

Scheme of Studies

Associate Degree in Science
Combination-III
(General Math, Economics & Statistics)

Semester-I

Sr. No	Course Code	Course Title	Crd. Hrs		
			Theory	Lab.	Total
1	ENG-1107	Functional English (C1)	3	0	3
2	ISL-1112/ ETH-1112	Islamic Studies/Ethics (C2)	2	0	2
3	MAT-1115	Calculus-I (Ma1, F1)	3	0	3
4	STA-1101	Statistics-I (S1, M1)	3	1	4
5	ARA-1101	Arabic (C3)	3	0	3
Total			14	1	15

ENG-1107

ENGLISH-I (Functional English)

Credit Hrs: 03

Basics of Grammar, Parts of speech and use of articles, Sentence structure, active and passive voice, Practice in unified sentence, Analysis of phrase, clause and sentence structure, Transitive and intransitive verbs, Punctuation and spelling, Comprehension: Answers to questions on a given text, Discussion: General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students), Listening: To be improved by showing documentaries/films carefully selected by subject teachers, Translation skills: Urdu to English, Paragraph writing: Topics to be chosen at the discretion of the teacher, Presentation skills: Introduction. **Note:** Extensive reading is required for vocabulary building

RECOMMENDED BOOKS

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
3. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-4
4. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

ISL-1112

ISLAMIC STUDIES

Credit Hrs: 03

Fundamental of Islam, Tauheed: Arguments for oneness of God, impact of Tauheed on human life, place of man in the universe, purpose of creation, textual study of Surah al- Rehman and Surah al- Furqan, Prophethood, need for prophet, characteristics of a prophet, finality of prophethood, seerat; life of prophet as embodiment of Islamic ideology, faith in hereafter aakhirat, effects of belief on worldly life. Ibadah: Concepts of Ibadah, Salat, Saom, Zakat, Hajj and jihad. The Holy Quran: Its revelation and compilation, The authenticity of the text, Hadith: Its need, authenticity and importance. Consensus (Ijma), analogy (Qiyas). Sources of Knowledge: Islamic approach to institution, Reason and experience. Revelation Wahi as a source knowledge. Moral and social Philosophy of Islam: The concept of good and evil, Akhlaq -e- Hasna with special reference to surah Al- Hujrat, Professional Ethics Kasb-e- Halal. Islamic Political Principles: Salient feature of the Islamic state, Madina character, Responsibilities of the Head of the state, Rights and Duties of Citizens. Economics Oder of Islam: Right to property, System of Taxation, Distribution of Wealth Zakat and Ushar, Interest Free Economy Shirakat and Muzarabat. Islam as Living Force: Application of Islam Teaching to Socio- Economic Development in the 20th Century.

RECOMMENDED BOOKS

1. Muhammad, H. "Emergence of Islam", IRI, Islamabad.
2. Muhammad, H. "Muslim Conduct of State"
3. Muhammad, H. "Introduction to Islam"
5. Hussain, H. H. "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.

6. Hasan, A. "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)

7. Mir, W. 1982. "Muslim Jurisprudence and the Quranic Law of Crimes"

Islamic Book Service.

8. Bhatia, H.S. 1989. "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi.

9. Muhammad, Zia-ul-Haq. 2001. "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad.

MAT-1115

CALCULUS-I

Credit Hrs: 03

Introduction, real numbers, intervals, absolute values and its properties, coordinates planes and graphs, lines, functions, operation on functions, graph of functions, shifting of graph limits, continuity, graphical and analytical approach. The derivatives, geometrical meanings of derivatives, tangent lines and rate of changes. Derivatives of Trigonometric functions, inverse trigonometric functions, the chain rules, implicit differentiation, differential derivative of hyperbolic, inverse hyperbolic, logarithmic, exponent function, first order differential equation and application, increase and decrease, concavity relative extrema, first and second derivatives test, Maximum and minimum of a function, applied maximum and minimum problem, L' hospital rules integration, basic rules of integration, formula of integration, integration by parts, by substitutions, partial fraction definite integrals, Riemann sur theorems of definite integral, first and second fundamental theorems of calculus definite integral with property areas between curves, Disk and washer, volumes by cylindrical shell and slicim length of plane curves, Area of surface of revolution, First order differential equation and applications, Roll's theorem, mean values theorem and its application, improper integral, convergent and divergence of integrals, straight line in R³, Planes, Cylindrical and Spherical coordinate surfaces, cylinders and cones, sphere, spherical trigonometry.

RECOMMENDED BOOKS

1. Calculus and analytical Geometry, by Thomas & Finny. 10th Edition.
2. Calculus & Analytical Geometry, by Howard anton, 7th Edition
3. Calculus & Analytical Geometry, by S.M. Yosuf.
4. Calculus & Analytical Geometry, by SkowSky. 6th Edition.

STA- 1101: INTRODUCTORY STATISTICS

Learning Objectives:

1. To have introduction of statistics as a field of knowledge and its scope and relevance to other disciplines of natural and social sciences.
2. To equipped and prepare students for advance courses in the field of statistics.
3. To achieve the capability of critical thinking about data and its sources; have idea about variables and their types and scale measures.
4. Be able to calculate and interpret descriptive statistics (able to classify, tabulate, describe and display data using software).

Learning Outcomes:

1. Acquire the basic knowledge of the discipline of Statistics.
2. Understand and differentiate between the types of data and variables.
3. Evaluate and Interpret basic descriptive statistics. Display and Interpret data graphs.

Course Contents:

The nature and scope of the Statistics, Variables and their types, Data and its sources, Scales of measurements, Tabulation and classification of data, Graphs and Charts: Stem-and leaf diagram, Box and Whisker plots and their interpretation. Measures of Central Tendency, Quantiles, Measures of Dispersion: Their properties, usage, limitations and comparison. Moments, Measures of Skewness and Kurtosis and Distribution shapes. Rates and ratios, Standardized scores.

