, the needs lots of help in internalizing how formal models can be used to explain the real world economy. Thus the course is dedicated to showing the application of the theory to real events and issues and in helping the student learn how to: think like an "economist". The numerous "Application" are designed to show how theory can be used to understand an important episode or issue such as the impact of tax reform, the causes and effects of the LDC debt crisis, the long run viability of manufacturing in the face of foreign competition, etc.**

**5. Detailed Course outline**

**Review Major Concepts in Macroeconomics (6Hrs)**

- The IS-LM model and aggregate demand and supply curves
- The role aggregate demand and supply
- Fixable prices and the demand curve
- Shifting the aggregate demand curve with monetary and fiscal policy
- The aggregate supply curve when the wage rate is constant
- Short run

**New Keynesian Explanation of the Business Cycle (4Hrs)**

- Essential features of the new Keynesian economics
- Real sources of wage stickiness
- Business cycle in the new Keynesian model
- Implications of the new Keynesian model

**The Classic and Keynesian Model of Income and Employment: The Nature and Extent of the Keynesian Revolution (4Hrs)**

- General theory
- Evolutionary or revolutionary
- Criticism of Keynesian theory
- Practical implications of the theory

**Unemployment and Full Employment (4Hrs)**

- Types of unemployment
- Meaning of full employment
- The classical view of employment
- The Keynesian view and implication
- Other views on full employment
- Measures to achieve and maintain full employment

**Applicability of Keynes Theory to Underdeveloped Countries (4Hrs)**

- Keynesian assumption and underdeveloped countries
- The Keynesian tools and underdeveloped countries
- Policy measures and LDCs

**Term Structure of Interest Rate (4Hrs)**

- Measuring of interest rate structure
- Factors determining the term structure of interest rate
- Theories of term structure of interest rate

**An Extension of an IS and LM Function general Equilibrium of Product and Money Market (4Hrs)**

- Introduction of the general equilibrium
- The product market equilibrium
- The money market equilibrium
- General equilibrium of product and money market changes in general equilibrium

**Wage-Price Flexibility and Employment (8Hrs)**

- Introduction and interpretation of wage and price flexibility
- The classical views
- Keynes's criticism of the classical view
- Keynesian view and interpretation
- Keynesian views on money-wage reduction and employment
- The Keynes effect and its criticism
- The pigou effect and its criticism
- Difference between the pigou effect and real balance
- Flexible monetary policy

**Inflation (8Hrs)**

- Introduction and meaning of inflation
- The inflationary gap
- Demand-pull or monetary theory of inflation
- Cost-push inflation
- Demand-pull Vs cost-push inflation
- Mixed demand-pull cost push inflation
- Sectoral or demand-shift inflation, structural inflation
- Mark-up inflation
- Open and suppressed inflation
- The Philips curve
- The relation between unemployment and inflation
- Stagflation, its analysis and effects
- Friendman's view
- The long-run Philips curve
- Cases of inflation
- Measures to control inflation and how they are applied in Uganda Effects of inflation

**Business Cycle: Meaning and Nature (6Hrs)**

- Meaning and the reasons for cycles
- Types of cycles
- Phases of a business cycle
- Recovery

- Prosperity
- Recession
- Depression
- Hawtrey's monetary theory of the trade cycle and its criticism
- Sehumpeter's theory of innovation and its criticism
- Keynesian theory of the trade cycle and its criticism

**Managing the Global Economy (8 Hrs)**

- International financial system
- Pure floating exchange rates
- Fixed exchange rates
- Classical gold standard
- Managed exchange rates
- International cooperation
- International institutions: Bretton Woods system, IFM, World Bank, Demise of Bretton Woods system, Today's hybrid system

**6. Suggested Reading List**

The references include but not limited to the following:


- *Baumol W.J and Blinder Alan, (2002),* Macroeconomics Principles and Policy
- *Abel and Bermake 2001*. Macroeconomics. Library of Congress Cataloging in Publication
- *Baily Neil Martin and Fredman (2003),* Macroeconomics: Financial markets and the International Sector, Richard D. Irwin Inc
- *Branson H.W. (1999)*. Macroeconomic Theory and Policy, 2nd Ed. Princeton University, New Delhi
- *Edward Shapiro, 2000*, Macroeconomics Analysis
- *Kohn Meri, 2000* Macroeconomics. Library of Congress. Cataloging in publication data
- *Lindsey and Dolar, 2002* Macroeconomics 8th Ed. Library of Congress. Cataloging in publication
- *Mankilo G.N. 1997*, Macroeconomics 3rd Ed. Harvard University
- *McConnell, Campbell and Brue, 2000*, Macroeconomics principles, Problems and Policies, 14th Ed. New York Mcgrew-hill inc
- *Jingan 2001*, macroeconomics Theory A-18, Rana pratapBagh, Delhi

**Public Finance and Fiscal Policy**

**1. Course Name:** Public Finance and Fiscal Policy

**2. Course Code:** This is a level III course

**3. Course Description**

**4. Course Objectives**

**This course is to equip learners with issues relating to taxation and public expenditure in developing countries. Students should be able to apply the issues learnt into the practical experience of developing economies.**

**5. Detailed Course outline**

**Introduction (7Hrs)**

- Definition and various types of public sector finance
- Similarities and non-similarities
- Public finance and economic system
- Principle of maximum social advantage

**Public Revenue (7Hrs)**

- Revenue receipts, capital receipts
- What is a tax?, tax base
- Buoyancy and elasticity of a tax
- Principles of taxation
- Characteristics of a good system and objectives of taxation in LDCs

**Tax Burden (8Hrs)**

- Introduction
- Theories ; ability to pay theory, objectives indices of ability to pay, subjective indices of ability to pay
- Optimal taxation, taxable capacity-short run factors and long run factors
- Usefulness of taxable capacity

**Incidence of Taxes** **(14Hrs)**

- The impact, incidence and effects of a tax
- Forward and backward shifting theories of tax shifting; concentration theory, diffusion theory, demand and supply theory.
- Imposition of a specific tax, adv alorem tax; a tax on monopoly, oligopoly, on profits on income.
- Deficit financing as a hidden tax
- Problem of double taxation

**Classification and Choices of Taxes** **(8Hrs)**

- Single Vs Multiple tax system
- Proportional Vs progressive tax system (arguments for & against)
- Direct Vs indirect taxes (arguments for and against)
- Effects of taxation (production and growth, different taxes, supply of resources, distribution, inequality, economic stabilisation).