Index numbers: construction and uses of index numbers, un-weighted index numbers (simple aggregative index, average of relative price index numbers), weighted index numbers (Laspeyres's, Paasche's and Fisher's ideal index numbers), Consumer price index (CPI) and Sensitive Price Indicators

Recommended Books:

1. Clark, G.M. and Cooke, D. (2011). "A Basic Course in Statistics", 5th edition, Arnold, London.
2. Ross, S. M. (2010). "Introductory Statistics", 3rd edition, Academic Press USA.
3. Mann, P. S. (2010) Introductory Statistics. Wiley.
4. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2012). "Probability and Statistics", 4th edition, Schaums Outlines Series. McGraw Hill. NY.
5. Walpole, P.E. Myers, R.H., Myers S.L. (2012). "Probability and Statistics for Engineers and Scientists", 9th edition, Prentice Hall.
6. Zaman, A. (2016), "Introduction to Statistics" Online access for book and related data sets.

a. <https://sites.google.com/site/introstats4muslims/textbook>

<https://sites.google.com/site/introstats4muslims/excel>.

ARA-1101

ARABIC

Credit Hrs: 03

الاولى الدرسي

تعریف فات، کی حرف، فعل اسم، مثالیں اسد تعمال، کائن اشارات اسمائے معانی۔ ال فاط، عربی *
مثالیں

امثالہ واسد تعمال کابل، نعم، اسد تفہام، کلمات *

الثانی الدرسي

مشق اسد تعمال، میں جملوں عربی متصلہ ضمائر اقسام کی ضمائر معانی، ال فاط *

ال ثلاث ال درس

ام ثلہ تہ عریف۔ ، اضافی مرکب ام ثلہ و تہ عریف فات کی نہ فی حروف لہ یست، لالہ یس، معانی ال فاض، *
مشق تہ رجمہ، جملے، عربی

ال سادس ال درس

مشق، م ثلہ میں اور مکسر جمع قواعد م ثلہ میں اور اقسام کی جمع جمع واحد، *

ال سابع ال درس

مشق ام ثلہ، ماضی، وفعل قواعد م ثلہ میں کی ماضی فعل کی لمات تہ عریف ماضی، فعل *

ال ثامن ال درس

مشق مکالمہ۔ مضارع، فعل قواعد ام ثلہ و مضارع، فعل کی لمات مضارع، فعل *

ال تاسع ال درس

مشق م ثلہ میں۔ و مصدنف فعل قواعد ام ثلہ و مصدنف فعل کی لمات و مصدنف فعل *

ال عاشر ال درس

مشق قواعد، م ثلہ میں۔ معتل، فعل صدیح، فعل کی لمات معتل، فعل صدیح، فعل *

ال حادی ال درس

مشق الخمس تہ، اسماء م ثلہ میں۔ موزن، موزن کی لمات موزن، موزن *

ال ثانی ال درس

ام ثلہ و عقود اعداد و قواعد ام ثلہ و اعداد اعداد *

ال ثلاث ال درس

ام ثلہ ای کی ماسد تعمال کی ان اور کی مای *

ال رابع ال درس

جملے م ثلہ میں، کی لمات فاعل، اسم *

ال خامس ال درس

م ثلہ میں جملے، الاجسام اعضاء *

ال سادس ال درس

ام ثلہ و کی لمات *

ال سابع ال درس

فعلیہ جملہ و اسمیہ جملہ *

ال ثامن ال درس

الحروف مخارج، قمریہ، شمسیہ، حروف حلقی، حروف مدہ حروف الہجاء، حروف *

ال تاسع ال درس

ضد تہ الامر ال ضیاء، اجمل ما، دُعا الامذ تارہ ناشدیدا لا *

پاکستان آباد اسلام یونورسٹی اوپن ایف بال علامہ العربی۔ ال لسان بک ٹریکسٹ

Semester-II

Sr.No	Course Code	Course Title	Crd. Hrs		
			Theory	Lab.	Total
1	ECO-1201	Economics (Ec1, M2)	3	0	3
2	COM-1205	Introduction to Computer (C4)	2	1	3
3	MAT-1215	Calculus-II (Ma2, F2)	3	0	3
4	STA-1202	Statistics-II (S2, M3)	3	1	4
5	ENG-1207	Composition & Comprehension (C5)	3	0	3
Total			14	2	16

ECO-1201

PRINCIPLES OF MICRO ECONOMICS

Objectives:

Microeconomics studies the behavior of specific economic units that make up the economic aggregates. Microeconomics is the subject matter of this course explaining the behavior of specific economic units. The main focus will be on theories of consumption, production, distribution and role of the government. Topics include demand, supply, household behavior and consumer choice, the cost structure of the firms, market structures, market failures and externalities, economic regulations and Good governance. The course will rely heavily on graphical analysis and simple numerical calculations.

Introduction to Economics:

Studying Choice in a World of Scarcity :The No-Free-Lunch Principle , The Cost-Benefit Principle , Reservation Prices , Economic Surplus , Opportunity Cost , The Role of Economic Models , To What Extent should an Activity be Perused , Micro Economic Versus Macro Economics , Economic Naturalism , Positive Versus Normative Economics , Some common Pitfalls for Decision Makers , Conclusion.

Consumer Behaviour:

Cardinal Approach/Utility Analysis, Marginal Utility, Law of Diminishing Marginal Utility, Law of Equi-Marginal Utility, Consumer Equilibrium Ordinal Approach of Consumer Behavior, Indifference Curves, Features of Indifference Curves, Budget Line, Consumer Equilibrium, Comparison between two approaches Conclusion.

Demand & Supply:

Demand Function, Law of Demand, Shift in Demand, Change in Demand Factors Affecting Demand, Supply Function, Law of Supply, Changes in Supply Price Equilibrium, Market Equilibrium.

Elasticity of Demand & Supply:

Price Elasticity of Demand & Supply, Point Elasticity of Demand & Supply Arc Elasticity of demand & Supply, Income Elasticity of Demand & Supply, Cross Elasticity of demand & Supply, Conclusion.

Efficiency and Exchange:

Market Equilibrium and Efficiency, Economic Surplus, the Cost of Preventing Price Adjustments, Taxes and Efficiency, Conclusion.

The Theory of production & Theory of Cost:

The Production Function , Total, average and marginal product, Laws of Returns to Scale , Short run Theory of Cost , Seven family cost curves, Relationship between Production and Cost Curves . Long-run Theory of Cost: Graphical Representation of Long Run Cost Economies, Diseconomies and Constant Returns to Scale.