**Public Debt** **(4Hrs)**

- Meaning of public debt, private debt
- public debt and economic growth, inflation, economy regulation
- Public debt and taxation

**Public Expenditure** **(10Hrs)**

- Meaning and nature of public expenditure
- Theories of public expenditure; Wagner's law of increasing state activities, Wiseman-Peacock hypothesis, the critical limit hypothesis.
- Demand and supply of government service
- Comparison between private and public expenditure
- Pure theory of public expenditure, kind of public expenditure, canons of public expenditure, effects of public expenditure.

**Public Budget** **(4Hrs)**

- Introduction
- Types of budgets, importance of budgets

- Causes and implications of budget deficits

**6. Suggested Reading List**

The references include but not limited to the following:


- *Dr. Bhatia H.L, (2003):* Public finance, Vikas publishing House PVT Ltd, New Delhi, 24th Ed.
- *Herber P.B, (1999*): Modern Public Finance. New Delhi
- *Bahemuka K.P, (2001)*: Income Tax in Uganda, Fountain Publishers.
- *Stuart Wall A.G, (1998):* Applied Economics, An Introductory Course, 7th Ed, Longman London and New York.
- *Mushgrave & Mushgrave*: Public Finance, Theory and Practice strings, Public Sector Economics.

**Economic Planning and Policy**

**1. Course Name:** Economic Planning and Policy

**2. Course Code:** This is a level III course

**3. Course Description**

**4. Course Objectives**

**The major objectives of the course avail the students with the analytical tools examine the planning techniques and how they influence policies. The focus of the course is on planning theories, models and illustrative examples of planning techniques are reviewed.**

**Additionally the course aims at providing students with an insight on how policies and planning techniques can promote economic stability and sustainability especially in the developing countries.**

**5. Detailed Course outline**

**Planning (4Hrs)**

Introduction to Economic Planning and policy

- Concept of economic planning
- Principles of economic planning
- Case for and against planning
- Characteristics of a sound policy

**Planning Process (12Hrs)**

- The planning process
- Process of systematic planning
- Plan administration and plan implementation
- Plan formulation
- Requisites for successful planning
- Planning by direction and planning by inducement
- Bottom-up versus Top-down approach

**Planning models** **(8Hrs)**

- Importance of planning model
- Aggregate planning model
- Sect oral planning model
- Inter-industry planning model
- Input-output model

**Micro planning** **(8Hrs)**

- Cost benefit analysis
- Social accounting
- Environmental impact assessment
- Project evaluation

**Planning Experience** **(8Hrs)**

- Economic planning in Uganda
- The future of economic planning
- The crisis in Uganda

**Policy**

Overview of policy instruments and their characteristics **(4 Hrs)**

Policies related to population and human recourse management **(4 Hrs)**

Policies related to saving, investment, capital formation foreign capital and trade **(4 Hrs)**

Policies related to agricultural and industrial development **(4 Hrs)**

Policies related to stabilization, structural adjustment, liberalization and globalization **(4 Hrs)**

**6. Suggested Reading List**


- Agrawal A.N and Kundan Lal (1977), Economic planning, Vikas publishing House PVT, New Delhi
- Tingan M.L ( ), Leading Issue in Economic Development, 6th Ed., Oxford University Press, New York
- Michael P. Todaro and Stephen C. Smith (2003), Economic Development 8th Ed. Addison Wesley, New York
- Silverster, Economic Growth, Development and planning

**Economic Research Methods**

**1. Course Name:** Economic research Methods (4CU)

**2. Course Code:**

**3. Course Description**

**4. Course Objectives**

**The main objective of the course is to equip learners with analytical skills in understanding the basic concepts of research in social sciences. They should be able to write a research proposal and a research report. They should be able to conduct field research apply the skills in the context of action oriented research relevant in solving real life situations.**

**5. Detailed Course outline**

**The research process (8Hrs)**

- Theory as a foundation of research problem
- Type of research

**Research methodology Foundation (12Hrs)**

- The scientific method
- The methodology of social science research
- Research methodology in economics

**Formulation of a research Proposal (8Hrs)**

- Planning the research
- The research problem
- Objectives, significance and scope
- Literature review and conceptual framework

**Research Methods and procedures (16Hrs)**

- Data collection methods and sampling types
- Research instruments and their construction
- Data coding, entry, cleaning and analysis

**Production of end Product** **(16Hrs)**

- Presentation of results
- Styles of writing the research report and referencing
- Dissemination of research findings

**6. Suggested Reading List**

**Monetary Economics**

**1. Course Name:** Monetary Economics (4CU)

**2. Course Code:**

**3. Course Description**

**4. Course Objectives**

The main objective of the course is to equip learners with analytical skills in understanding the basic concepts of monetary economics in the context of developing countries. They should be able to apply the skills in developing monetary policies

**5. Detailed Course outline**

**Issues in Monetary Economics** **(8Hrs)**

- Definition and functions of money
- Evaluation of monetary standards
- Advantages and disadvantages of a monetary economy
- The quantity theory of money

**The Demand of Money** **(8Hrs)**

- The scientific method
- The methodology of social science research
- Research methodology in economics

**Formulation of a research Proposal** **(8Hrs)**

- Keynes and transactions theories of demand for money
- Portfolio theories of money demand; The Baumol – Tobin model
- The monetarists views on the demand for money

**The Hansen Hickisian IS-LM Curve Analysis** **(12Hrs)**

- Equilibrium level of income
- Classical and Keynesian analysis

**Money Supply** **(8Hrs)**

- Balance of payment, fiscal policy, policy mix and balance and money supply process
- Instruments for varying money supply like, bank rate, open market operations etc.

**Financial Intermediation** **(8Hrs)**

- Financial intermediaries contract between banking and non-bank financial intermediaries
- Credit markets, money and capital markets
- Formal and informal money markets
-

**Monetary Institutions** **(8Hrs)**

- Commercial banks and their functions
- Central bank and its functions
- Bank deposits, credit allocation and money/credit multiplier

**Money in a Monetary Economy** **(8Hrs)**

- Changing paradigms in monetary economics
- Monetary policy in developing countries

**6. Suggested Reading List**

**International Economics**

**1. Course Name:** International Economics

**2. Course Code:** This is level II or III course

**3. Course Description**

**4. Course Objectives**

**The main objective of the course is to introduce students to various aspects of trade theory and expose them to current issues in international economic relations. It will broaden and sharpen the student's analytical ability. Greater emphasis will be placed on the analysis and application of international economic theories to the problems of developing countries. Special reference will be made to the Ugandan economy.**

**Upon completion of the course, the students should have the theoretical and practical foundations necessary for a more advanced study in the field of international economics or be able to undertake employment that requires some background of international economies.**

**5. Detailed Course outline**

**Part I**

**Introduction (2Hrs)**

- The basis for, and gains from international trade
- Distinction between internal and international trade
- The subject matter of international economics
- The purpose of international economic theories and policies
- Current international economic problems

**The Classical International Trade Theories (2Hrs)**

- Absolute advantage
- Comparative advantage

**International Trade Equilibrium: Neo-classical Analysis (8Hrs)**

- Trade equilibrium under constant, increasing and decreasing cost conditions
- Gains from exchange and gain from specialization
- International trade as a substitute for economic growth
- Theory of immeserizing growth

**The Modern Theory (4Hrs)**

- The Heckscher-Ohlin (H-O) theorem
- Leontif paradox
- Samuelson's factor-price equalization theory
- Rybcynski: factor endowment and relative commodity prices

**International Trade Restrictions and Policy (3Hrs)**

- Natural obstacles
- Man made obstacles
- Protectionism tools

**WTO, AGOA and IGAD (2Hrs)**

- Types of tariffs
- Arguments for and against tariffs
- Effects of tariffs on general and partial equilibria perspectives
- Theory of optimum tariffs

**Commercial Policy: The theory of customs Union (6Hrs)**

- Partial equilibrium analysis of a customs union
- Pre-custom union equilibrium
- Post-customs union equilibrium
- Net welfare effect of customs union
- General equilibrium analysis of a customs union
- The Lipsey model

**Part II: Open Economy Macroeconomics**

**Balance of Payments (BOPs): Definitions and Concepts (4Hrs)**

- BOP accounts
- BOP settlement and adjustment
- Full employment equilibrium of true balance
- BOP and economic policy

**Foreign Trade and National Economics (3Hrs)**

- Foreign trade multiplier with no foreign repercussions
- Feedback foreign trade multiplier model of investment

**Balance of Payment and Foreign Exchange Rate (4Hrs)**

- Foreign exchange rate determination
- Falling foreign exchange rate situation
- Rising foreign exchange rate situation

**Balance of Payments Adjustment Mechanisms (7Hrs)**

- BOP automatic adjustment with flexibility in prices, interest rates and income levels
- BOP automatic adjustment mechanism with flexibility in exchange rates
- Exchange rate policies: fixed or pegged, managed, floating

**Balance of Payments Adjustment: Policy Issue (7Hrs)**

- Monetary and fiscal policies
- Devaluation
- Internal and external balance expenditure-changing and switching policies
- Exchange control

**Optimum Currency Area Theories (4Hrs)**

- Factor mobility theory
- open economy theory
- product diversification theory
- propensity to inflation theory
- the policy-mix theory

**International Liquidity and World Monetary System (6Hrs)**

- International liquidity
- Problem of inadequacy
- IMF and international liquidity
- The need for IMF and the objectives of IMF
- The international monetary system

**6. Suggested Reading List**

**The Uganda Economy**

**1. Course Name:** The Uganda Economy

**2. Course Code:** This is a level IIII course

**3. Course Description**

This is an applied course in economics to fully utilize the economic theory to explain the Ugandan context.

**4. Course Objectives**

**The main objective of the course therefore is to give an insight to the students on the performance of the Ugandan economy at the micro and macro levels. The course will cover:**

**All sector of the economy i.e. Agriculture, Industry, Service etc and all the macroeconomic problems such as inflation, unemployment, debt etc.**

**The specific objective therefore is to expose the students to the nature and working of the Ugandan economy as a business environment.**

**5. Detailed Course outline**

**Micro Dimensions of the Ugandan Economy (5Hrs)**

This will mainly look at poverty and other related indicators. It will give a background to the characteristics of LDC's and specifically the Ugandan case. Historical perspective of the Ugandan economy (before independence, pre liberalization and liberalization era) and the current structure of Ugandan economy.

**National Income (5Hrs)**

This will mainly look at the performance of the different sectors in the economy e.g. agriculture, industry, service and public sectors in Uganda. Time series information will be collected for a given period of time before and after the economic recovery programme (ERP).

**Inflation (5Hrs)**

The problem of inflation the Uganda case will be studied and policies that have been implemented to curb the situation will also be covered

**External sector (5Hrs)**

This will mainly look at the performance of the export sector and debt problem. The exchange rate regime will also be studied and its impact on export and import competitiveness.

**Monetary Sector (5Hrs)**

An analysis on the movement of monetary variables such as money supply, savings and other financial assets such as treasury bills will be covered using empirical data. Financial intermediate, from the Uganda case will also be examined.

**Unemployment problems (5Hrs)**

This is a very big problem in the country at the moment. An analysis of the cases and possible solutions will be studied.

**Structural Adjustment Programme (SAP) (5Hrs)**

These policies were adopted and fairly implemented in 1987 by the NRM government. There is need therefore to look at the policy package and their performance in Uganda.

**Regional Cooperation/Economic Integration (5Hrs)**

This will mainly cover COMESA and newly rejuvenated East African cooperation.