Market Structure:

Perfect Competition vs. Pure Competition, Different Possibilities of SR firm Equilibrium, Profit Maximization in the Short-run and long-run
 Monopoly: Short run and Long run Equilibrium under Monopoly. Conclusion (Comparison of both) Imperfect Competition: Monopolistic Competition, Price and output determination in monopolistic competition , Comparison perfect competition with monopolistic competition Oligopoly: Definition, Strategic behavior and game Theory, Price Rigidity and the kinked demand curve, Conclusion (Comparison of both) Labor Markets
 The Market Demand for Labor, Supply of labor, Shifts in the market demand for and supply of labor, Inefficiency wages, monopsony

Textbooks & Supplies:

1. Mankiw, "Principles of Economics" 7th Edition, (2008), Southwest Publishers
2. Miller, R. L –EconomicsToday-14th Edition (2005) Addison Wesley

Supplementary Material:

Samuelson Nordons –Economics -18th edition (2004), McGraw-Hill, Inc.
 McConnell and Bruce-Principles of Economics -17th Edition, (2006), McGraw-Hill.

COM-1205 INTRODUCTION TO COMPUTING Credit Hrs: 03

Brief history of computers and their applications, Major, components of a computer (CPU and Memory, Data storage devices, Input/Output devices), Software (Standards, Application software, System software, Standard options, Windows, Linux and Macintosh) Computers Networks, Telecommunication basics, The Internet and the World Wide Web, Web Pages, Intro to Information Systems in Business, Office automation tools, Word processing, Graphic packages, Databases and Spreadsheets, Current trends in research and future prospects, Legal and moral aspects of Computer Science, Presentation Software etc.

RECOMMENDED BOOKS

1. Meta, Toledo, Roman, Schaum's Outline of Introduction to Computer Science, McGraw Hill, Book Company, 2000
2. Kelly, Julia, Nelson, Stephan L., Office XP The Complete Reference, McGraw Hill Book Company, 2001.
3. Joseph, Rubin, Excel 2007, CPA Company, 2007
4. Michael, Halvorson, Microsoft XP 2000, Microsoft Press Washington, 2007.

MAT-1215 CALCULUS-II Credit Hrs: 03

Sequences, Monotone sequences, convergence of sequence, infinite series, partial sum, convergence test Alternating sequence, conditional convergence, Power series Taylor's and Maclaurin's series, differential and integration of series. Arc length in polar, Cartesian, parametric curves, surface area, area in polar and Cartesian form of curves. Area of revolution in polar and Cartesian forms. Conversion of systems, Unit tangent and normal Vectors, Curvature and radius of Curvature, Motion along a curve. Function of several variables, homogeneous function Euler theorem, Partial derivatives, Laplace equation. Differentiability and chain rules, Tangent planes, total differential, Directional Derivatives

Gradient of two functions Function of n- Variables maxima and minima of two functions Lagrange Multipliers Double integral, triple integrals Centroid, center of Gravity, Total mass. Triple integrals, Jacobians, triple integrals in cylindrical and Spherical coordinates. Introduction to conic section, rotation of axes, Parabola, Ellipse, Hyperbola, Sketching of conics Volumes of Surfaces, complex numbers: DeMoivre's theorem and its applications, Complex functions, analytical functions, harmonic and conjugate, harmonic functions, Cauchy- Rehmunn equations (in Cartesian and polar coordinates). Line integrals, Green's theorem, Cauchy' theorem, Chauchy's integral formula, singularities, poles, residues and contour integration and applications.

RECOMENDED BOOKS

1. Calculus & Analytical Geometry, by Thomas & Finny, 10th Edition
2. Calculus & Analytical Geometry, by Howard Anton, 7th Ed
3. Calculus & Analytical Geometry, by S.M. Yousaf
4. Calculus & Analytical Geometry, by Skowsky, 6th Edition.

STA- 1202: Introduction to Probability Theory

Learning Objectives:

1. Understand basic concepts of probability, conditional probability, independence etc.
2. Be familiar with some of the more commonly encountered random variables, particularly the Binomial and Normal random variable.
3. Be able to calculate first two moments of common random variables i.e. means and variances.
4. Be able to apply the concepts of random variables to scientific applications. Computation of uncertainty using probability techniques.

Learning Outcomes:

1. Acquire the basic knowledge of probability and probability distribution.
2. Understand the concepts of basic techniques of measuring the uncertainty problem.
3. Analyze the problem of genetics finance and telecommunications by using probability techniques.

Course Contents:

Set theory and its operations, Probability Concepts, Addition and Multiplication Rules, Bivariate Frequency Tables, Joint and Marginal Probabilities, Conditional Probability and Independence, Bayes' Rule. Random Variables, Discrete Probability Distribution, Mean and Variance of a Discrete Random Variable, Bernoulli Trials, Properties, Applications and Fitting of Binomial, Poisson, Hypergeometric, Negative Binomial and Geometric Distributions. Continuous Random Variable, Probability Density Function and its Properties, Normal Distribution and its Properties, Standard Normal Curve.

Recommended Books:

1. Cacoullos, T. (2012). *Exercises in probability*. Springer Science & Business Media.

2. Mclave, J.T., Benson, P.G. and Snitch, T. (2005) "*Statistics for Business & Economics*" 9th Edition. Prentice Hall, New Jersey.
3. Santos, David (David A.) (2011). *Probability: an introduction*. Jones and Bartlett Publishers, Sudbury, Mass 20.
4. Walpole, P.E. Myers, R.H., Myers S.L. (2012). "Probability and Statistics for Engineers and Scientists", 9th edition, Prentice Hall.

Semester-III

Sr.No	Course Code	Course Title	Crd. Hrs		
			Theory	Lab.	Total
1	PS-2317	Pakistan Studies (C6)	2	0	2
2	ECO-2302	Economics-II (Ec2, M4)	3	0	3
3	STA-2303	Statistics-III (S3, M5)	3	1	4
4	MAT-2315	Linear Algebra (Ma3, M6)	3	0	3
5	ENG-2307	Communication Skills (C7)	3	0	3
6	ECO-2303	Economics-III (Ec3, M7)	3	0	3
Total			17	1	18

An overview of the British Rule in the sub-continent, two nation theory & role of Sir Sayyed for the revival of Muslims, major political organization (congress muslim league), Constitutional reforms, Constitutional & political struggle (separate electrolate, Lucknow Pact), Tehrik –e-Khilafat, Nehru Report, Jinnah’s 14 point, e-Allah Abad Address 1930, Round table conferences, Election of 1937 and Congress Minstries, Pakistan Moment (194047), Crips proposal 1942, Wavell plane and shimla conference 1945, Election of 1945-46, Cabinet mission plan 1946, 3rd June plane and Red cliff award, Pakistan's Immediate Problems: Administrative problems, problems of Refuges, Problems of Accession of states(Kashmir, Hyderabad, June Garh), Distribution of Assets, Canal Water dispute, political and constitutional Development, Hurdles of Constitution Making, 1956 constitution, Islamic clauses) 1962 constitution (Islamic clauses) and Ayub Era, Yahya Regime and first General election 1970, Bhutto in power 1973 constitution (Islamic clauses), Zia government steps for Islamization, Era of Democracy (1988-1999), Pakistan’s foreign policy: Relations with USA, Soviet union, Relations with neighboring countries (India, china, Iran, Afghanistan), Relations with Saudi Arabia and Turkey, Pakistan and International Organizations (UNO, OIC, ECO,SAARC), M.D. Zafar, Pakistan studies, Aziz Book Depot Urdu Bazaar Lahore.