**Privatization** **(5Hrs)**

Theory and practice

**6. Suggested Reading List**

There are no specific texts for this course but more recent papers and publications will be used. This will include:

*Birungi P, (1995),* Output Growth, Money Supply and Inflation in Uganda, an M.A. Dissertation, Makerere university

*Mbiire B. and Watumwa, (1992),* Money Supply, Exchange Rate and Inflation in Uganda: Peper presented at the AERC, Nirobi

*Ssemogerere G. (1995),* Employment and Labour Markets, During Adjustment in East and Southern Africa, the case of Uganda, Paper presented for ILO workshop.

*Fredrick Ebert Foundation, (1995),* Selected public lectures on privatization in Uganda

*Ssemogerere G.n. and Kasekende, L.A (1994),* Constraints to the development and Diversification of non-traditional Export in Uganda, 1981-90: Paper presented at the AERC

*The World Bank, (1993),* Uganda Growing out of Poverty, The World Bank, Washington D.C

……., (1996), Uganda the Challenge of Growth and Poverty Reduction, the Uganda Government, background to the Budget various issues

World Development report

Other relevant texts given by lecturer

**History of Economic Thought**

**1. Course Name:** Economic Thought

**2. Course Code:** This is a 2nd and 3rd year course

**3. Course Description**

The main parts of the course are 3

- Economic thought before the science of economics
- The evolution of economics as science
- General account of recent leading schools

**4. Course Objectives**

- **To give the student a historical perspective of the development of economics as an important subject of study**

- **To help the student to start thinking rationally and help him/her develop his/her intellectual capacity**

**5. Detailed Course outline**

The subject to be studied under economic thought before the science of economics are:

Economic thought of the Architects

- Oriental economic thought, especially the concepts of the Hebrewa and Hindus
- The economic thought of Aristotle and Plato
- The economic thought of the Romans
- The middle ages
- mercantilism

**Subject to be studied under the Evolution of Economics as a science are:**

- The physiocrates and the revolution in social philosophy
- Adam Smith, his immediate predecessors and the revolution in industry
- Malthus and the theory of distribution, especially the rent doctrine

- Senior and the abstainance theory
- Say and other general and French expositors
- John Stuart Mill and his principles of political economy
- The rise scientific socialism
- Jevons, Walras and the mathematical school
- Marshall and his system of equilibrium
- The development of business cycle theory
- Monopolistic and imperfect competition
- Veblen and institutionalism
- Keynes and his policies
- General equilibrium economics and econometrics

**Subject to be studied under general account of recent leading school are:**

Economic thought in Germany and Austria from 1870 to World War II

Economic thought in France (and Benelax) from 1870 to World War II

Economic thought in England from 1870 to about 1936

Economic thought in the United State: 1870 – 1946

**Principles of Development Economics**

**1. Course Name:** Principles of Development Economics

**2. Course Code:** This is a 1st Year Course and a requirement for
Development Economics

**3. Course Description**

The course will cover the following topics: introduction to development economics, economic growth and economic development, theories of development, challenges of economic development and education and development. Others will include health and development, foreign aid and foreign capital as well as country experience in economic development.

**4. Course Objectives**

**To acquaint the students with the theory and concepts of development, so that they are able to understand the process of economic development in among different economies.**

**5. Detailed Course outline**

**1.0 INTRODUCTION (4hrs)**

- Introduction to the concepts of development
- Why study Development Economics?
- Measuring Development
- Characteristics and problems of developing countries

**2.0 ECONOMIC GROWTH AND ECONOMIC DEVELOPMENT (6hrs)**

- Definitions of Economic growth and Economic Development
- Differences and similarities
- Determinants/ causes of economic growth
- Obstacles to economic development

**3.0 THEORIES OF ECONOMIC DEVELOPMENT (10hrs)**

The classical theory: Adam Smith's theory of development

- Rostow's stages of economic growth
- Malthusian theory of economic development
- The Sectoral priority theories- Balanced growth theory and unbalanced theory
- Their relevancy to developing countries

**4.0 CHALLENGES OF EONOMIC DEVELOPMENT**

4.1 POVERTY (4hrs)

**Concepts and measures**

- Causes of poverty -Characteristics of the poor
- Policy options for reducing\ mitigating poverty and income disparities in development countries: the experience of Uganda

**4.2 AGRICULTURAL STAGNATION, TRANSFORMATION AND DEVELOPMENT IN DEVELOPING COUNTRIES (9hrs)**

- The role of Agriculture in economic development
- Problems facing the Agriculture sector
- Structure of the World Agriculture
- Transitional stages
- Agricultural policies and practices in Uganda: continuity and change
- The monetary and non-monetary sectors in agriculture -a case study of Uganda
- The role of women in the agricultural sector

**5.0 EDUCATION AND DEVELOPMENT (9hrs)**

- The role of education in development

- The formal and informal education
- The relevance of indigenous knowledge
- Education policies /systems in developing countries;
- The case Universal Primary Education (UPE).

**6.0 HEALTH AND DEVELOPMENT (3hrs)**

- The relationship between health and development
- Positive contributions of a healthy population to economic development

**7.0 FOREIGN AID AND FOREIGN CAPITAL INVESTMENT**

**(6hrs)**

- Meaning of foreign aid/ foreign capital
- Types of foreign aid
- Arguments for and against foreign aid
- Role of multi-national corporation (MNCs)

**8.0 COUNTRY EXPERIENCE IN ECONOMIC DEVELOPMENT (10hrs)**

- Uganda
- NICs: South Korea
  Malaysia
  China
  Singapore

**6. Suggested Reading List**

*Jhingan ML. (1998),* The Economics of Development and Planning, 31st Revised and enlarged edition, Vrinda Publication

*Nafzinger E. Weyre (1997),* The Economics of Developing Countries, 3rd Edition

*Meier M. Gerald* , Leading Issues in Economic Development

Ray Debraj, Development Economics

*Todaro P. Micheal,* Economic Development (8th Edition)

*Todaro P. Mcheal*, Economics for a Developing World

## QUANTITATIVE METHODS

1. **Course Name:** Quantitative Methods

2. **Course Code:** This is a level 1 course for first year students

3. **Course Description**

   This course entails the basic principles of statistics, sampling techniques, statistical distribution and theory of probability. It prepares students to be able to organize, tabulate, analyze, test hypotheses and make inferences, estimations and predictions from data obtained from a field of study.

4. **Course Objectives**

   At the end of this course students should be able to:

   a) Present general statements in a precise and definite quantitative form
   b) Condense mass of data into a few significant figures
   c) Use figures to compare with others of the same kind
   d) Formulate and test hypotheses and develop new theories
   e) Provide helpful means of forecasting future events
   f) Provide the basic materials for framing suitable policies to tackle economic problems

5. **Detailed Course Outline**

- **Introduction (4 Hrs)**

  - Nature of Statistics
  - Definition of some Statistical Terms

- **Tabulation and Graphical Representation of Statistical Data (4 Hrs)**

- **Frequency Distribution**
- Graphs and Charts

- **Histograms**
- Frequency Polygon
- Ogives
- Pie Charts

- **Elementary Probability Theory (6 Hrs)**

  - Some Basic Concepts of Probability
  - Sets and Events
  - Axioms of Probability
  - Statistical Independence, Dependence and Conditional Probability
  - Permutations and Combinations

- **Measures of Location (8 Hrs)**

  - Arithmetic Mean (Grouped and Ungrouped Data)
  - The Median (Grouped and Ungrouped Data)
  - The Mode
  - Comparing the Mean, the Mode and the Median
  - Geometric Mean and the Harmonic Mean
  - Other Measures of Location; Quartile, Decile, Percentiles etc

- **Measures of Dispersion (4 Hrs)**

  - The Range
  - The Mean (Average) Deviation
  - The Variance and Standard Deviation
  - The Coefficient of Variation

- **Distribution Theories and Measurement (10 Hrs)**

- Normal Distribution
- Binomial Distribution
- Poisson Distribution
- Skewness
- Kurtosis

- **Elementary Sampling Theory (6 Hrs)**

  - Some Basic Concepts of Sampling
  - Sampling Distribution
  - Probability Sampling Techniques
  - Non-Probability Sampling Techniques

- **Hypothesis Testing (10 Hrs)**

  - Test of significance using large samples
  - Test of significance using small samples
  - Test of significance using probability values
  - Test of significance using proportions
  - Chi-square and Goodness of Fit
  - F-test and Analysis of Variance

- **Correlation and Regression Analysis (8 Hrs)**

  - Correlation
  - Partial and Multiple Correlation
  - Linear and Multiple Regression
  - Statistical Inference in Regression

**6. Suggested Reading List**

NB Students are advised to read extensively on the text books recommended by the lecturer, notes prepared by the lecturer and any other relevant books, web site and resources in the libraries

The reading list will include but not limited to the following texts


Aggarwal, Y. P 1990. **Statistical Methods**. Delhi: Sterling Publishers

Anderson, D. R. Sweeney, D. J. & Williams T. A. 1987. **Statistics for Business and Economics**. New York: West Publishing Company

Gordon, S. P. & Gordon F. S. 1994. **Contemporary Statistics**. New York: McGraw Hill Inc.

Gupta, S. P. 2004. **Statistical Methods**, 33rd ed. New Delhi: Sultan Chand & Sons

Hartley, A. 1998. **Statistics**. Delhi: Asanta Book International

Mason, Lind & Marchal, 1999. **Statistical Techniques in Business and Economics**. New York: Irwin McGraw Hill

Ramathan, R. 1995. **Introduction to Econometrics with Application**, 3rd ed. London: Brace College Press

Triola, M. F. 1998. **Elementary Statistics** 7th ed. California: Addison-Wesley

Webster, A. L. 1956. **Elementary Statistics for Business and Economics**. London: Irwin

**Mathematical Economics**

1. **Course Name**: Mathematical Economics

2. **Course Code:** This is a level 1 course for first year students

3. **Course Description**

The course covers frequently used mathematical techniques and their application in analyzing economic problems. The topics covered include:

- Set theory
- Static analysis
- Linear model and matrix algebra
- Functions and the rate of change
- The concept of the derivative and their application in economics
- Rules of differentiation and their use in comparative statistics
- Optimization problems
- Dynamic analysis
- Integral calculus
- Mathematic programming

4. **Course Objectives**

The main objective of this course is to demonstrate how the use of formal mathematical reasoning can produce a deeper understanding of economic theory. The course focuses on mathematical tools and illustrates them with application to economic theory whose knowledge is assumed.

5. **Detailed Course Outline**

- **Introduction (4 Hrs)**

  - Nature of Economics

- Modeling
- Number Systems
- Sets and Operations

- **Fundamental Techniques in Algebra (4 Hrs)**

  - Rules of Algebraic Expressions
  - Exponents and Logarithms
  - Binomial Expansion

- **Matrix Algebra (6 Hrs)**

  - Definition
  - Properties of Matrices
  - Matrix Addition, Subtraction and Multiplication
  - Matrix Inversion
  - Crammer's Rule
  - Economic Application of Matrix Algebra

- **Static Analysis (6 Hrs)**

  - Single Commodity Market Model
  - National Income Model
  - Input-Output Model
  - Limitations of Static Analysis

- **Comparative Static Analysis (6 Hrs)**

  - Implicit Function Theorem
  - Application of Comparative Static Analysis
  - Comparative Static in General
  - Function Models

- **Differential Calculus (8 Hrs)**

- Derivatives and Differential Equations
- Economic Application of Derivatives
- Partial Differentiation
- Economic Application of Partial Differentiation

- **Integral Calculus** **(8 Hrs)**

  - Indefinite Integrals
  - Definite Integrals
  - Economic Application of Integration

- **Optimization** **(8 Hrs)**

  - Optimum Value and Extreme Value
  - Relative Maxima and Minima
  - Non-constrained Optimization
  - Constrained Optimization
  - Economic Application of Constrained and Non-constrained Optimization
  - Lagrangian Function and its Application

- **Optimization with Equality Constraints** **(4 Hrs)**

  - Effects of a Constrain
  - Utility Maximization and Consumer Demand
  - Homogenous Functions
  - Least-Cost Combination of Inputs

- **Other Optimization Techniques** **(6 Hrs)**

  - Linear Programming
  - Graphical Method
  - Simplex Method
  - Duality

## 6. Suggested Reading List

NB Students are advised to read extensively on the text books recommended by the lecturer, notes prepared by the lecturer and any other relevant books, web site and resources in the libraries.