RECOMMENDED BOOKS

1. Sheikh Muhammad Rafique, Pakistan studies, urdu Bazar Lahore
2. Sheikh Muhammad Rafique, History of Pakistan, urdu Bazar Lahore.

ECO-2302 PRINCIPLES OF MACROECONOMICS

Objectives:

The course is designed for the beginners with no formal background or little acquaintance with economics. The objective is to give the students with a clear understanding of the basic concepts, tools of analysis and terminologies used in macroeconomics. The teacher is expected to draw examples from the surrounding world to clarify the concepts.

Course Contents:

Introduction:

The economy in aggregate, Complexities of the world of business, Scope of macroeconomics, Brief account of classical and the development of macroeconomic

after the World War-II, Concept of business cycles: Boom and Depression, three concerns of macroeconomics, Inflation, GDP growth and unemployment, Macroeconomic variables and their mutual relationship, Macro-models as abstraction from the real economy.

National Income:

Definition and concept of national income, Measures of national income: Gross Domestic Product (GDP) and Gross National Product (GNP), GDP at factor cost and at market prices, Computation of national income: Product, Income and Expenditure approaches, Circular flow of income, Nominal

versus Real income, Per capita income and the standard of living.

Components of Aggregate Demand:

The Concept of Open and closed economy models, Concept of aggregate markets: Product, Money, Labor and Capital markets, Components of aggregate demand: Consumption, Investment and Government spending, Income and expenditure identities. Money and Monetary policy, Fiscal Policy.

Recommended Texts:

1. Mankiw, G—Principles of Economics- latest edition.
2. Samuelson and Nordhaus - Economics –latest edition

Additional Texts:

1. Parkin, Michael - Macroeconomics, latest edition
2. Miller, R.L.— Economics Today – latest edition

STA- 2303: Basic Statistical Inference

Learning Objectives:

1. To understanding of basic techniques of sampling and estimation, their properties and application
2. To select a sample from a given population and use it to make inferences about the population and its parameter
3. To test, deduce and infer the validity of different types of hypotheses and models built on the basis of the raw data collected in diverse problem-situations.

Learning Outcomes:

1. Acquire the knowledge of the sampling distributions and their properties.
2. Derive the appropriate estimators for parameters using best estimation procedure.
3. Use appropriate sampling distributions for interval estimation and hypotheses testing.
4. Apply appropriate inferential procedures to handle the practical situations.

Course Contents:

Sampling and sampling distribution of sample mean, proportion, difference between means and difference between proportions; Point and interval estimate properties of good point estimator; Testing of hypothesis for population mean, difference between population means and population proportion and difference between two population proportions, difference between means for paired data; Single population variance, ratio of two variances; Non-parametric methods: The sign test, Wilcoxon's signed rank test, Mann-Whitney U test, Median test, Run test, Kolmogorov-Smirnov test, Kruskal-Wallis test, Median test for k-samples, Friedman test.

Recommended Books:

1. Ross, S. (2019). *A first course in Probability*. 10th edition. Pearson Education Limited.
2. DeGroot, M. Schervish, M. (2017). *Probability and Statistics*. 4th edition. Pearson Education Limited.
3. Srivastava, M.K., Khan, A.H. and Srivastava, N. (2014). *Statistical Inference: Theory of Estimation*. Prentice-Hall of India Pvt. Ltd
4. Clark, G.M. and Cooke, D. (2011). "A Basic Course in Statistics", 5th edition, Arnold, London.
5. Mclave, J.T., Benson P.G. and Sincich, T. (2014). "Statistics for Business and Economics". 12th edition, Pearson Education Ltd, U.K.
6. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2015). "Probability and Statistics". 3rd edition, Schaums Outlines Series. McGraw-Hill. NY.

MAT-2315

LINEAR ALGEBRA

Credit Hrs: 03

System of Linear Equations: Basic concepts. Standard matrix form, Inverse of matrix, Matrix operations, Elementary row and column operation Echelon & Reduce Echelon form System of homogeneous & non-homogeneous linear equations (Gauss Elimination and Gauss-Jordan). Application of linear equations, Linear Dependence & Independence sets of vectors, Linear Transformations. Vector spaces: Definitions, Properties of vector spaces, vector spaces and subspaces, Basic, Dimensions of vector space, Eigen vector & Eigen value, Characteristic Equations, Eigen vectors and Linear Transformations, Inner Product, Length and Orthogonality sets, Gram Schmidt process, Inner Product Spaces.

RECOMMENDED BOOKS

1. Linear algebra and its application (3rd edition) by David C. Lay.
2. Advance Engineering Mathematics by Ervin KAREYZIG, 9th Edition.
3. Elementary Linear Algebra (8th edition) by ANTON.

ENG-2307

ENGLISH-III (Communication Skills)

Credit Hrs: 03

Paragraph writing, Practice in writing a good, unified and coherent paragraph, Essay writing, Introduction, CV and job application, Translation skills, Urdu to English, Study skills, Skimming and scanning, intensive and extensive, and speed reading, summary, and précis writing and comprehension, Academic skills, Letter/memo writing, minutes of meetings, use of library and internet, Presentation skills, Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review.

RECOMMENDED BOOKS

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

2. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
3. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).
4. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
5. Reading and Study Skills by John Langan
6. Study Skills by Richard Yorky.

STA-2320

PROBABILITY AND STATISTICS

Credit Hrs: 03

Objective:

This course is to introduce the notions of probability and statistics to enable students to apply in the different fields of actions in physics. The concepts of data preparation and analysis is the key feature of this course.