The reading list will include but not limited to the following texts


1. Chiang, C. A. 1984. **Fundamental of Mathematical Economics**, 3rd ed. London: McGraw Hill

2. Dowling, E. F. **Mathematics for Economics**. McGraw Hill Book Co. Schaums Outline Series in Economics

3. Holder, K. & Pearson, A. W. **Introductory Mathematics for Economists**. Macmillan Press

4. Jacques, I. 1999. **Mathematics for Economics and Business**, 3rd ed. London: Prentice Hall

5. Mesquinta, A. G. 1978. **Business Mathematics and Statistics**. London: Longman

6. Mukras, M. S. 1978. **Elements of Mathematical Economics**. Nairobi: Kenya Literature Bureau

**Econometrics**

1. **Course Name**: Econometrics

2. **Course Code**: This is a level 3 course for third year students

3. **Course Description**

   This course entails the models and methods used to estimate relationships and test hypotheses pertaining to economic variables. This course applies many of the concepts and techniques learned in quantitative methods to regression analysis. Students are expected to be comfortable with basic algebra and matrices used to illustrate many of the important theoretical concepts. The course teaches students to understand as well as conduct basic empirical research in Economics. Topics include:

   - Correlation
   - Simple and Multiple Regression Analysis
   - Homoskedasticity and Heteroskedasticity
   - Autocorrelation
   - Multicolinearity
   - Simultaneous Equation Models

4. **Course Objectives**

   This course is intended to;

   - enable the learner to explain the models and methods used in analyzing economic variables
   - equip the learner with econometric analytical tools that can be used in analyzing economic variables
   - enable the learner to use the analytical tools he/she has learned to compute and any given economic variable
   - enable the learner attain proficiency in the use of econometric tools.

5. **Detailed Course Outline**

- **Nature of Econometrics** **(4 Hrs)**

  - Terminology
  - Probability and Distribution Theory
  - Random Variables and Probability Distribution

- **Correlation** **(4 Hrs)**

  - The Correlation Coefficient
  - The Rank Correlation Coefficient
  - Partial Correlation Coefficient

- **Regression Analysis** **(4 Hrs)**

  - Simple Linear Regression Model (OSL-Method)
  - Classical Regression Model and its Assumptions
  - Generalized Least Square and the violation of Gauss-Makov Assumptions
  - Goodness of Fit
  - Non-Linear Regression
  - Regression and Analysis of Variance (ANOVA)
  - Multiple Linear Correlation

- **Regression Diagnostics** **(4 Hrs)**

  - Non-normality, Outliers, Leverage and Influential Points
  - Testing for normality and use of transformed variables
  - Residual Analysis

- **Modeling Mean and Explanatory Data Analysis** **(6 Hrs)**

  - Assumptions of Normality of Mean
  - Homoskedasticity
  - Heteroskedasticity

- Outliers, Skewness and Data Transformation

- **Model Selection, Specification and Hypothesis Testing**

  **(6 Hrs)**

  - Specification errors and their consequences
  - Misspecification tests in regression analysis
  - Model selection approach

- **Errors and Estimators** **(6 Hrs)**

  - Standard Error Test
  - The Z-test of Least Square Estimates
  - The Student T- test
  - Confidence Intervals
  - Tests of Significance

- **Autocorrelation** **(8 Hrs)**

  - Introduction
  - Tests for Detecting Autocorrelation
  - Correcting for Autocorrelation
  - Methods for estimating Autocorrelation Parameters

- **Multicollinearity** **(8 Hrs)**

  - Introduction
  - Testing for Multicollinearity
  - Correcting for Multicollinearity
  - Multicollinearity and Prediction

- **Simultaneous Equation Models** **(6 Hrs)**

- Specification and Estimation
- The Simultaneous Equation Bias> Inconsistency in OLS Estimetors
- The Identification Problem
- Estimation Methods : ILS, Recursive Models and 2SLS

- **Introduction to Computer Statistical Applications (4 Hrs)**

  - Statistical Package for Social Sciences (SPSS)
  - Statistical Analysis System (SAS)

**6. Suggested Reading List**

NB Students are advised to read extensively on the text books recommended by the lecturer, notes prepared by the lecturer and any other relevant books, web site and resources in the libraries

The reading list will include but not limited to the following texts

Gordon, S. P. & Gordon, F. S. 1994. **Contemporary Statistics**. New York: McGraw Hill Inc.

Gujerad, **Basic Econometrics**

Johnston, J. 1987. **Econometric Methods**, New York: McGraw Hill Inc.

Katz, A. D. 1982. **Econometric Theory and Applications**, London: Prentice Hall

Kmenta, J. 1986. **Elements of Econometrics**, Macmillan

Koutsoyiannis, A. 2001. **Theory of Econometrics**. Delhi> Replika Press Pvt. Ltd.

Maddala, G. S. **Econometrics**, McGraw Hills Inc.

## 7. Teaching mode and Assessment Pattern

***Duration of Course***

The course is to be covered in one academic semester (15-week) with three hours of instructions per week and one-hour tutorial session per week. The course will be equivalent to 4 Credit Units (CUs).

**Mode of instruction**

- Lectures to be conducted by the lecturers
- Tutorials are to be conducted by teaching assistants
- Students are encouraged to seek guidance and assistance from other members of department/Faculty

***Assessment Pattern***

At least one assignment and one test will be administered, all contributing to 30% of the final mark. At the end of the semester, one examination that accounts for 75% will be administered.