What is Statistics? Definition of Statistics, Population, sample Descriptive and inferential Statistics, Role of statistics in physics, Observations, Data, Discrete and continuous variables, Errors of measurement, Significant digits, Rounding of a Number, Collection of primary and secondary data, Sources, Editing of Data. Exercises. Presentation of Data Introduction, basic principles of classification and Tabulation, Constructing of a frequency distribution, Relative and Cumulative frequency distribution, Diagrams, Graphs and their Construction, Bar charts, Pie chart, Histogram, Frequency polygon and Frequency curve, Cumulative Frequency Polygon or Ogive, Histogram, Ogive for Discrete Variable. Types of frequency curves.

Exercises. Measures of Central Tendency: Introduction, Different types of Averages, Quintiles, The Mode, Empirical Relation between Mean, Median and mode, Relative Merits and Demerits of various Averages. Properties of Good Average, Box and Whisker Plot, Stem and Leaf Display, definition of outliers and their detection. Exercises. Measures of Dispersion Introduction, Absolute and relative measures, Range, The semi-Inter-quartile Range, The Mean Deviation, The Variance and standard deviation, Change of origin and scale, Interpretation of the standard Deviation, Coefficient of variation, Properties of variance and standard Deviation, Standardized variables, Moments and Moments ratios. Exercises. Regression and Correlation: Introduction, cause and effect relationships, examples, simple linear regression, estimation of parameters and their interpretation. r and R^2 . Correlation. Coefficient of linear correlation, its estimation and interpretation. Multiple regression and interpretation of its parameters. Examples. Probability

and Random Variable.: Introduction to probability, sample Space, Events, Laws of probability with their applications, Conditional probability, dependent and independent events, Bayes theorem and its applications. Random variable discrete and continuous random variable with their application. Mathematical Expectation, Mean, Variance etc. Statistical Packages and data analysis. SPSS software, Data analysis on excel and E Views etc.

Recommended Books:

1. R.E. Walpole, Introduction to Statistics. Macmillan Publishing Co., Inc. New York, 3rd Ed, 1982.
2. F. Muhammad, Statistical Methods and Data Analysis, Kitab Markaz, Bhawana Bazar Faisalabad, 2005.
3. B L Agarwal, Basic Statistics? New Age International, 2006. 4. Carver, Nash, Doing Data Analysis with SPSS version 14.

ECO-2303 INTERMEDIATE MICROECONOMICS

PRE REQUISITE: Principles of Microeconomics

Objectives:

The course seeks to provide an understanding of the core economic models for the analysis of decisions by consumers, markets and firms. It would provide some illustrations of the applications of some models to contemporary issues in economics. It also emphasizes upon the welfare concept in economics

An introduction to Economic models:

Optimization techniques, Constructing a model, Optimization and equilibrium,

Utility:

Constructing a Utility Function, Maximization of function of one variable Functions of several variables, Constrained maximization, utility maximization Axioms of rational choice, Utility, Indifference curves and marginal rate of substitution Utility functions for specific preferences, Utility maximization: optimization principle Indirect utility function, Income and substitution effects, Demand relationship among goods Demand functions, Changes in income, Changes in goods price, Individual demand curve Compensated demand curve, Mathematical development response to price changes, Consumer surplus revealed preferences, Substitutes and compliments Substitutability with many goods composite commodities.

From Individual to Market Demand:

The Inverse Demand Function, the Elasticity of a Linear Demand Curve Elasticity and Demand, Elasticity and Revenue, Elasticity and Marginal Revenue.

Supply:

Market supply, Market equilibrium, Effect of tax Taxation with Linear Demand and Supply Passing along a Tax, Consumer and producers' burden of tax, deadweight Loss of a Tax.

Production function:

Marginal productivity, Iso quant maps and the rate of technical substitution Returns to scale, the elasticity of substitution, Cost functions Cost functions and the shifts in the cost curves, Short run long run distinction, Profit maximization.

Firms:

The nature and behavior of firms, Profit maximization, Marginal revenue, and short run supply by a price taking firm, Profit functions, Profit maximization

and input demands.

Monopoly:

Linear Demand Curve and Monopoly, Markup Pricing, The Impact of Taxes on a Monopolist, Inefficiency of Monopoly, Deadweight Loss of

Monopoly, Price Discrimination, First Degree Price Discrimination, Second-Degree Price Discrimination, Third-Degree Price Discrimination

Oligopoly:

Choosing a Strategy, Quantity Leadership, the Follower's Problem, the Leader's Problem Price Leadership Comparing Price Leadership and Quantity Leadership, Simultaneous Quantity Setting Cournot Equilibrium, Simultaneous Price Setting, Collusion.

Game theory:

Basic concepts, Nash equilibrium, Existence of Nash equilibrium, the prisoners dilemma, A two period game, Pricing in static games, Entry exit and strategy, Games of incomplete information.

The Edge Worth Box:

Trade, Pareto Efficient Allocations, Market Trade, The Algebra of Equilibrium Walras' Law, Relative Prices, Equilibrium and Efficiency, Pareto Efficiency, Social Welfare Functions Welfare Maximization, Individualistic Social Welfare Functions, Fair Allocations.

Textbooks:

- 1) Intermediate Microeconomics: A Modern Approach, 7th Edition by Hal R. Varian.
- 2) Microeconomics by Pindyck and Rubinfeld 8th Edit.
- 3) Microeconomic theory Basic Principles and Extensions, 9th Edition by Nicholson, W.

Semester-IV

S- No	Course Code	Course Title	Crd. Hrs		
			Theory	Lab.	Total
1	ECO-2404	Economics-IV (Ec4, M8)	3	0	3
2	MAT-2404	Ordinary Differential Equations (Ma4, M9)	3	0	3
3	STA-2404	Statistics-IV (S5, M10)	3	1	4
4	ECO-2420	Economics-V (E1)	4	0	4
5	*SUB-2499	Project Or	4 or 3	4 1	4
	MAT/STA/ECO 2401	Mathematics/ Statistics /Economics(E2) Or Programming Fundamental			
Total			17	1	18

*SUB(MAT or STA or ECO)

ECO-2404 INTERMEDIATE MACROECONOMICS

PRE REQUISITE: Principles of Macroeconomics

Reading Material:

Textbook:

1. Mankiw, N. Gregory (2013). Macroeconomics. 8th Edition, Worth Publishers.
2. *Supplementary Texts*
3. Abel, Andrew, B., Bernanke, Ben S. & Croushore, D. (2010). Seventh Edition. Addison-Wesley.
4. Williamson, Stephen D. (2010). Macroeconomics. 4th Edition, Prentice Hall.