The course will be graded as follows:

| Marks % | Letter Grade | Grade Point |
|---|---|---|
| 80-100 | A | 5.0 |
| 75-79.9 | B+ | 4.5 |
| 70-74.9 | B | 4.0 |
| 65-69.9 | B- | 3.5 |
| 60-64.9 | C+ | 3.0 |
| 55-59.9 | C | 2.5 |
| 50-54.9 | C- | 2.0 |
| 45-49.9 | D+ | 1.5 |
| 40-44.9 | D | 1.0 |
| 35-39.9 | D- | 0.5 |
| Below 35 | E | 0.0 |

The pass mark shall be 50%.

## 8. Responsibility of the student

- To regularly attend all lectures and tutorial sessions
- To do all course works, tests and examinations
- To participate actively during lectures and tutorial sessions

**9. Responsibility of the Course Lecturer**

- Regular and punctual teaching, accurate and prompt grading of assignments, tests and examinations.

**Electives/Other Courses**

**Urban Economics**

1. **Course Name:** Urban Economics

2. **Course Code:** This is a level 3 course for third year students

3. **Course Description**

   This course provides an introduction to urban economics within a context of public policy and planning. It is balanced between theory and application and targeted to students interested in better understanding the rationale for and effects of urban policy and planning. Urban real estate markets and the effects of public sector intervention, theoretical foundations of current urban problems and controversies and introductory microeconomics will be explored in this course.

4. **Course Objectives**

   - At the end of this course students should be able to:
   - Develop a theoretical foundation in the economics of urban development and real estate markets, with special emphasis on the housing market.
   - Develop familiarity with empirical research in urban economics
   - Develop an understanding of the motivation for public intervention in urban markets and the instruments used by local governments to do so
   - Apply theory to selected contemporary urban problems: urban sprawl,

traffic congestion, and housing affordability

- Apply theory to current controversies in urban planning and policy.

**5. Detailed Course Outline**

- **Urban Economic Growth, Labor and Real Estate Markets**

**(8 Hrs)**

- Local real estate markets
- Evolution of urban areas
- Employment patterns and trends
- Regulatory growth management programs
- Monocentric model
- Firm location

- **Housing** **(8 Hrs)**

- Housing policy
- Urban sprawls and spatial structures
- Housing market analysis
- Housing affordability
- Housing discrimination and racial segregation
- Poverty concentration and spatial mismatch hypothesis
- Neighborhood decline and revitalization
- Government intervention
- Rent control

- **Traffic and Transit** **(6 Hrs)**

- Traffic congestion
- Urban land use models
- Highways
- Urban transportation problems
- Road and rail transit

- **Zoning and Property Taxes** **(6 Hrs)**

  - Zoning laws
  - Zoning models
  - Metropolitan fragmentation
  - Central business unit

- **Urban Economy and Industrialization** **(6 Hrs)**

  - Cottage Industries
  - Industrial policy and strategy
  - Industrial areas
  - Industrial problems

- **Urban Infrastructure** **(6 Hrs)**

  - Financing infrastructure
  - Regulation for revenue

- **Urban Planning** **(8 Hrs)**

  - Need for urban planning
  - Urban planning strategies and models
  - The crisis in urban planning and reconstruction
  - Urban planning and structures in Uganda
  - Modernization

- **Urban Economic Problems of LDC'S** **(6 Hrs)**

  - Poor infrastructure
  - Urban unemployment
  - Rural-urban migration
  - Homelessness and poverty concentration

- Development of slums

- **Urban Welfare Economics (6 Hrs)**

  - Education
  - Food
  - Water
  - Shelter
  - communication

**6. Suggested Reading List**

NB Students are advised to read extensively on the text books recommended by the lecturer, notes prepared by the lecturer and any other relevant books, web site and resources in the libraries

The reading list will include but not limited to the following texts

DiPasquale, Denies and Wheaton, W.C. 1996. **Urban Economics and Real Estate Markets**. Prentice Hall: Englewood Cliffs, NJ. (D&W)

Jhingan, M. L. **The Economics of Development and Planning**, New Delhi: Konark Publishers. 34thEd.

Meier, G. M. **Leading Issues in Economic Development**, New Delhi: Oxford University Press

Singh, K. **Urban Sociology**, Lucknow: Prakashan Kendra

Todaro, M. P. **Economic Development in the Third Word**, Hyderabad: Orient Longman

Toley, S. G. & Vinod, T. The Economics of Urban Policies in Developing Countries

**Rural Economics**

1. **Course Name:** Rural Economics

2. **Course Code:** This is a level 2 course for second year students

3. **Course Description**

   Lecture topics will cover the economic problem, market supply and demand, the theory of consumer behaviour, the theory of the firm, production efficiency and technical change, monopoly and an introduction to welfare economics including Pareto optimality and alternative views of equity. Tutorial topics may include the role of the market and the state, partial equilibrium analysis of the effects of sales tax, Theodore Schultz's "poor but efficient" hypothesis, peasant farm household models, sharecropping and interlocking markets. Uganda's rural economics, structures, organizations, institutions, and policy will also be disused in this course.

4. **Course Objectives**

   At the end of this course students should be able to:

   - articulate the basic concepts and underlying principles of microeconomic theory in rural economics
   - explain the role of economists and the state in rural development
   - explain the theories of production, consumption exchange and welfare
   - relate these theories to rural structures and development problems in Uganda

5. **Detailed Course Outline**

- **Introduction** **(4 Hrs)**

  - Definition of Rural Economic
  - Production Theories
  - Consumption Theories

- Theories of Exchange
- Theories of Consumer Behaviour

- **Rural Economy and its Structures (6 Hrs)**

  - Features of Rural Economy
  - Occupation of Rural Economy
  - Land Tenure, Reforms and Measures
  - Property in Rural Areas
  - Poverty in Rural Areas

- **Rural Economics, Markets and Development (6Hrs)**

  - Foundation of New Institutional Economics
  - The concepts of bounded rationality, asymmetric information, psychological characteristics of the economic agents
  - Uncertainty and transaction costs
  - Modern view on the nature and role of the rural market
  - Institutional approach on the problems of rural development and growth