And other readings and handouts, as required.

Topics and Chapters to be Covered:

A. INTRODUCTION TO MACROECONOMICS

1. The Science of Macroeconomics (Mankiw Ch#1, ABC Ch#1, Williamson Ch#1)

- 1.1 What Macroeconomists Study
- 1.2 How Economists Think

2. The Data of Macroeconomics (Mankiw Ch#2, ABC Ch#2, Williamson Ch#2)

- 2.1 Measuring the Value of Economic Activity: Gross Domestic Product
- 2.2 Measuring the Cost of Living: The Consumer Price Index
- 2.3 Measuring Joblessness: The Unemployment Rate
- 2.4 From Economic Statistics to Economic Models

3. National Income: Where it comes from and Where it Goes? (Mankiw Ch#3, ABC Ch#3, Williamson Ch#4)

- 3.1 What Determines the Total Production of Goods and Services?
- 3.2 How Is National Income Distributed to the Factors of Production?
- 3.3 What Determines the Demand for Goods and Services?
- 3-4 What Brings the Supply and Demand for Goods and Services into Equilibrium?

B. MONEY, PRICES, AND UNEMPLOYMENT

4. The Monetary System: What it is and How it Works? (Mankiw Ch#4, ABC Ch#7, Williamson Ch#11, 16)

- 4.1 What Is Money?
- 4.2 The Role of Banks in the Monetary System
- 4.3 How Central Banks Influence the Money Supply

Inflation: It Causes, Effects, and Social Costs (Mankiw Ch#5, ABC Ch#7,12, Williamson Ch#18)

- 5.1 The Quantity Theory of Money
- 5.2 Seigniorage: The Revenue From Printing Money

5-3 Inflation and Interest Rates

5-4 The Nominal Interest Rate and the Demand for Money

5.5 The Social Costs of Inflation

5.6 Hyperinflation

5. Unemployment (Mankiw Ch#7, ABC Ch#3,12, Williamson Ch#17)

6.1 Job Loss, Job Finding, and the Natural Rate of Unemployment

6.2 Job Search and Frictional Unemployment

6.3 Real-Wage Rigidity and Structural Unemployment

6.4 Labor-Market Experience: The United States

6.5 Labor-Market Experience: Europe

C. THE ECONOMY IN THE SHORT RUN: ECONOMIC FLUCTUATIONS

6. Introduction to Economic Fluctuations (Mankiw Ch#10, ABC Ch#8, Williamson Ch#3)

7.1 The Facts About the Business Cycle

7.2 Time Horizons in Macroeconomics

How the Short Run and Long Run Differ

The Model of Aggregate Supply and Aggregate Demand

7.3 Aggregate Demand

The Quantity Equation as Aggregate Demand

Why the Aggregate Demand Curve Slopes Downward

Shifts in the Aggregate Demand Curve

7.4 Aggregate Supply

The Long Run: The Vertical Aggregate Supply Curve

The Short Run: The Horizontal Aggregate Supply Curve

From the Short Run to the Long Run

7.5 Stabilization Policy

Shocks to Aggregate Demand

Shocks to Aggregate Supply

7. Aggregate Demand I: Building the IS-LM Model (Mankiw Ch#11, ABC Ch#9)

8.1 The Goods Market and the IS Curve

8.2 The Money Market and the LM Curve

8.3 The Short-Run Equilibrium

8. Aggregate Demand II: Applying the IS-LM Model (Mankiw Ch#12, ABC Ch#11)

9.1 Explaining Fluctuations with the IS–LM Model

9.2 IS–LM as a Theory of Aggregate Demand

9.3 The Great Depression

9. Aggregate Supply and the Short-run Tradeoff Between Inflation and Unemployment (Mankiw Ch#14, ABC Ch#11, Williamson Ch#13)

10.1 The Basic Theory of Aggregate Supply

10.2 Inflation, Unemployment, and the Phillips Curve

10. A Dynamic Model of Aggregate Demand and Aggregate Supply (Mankiw Ch#15)

11.1 Elements of the Model

11.2 Solving the Model

11.3 Using the Model

11.4 Two Applications: Lessons for Monetary Policy

11.5 Toward DSGE Models

11. Classical Business Cycle Analysis: An Equilibrium Business Cycle Model (ABC Ch#10, Williamson Ch#12)

12.1 Business Cycles in the Classical Model

12.2 Money in the Classical Model

12.3 The Misperceptions Theory and the non-neutrality of Money

MAT-2403

DIFFERENTIAL EQUATIONS

Credit Hrs: 03

Introduction to ODEs (physical motivation), First order ODEs (separate variables, homogeneous equations, exact equations, linear equations, Bernoulli equation and other examples), applications of first order ODEs linear and non-linear, linear differential equations of higher order (initial value and boundary value problems, linear dependence and independence, solutions of linear equations, constructing a second solution from a known solution, homogeneous linear equations with constant coefficients, undetermined coefficients, variation of parameters), applications of second order ODEs (simple harmonic equation, damped and forced oscillators, electrical circuits and springs), differential equations with variable coefficients (Cauchy-Euler equation, power series solution of differential equation- solutions about ordinary and singular points-Legendre's and Bessel's equations as examples), Laplace transform (Laplace transform and its inverse properties, use in solving differential equations, Dirac function).

RECOMENDED BOOKS

1. D. G. Zill and M. R. Cullen, Differential equations with boundary value problems, 3rd Ed., National Book Foundation.
2. E. Kreyszig, Advanced engineering mathematics, Jhon Wiley, 8th
3. K. F. Riley, M. P. Hobson and S. J. Bence, Mathematical Methods for Physicists, Cambridge University Press 2006.

STA-2404: Introduction to Regression and Analysis of Variance

Learning Objectives:

1. To provide foundations of regression analysis.
2. To provide basic knowledge and art of statistical data analysis
3. To predict and draw inference about the parameters of the parameters of population.

Learning Outcomes:

1. Explore more adequately the connection between theories of regression.
2. Analysis of real world problems.
3. Prediction of dependent variable.