- **Rural Economy and Agriculture (6 Hrs)**

  - The Green Revolution
  - Subsistence farming
  - Commercial farming
  - Cooperative farming
  - Agricultural labour
  - Agricultural constrains
  - Uganda's rural agricultural system

- **Rural Economy and Industrialization (6 Hrs)**

  - Cottage Industries
  - Industrialization and agricultural development

- Industrialization and the food supply
- Industrialization and export agriculture
- The dual-sector models of Lewis, Fei-Ranis, and Jorgenson

- **Rural Organizations and Contracts (4 Hrs)**

  - Forms of internal and hybrid organization of the farmers transactions
  - Contractual forms of farmers transactions
  - Different types of contracts, their role in rural exchange, advantages and disadvantages

- **Rural Institutions and International Organizations (6 Hrs)**

  - Difference between Economics with and without institutions
  - The nature, types, and functions of rural institutions
  - Institutional approach to a wide range of agro-economic problems
  - Specific institutions typical for different countries
  - Major international organizations and initiatives that influence and direct rural development

- **Rural Planning and Reconstruction (4 Hrs)**

  - Need for rural planning
  - Rural planning strategies and models
  - The crisis in rural planning and reconstruction

- **Rural Policy and Analytical Tools (6 Hrs)**

  - Recently developed theories on modern rural policy
  - The positions and goals of all stakeholders in rural development
  - Various national, regional and international issues on rural policy
  - The quantitative and appropriate mathematical analytical applications used in rural economic analysis

- **Rural Economic Problems (4 Hrs)**

  - Rural infrastructure
  - Rural income and unemployment
  - Rural-urban migration
  - Indebtedness

- **Rural Research and Development (4 Hrs)**

  - Modern research techniques
  - Using empirical data for analysis
  - Incorporating business approaches in rural research

- **Rural Welfare Economics (4 Hrs)**

  - Education
  - Food
  - Water
  - Shelter
  - communication

**6. Suggested Reading List**

NB Students are advised to read extensively on the text books recommended by the lecturer, notes prepared by the lecturer and any other relevant books, web site and resources in the libraries

The reading list will include but not limited to the following texts

Jhingan, M. L. **The Economics of Development and Planning**, New Delhi: Konark Publishers. 34$^{th}$Ed.

Meier, G. M. **Leading Issues in Economic Development**, New Delhi: Oxford University Press

Singh, K. **Rural Sociology**, Lucknow: Prakashan Kendra

Todaro, M. P. **Economic Development in the Third Word**, Hyderabad: Orient Longman

**Transport Economics**

1. **Course Name:** Transport Economics

2. **Course Code:** This is a 2nd or 3rd year course

3. **Course Description**

The Course examines the economic problems of transport operations and planning at firm, local and national government levels. Precisely it looks at transport providers, demand and supply transport, transport policies, intervention and regulation as well as transport planning models.

4. **Course Objectives**

To offer training in the application of economic techniques and skills to the problems of the transport sector. To make students appreciate the role of transport in the economic development of their countries.

5. **Detailed Course outline**

**1.0 Introduction (8hrs)**

- The context of transport economics
- Principles of transport economics
- Transport infrastructure, transport providers and users;
- The role of transport in the national and regional economy,
- Transport, logistics and supply-chain management

- Consideration of the economic, social and environmental impacts of transportation; Review of recent debates on relationship between transportation infrastructure and economic growth.

**2.0 Transport providers - the transport firm and transport industries (6hrs)**

- Revenue, costs (shared, joint & common) and the supply function for transportation firms;
- Competition, contestability and monopolistic behaviour; production and costs functions Economies of scale, economies of density and economies of scope;
- Economics of freight versus passenger traffic.

**3.0 Analysis of Transport Demand (5hrs)**

- Nature of transport demand; elasticities; consumer surplus; valuation of travel time; demand for car ownership; demand for public transport.

**4.0 Pricing policies (7hrs)**

- Provision of public infrastructure; Pricing/charging policies for uncongested facilities; Economic theory of public utility rate setting;
- Optimal charging/pricing systems for congested facilities;
- Capital recovery theorem; Examples of road pricing schemes; Issues (economic, political and legal) arising in relation to congestion charging.

**Cost-Benefit analysis (7hrs)**

- Economic concepts of costs and benefits;
- Comparison of private and public enterprise objectives; undertaking Cost-Benefit analysis for public transport projects;
- Valuation of benefits and costs; present value maximization; Case studies

of transport project evaluations: Road construction/improvement projects - airport construction projects

**6.0 Intervention and regulation (7hrs)**

- Monopoly; safety; cross-subsidy; externalities; costs of regulation.
- Examples of regulation in the airline industry and the bus industry.
- Privatization of the transport

**7. 0 Network design models and transportation planning (5hrs)**

Elements of a transport network; the transportation problem of linear programming; general form of network design models; gravity models and the concept of 'entropy' in transport networks.

**6. Suggested Reading List**


1. Button Kenneth (Ed.) (2003), Recent Developments in Transport Economics, Edward Elgar Publishers

2. Button K.J. and D. Pitfield (eds) (1991) Transport Deregulation – An International Movement, Macmillan, London
3. Button K.J. and D. Banister (eds) (1991) Transport in a Free Market Economy, Macmillan, London

**4.** Campbell F Harry and Richard P. C. Brown (2003), Benefit-Cost Analysis**,** Cambridge University Press
5. Cole Stuart (2005), Applied Transport Economics, 3rd Edition

**6.** Hensher A. David and Ann M. Brewer (2001), Transport: An Economics and Management Perspective. Oxford University Press.

7. Mccarthy Patrick (2001), Transportation Economics, Blackwell Publishers

Rietveld Piet, Kenneth Button, Peter Nijkamp (Eds.) (2003), Urban Transport, Edward Elgar Publishers

**NB: The following elective courses are yet to be submitted**

- Agricultural Economics
- Industrial Economics
- Environmental Economics
- Resource Economics
- Business Law
- Project planning and Management (PPM)
- Fundamental Accounting
- Managerial Economics
- Labour Planning and Management
- Strategic Management
- Public Economics