Course Contents:

Relationship between variables, Simple linear regression model, Estimation of parameters by method of least squares and corresponding variance estimates, Testing and confidence intervals for least squares estimators, mean prediction and individual prediction. Multiple linear regression with two regressors, coefficient of multiple determination, Partial and multiple correlation up to three variables. Inference of simple, partial and multiple correlation coefficients, Analysis of variance for one-way classification and two-way classification. Decomposition of total sum of squares, Multiple comparison tests; least significant difference and Duncan's multiple range test, Tukey test and Least significant difference test.

Recommended Books:

1. Montgomery, D. C., Peck, E. A., and Vining, G. G. (2012). Introduction to linear regression analysis (Vol. 821). John Wiley and Sons.
2. Dielman, T. E. (2001). Applied regression analysis for business and economics. Pacific Grove, CA: Duxbury/Thomson Learning.
3. Rawlings, J. O., Pantula, S. G., and Dickey, D. A. (2001). Applied regression analysis: a research tool. Springer Science and Business Media.

ECO-2405**DEVELOPMENT ECONOMICS****Objective:**

This is a first course in development economics that studies the economics of low and middle income countries. Topics include the structure of developing countries, their institutions, the policies their governments follow, the contours of poverty and inequality, and the ongoing struggles with economic growth. Apart from that it would cover theoretical foundations for different policy issues such as--What is the role of markets? Is government intervention in a market is a good thing? Do we need to be concerned about inequality? and why? What are institutions, and how do they facilitate or hinder economic development? Is development necessarily uneven, with some sectors growing and others stagnating? How do we think about the political economy of development: from voting or lobbying all the way to conflict? What are local problems and policies and what are international problems and policies?

Contents:**An overview of Development:**

Historical experiences of developing countries, broad conceptual explanation of underdevelopment, comparative economic development, emerging major issues of developing world, basic theories of growth and development, and

contemporary models of underdevelopment/development.

Domestic problems and Policies:

The nexus of poverty, inequality and underdevelopment, the distribution of wealth and resources, poverty and nutrition, demographic transition, population growth; its causes and consequences, urbanization/rural-urban migrations; its causes and consequences, human capital; education, health and development, agriculture and rural development, wars and conflicts, environment and natural resources, sustainable development.

International problems and Policies:

Trade/access to factor and product markets and development, balance of payment problems, debt, stabilization policies, international shocks, foreign finance, foreign aid, international wars and conflicts, migration and remittances.

Markets and Development:

The role of markets in development, credit, financing, SME's, industrial and trade policies, land, labor and agriculture, livestock, market failure and government intervention, stabilization policies.

Institutions and Development:

What are institutions, how do they facilitate or hinder economic development? The political economy, democracy vs dictatorship, decentralization, good governance, corruption, rent seeking, ethnic conflict, gender inequality, voting and lobbying, the role of civil society.

Recommended Books:

1. Todaro, M. P. and S. C. Smith. *Economic Development*, 11th edition (2011). Palgrave.
2. Debraj Ray. *Development Economics*, (1998), Princeton University Press.

Topic-wise break-ups:

D. PRINCIPLES AND CONCEPTS

**1. *Introducing Economic Development: A Global Perspective*
(*Todaro Ch. 1, Ray Ch. 1*)**

1.1 *How the Other Half Live*

1.2 *Economics and Development Studies*

1.3 *What Do We Mean by Development?*

1.4 *The Millennium Development Goals*

2. *Comparative Economic Development* (*Todaro Ch. 2, Ray Ch. 1*)

2.1 *Defining the Developing World*

2.2 *Basic Indicators of Development: Real Income, Health, and Education*

2.3 *Holistic Measures of Living Levels and Capabilities*

2.4 *Characteristics of the Developing World: Diversity within Commonality*

2.5 *How Low-Income Countries Today Differ from Developed Countries in Their Earlier Stages*

2.6 *Are Living Standards of Developing and Developed Nations Converging?*

2.7 *Long-Run Causes of Comparative Development*

3. Classic Theories of Economic Growth and Development (Todaro Ch. 3, Ray Ch. 2)

3.1 *Classic Theories of Economic Development: Four Approaches*

3.2 *Development as Growth and the Linear-Stages Theories*

3.3 *Structural-Change Models*

3.4 *The International-Dependence Revolution*

3.5 *The Neoclassical Counterrevolution: Market Fundamentalism*

3.6 *Classic Theories of Development: Reconciling the Differences*

4. Contemporary Models of Development and Underdevelopment (Todaro Ch. 4)

4.1 *Underdevelopment as a Coordination Failure*

4.2 *Multiple Equilibria: A Diagrammatic Approach*

4.3 *Starting Economic Development: The Big Push*

4.4 *Further Problems of Multiple Equilibria*

4.5 *Michael Kremer's O-Ring Theory of Economic Development*

4.6 *Economic Development as Self-Discovery*

4.7 *The Hausmann-Rodrik-Velasco Growth Diagnostics Framework*

E. PROBLEMS AND POLICIES: DOMESTIC

5. Poverty, Inequality, and Development (Todaro Ch. 5, Ray Ch. 6, 7 & 8)

5.1 *Measuring Inequality and Poverty*

5.2 *Poverty, Inequality, and Social Welfare*

5.3 *Absolute Poverty: Extent and Magnitude*

5.4 *Economic Characteristics of High-Poverty Groups*

5.5 *Policy Options on Income Inequality and Poverty: Some Basic Considerations*

6. Population Growth and Economic Development: Causes, Consequences, and Controversies (Todaro Ch. 6, Ray Ch. 9)

6.1 *The Basic Issue: Population Growth and the Quality of Life*

6.2 *Population Growth: Past, Present, and Future*

6.3 *The Demographic Transition*

6.4 *The Causes of High Fertility in Developing Countries: The Malthusian and Household Models*

6.5 *The Consequences of High Fertility: Some Conflicting Perspectives*

6.6 *Some Policy Approaches*

7. Urbanization and Rural-Urban Migration: Theory and Policy

(Todaro Ch. 7, Ray Ch. 10)

7.1 *The Migration and Urbanization Dilemma*

7.2 *The Role of Cities*

7.3 *The Urban Giantism Problem*

7.4 *The Urban Informal Sector*

7.5 *Migration and Development*

7.6 *Toward an Economic Theory of Rural-Urban Migration*

8. Human Capital: Education and Health in Economic Development

(Todaro Ch. 8, Ray Ch. 4 & 13)

8.1 *The Central Roles of Education and Health*

8.2 *Investing in Education and Health: The Human Capital Approach*

8.3 *Child Labor*

8.4 *The Gender Gap: Discrimination in Education and Health*

8.5 *Educational Systems and Development*

8.6 *Health Measurement and Distribution*

8.7 *Disease Burden*

8.8 *Health, Productivity, and Policy*

9. Agricultural Transformation and Rural Development (Todaro Ch. 9, Ray Ch. 11)

9.1 *The Imperative of Agricultural Progress and Rural Development*

9.2 *Agricultural Growth: Past Progress and Current Challenges*

9.3 *The Structure of Agrarian Systems in the Developing World*

9.4 *The Important Role of Women*

9.5 *The Microeconomics of Farmer Behavior and Agricultural Development*

9.6 *Core Requirements of a Strategy of Agricultural and Rural Development*

10. The Environment and Development (Todaro Ch. 10)

10.1 *Environment and Development: The Basic Issues*

10.2 *Rural Development and the Environment: A Tale of Two Villages*

10.3 *Global Warming and Climate Change: Scope, Mitigation, and Adaptation*

10.4 *Economic Models of Environment Issues*

10.5 *Urban Development and the Environment*

10.6 *The Local and Global Costs of Rain Forest Destruction*

10.7 *Policy Options in Developing and Developed Countries*

11. Development Policymaking and the Roles of Market, State, and Civil Society (Todaro Ch. 11)

11.1 *A Question of Balance*

11.2 *Development Planning: Concepts and Rationale*

11.3 *The Development Planning Process: Some Basic Models*

11.4 Government Failure and the Resurgent Preference for Markets over Planning

11.5 The Market Economy

11.6 The Washington Consensus on the Role of the State in Development and Its

11.7 Development Political Economy: Theories of Policy Formulation and Reform

11.8 Development Roles of NGOs and the Broader Citizen Sector

11.9 Trends in Governance and Reform

F. PROBLEMS AND POLICIES: INTERNATIONAL AND MACRO

12. International Trade Theory and Development Strategy (Todaro Ch. 12, Ray Ch. 16)

12.1 Economic Globalization: An Introduction

12.2 International Trade: Some Key Issues

12.3 The Traditional Theory of International Trade

12.4 The Critique of Traditional Free-Trade Theory in the Context of Developing-Country Experience

12.5 Traditional Trade Strategies for Development: Export Promotion versus Import Substitution

12.6 The Industrialization Strategy Approach to Export Policy

12.7 South-South Trade and Economic Integration

12.8 Trade Policies of Developed Countries: The Need for Reform and Resistance to New Protectionist Pressures

13. Balance of Payments, Debt, Financial Crises, and Stabilization Policies (Todaro Ch. 13)

13.1 International Finance and Investment: Key Issues

13.2 The Balance of Payments Account

13.3 The Issue of Payments Deficits

13.4 Accumulation of Debt and Emergence of the Debt Crisis

13.5 Attempts at Alleviation: Macroeconomic Instability, Classic IMF Stabilization Policies, and Their Critics

13.6 “Odious Debt” and Its Prevention

13.7 Resolution of 1980s–1990s Debt Crises and Continued Vulnerabilities

13.8 The Global Financial Crisis and the Developing Countries

14. Foreign Finance, Investment, and Aid: Controversies and Opportunities (Todaro Ch. 14)

14.1 The International Flow of Financial Resources

14.2 Private Foreign Direct Investment and the Multinational Corporation

14.3 The Role and Growth of Remittances

14.4 Foreign Aid: The Development Assistance Debate

14.5 Conflict and Development

15. Finance and Fiscal Policy for Development (Todaro Ch. 15, Ray Ch. 18)

15.1 The Role of the Financial System in Economic Development

15.2 The Role of Central Banks and Alternative Arrangements

15.3 Informal Finance and the Rise of Microfinance

15.4 Reforming Financial Systems

15.5 Fiscal Policy for Development

15.6 State-Owned Enterprises and Privatization

15.7 Public Administration: The Scarcest Resource

Additional Readings:

1. Sokoloff, K. and S. Engerman (2000), "History Lessons: Institutions, Factor Endowments, and Paths of Development in the New World," *Journal of Economic Perspectives*.
2. Acemoglu, D., Johnson, S. and J. Robinson (2001), "The Colonial Origins of Comparative Development: An Empirical Investigation," *American Economic Review*.
3. S. Anderson and D. Ray (2010), "Missing Women: Age and Disease," *Review of Economic Studies*.
4. K. Munshi and J. Myaux (2006), "Social Norms and the Fertility Transition," *Journal of Development Economics*.
5. J. Esteban, L. Mayoral and D. Ray (2012), "Ethnicity and Conflict: Theory and Facts," *Science*.
6. Acemoglu, Daron and James A. Robinson (2006), *Economic Origins of Dictatorship and Democracy*, Cambridge University Press;
7. Basu, K. *Analytical Development Economics: The Less Developed Economy Revisited*. (Cambridge: MIT Press)
8. Thirlwall, A. P. *Growth, and Development with Special Reference to Developing Economies*. (Basingstoke: Palgrave Macmillan)

Course Code: MAS-2415

Title: Mathematical Statistics

Credit Hrs: 03

Course Outline: The postulates of probability, Some elementary theorems, Addition and multiplication rules, Baye's rule and future Baye's theorem, Random variables and probability functions, Uniform, Bernoulli and Binomial distribution, Hypergeometric and geometric distribution, Negative binomial and Poisson distribution, Uniform and exponential distribution, Gamma and beta distributions, Normal distribution, Moments and moment generating functions Moments of binomial, hypergeometric, Poisson, gamma, beta and normal distributions

Text and Reference Books

1. M. H. De-Groot and M. J. Schervish, *Probability and Statistics*, 3rd Edition, Addison Wesley, 2002.
2. A. Papoulis, *Probability, Random Variables, and Stochastic Processes*, 3rd Edition, Mc-Graw Hill, 1991.
3. T. Sincich, *Statistics by Examples*, Dellen Publishing Company, 1990.
4. A. S. Hirahi. *A Course in Mathematical Statistics*, 4th Edition, Ilmi Kitab Khana, Lahore, Pakistan, 2012.
5. S. M. Chaudhry and S. Kamal, *Introduction to Statistical Theory Part-II*, Ilmi Kitab Khana, Lahore, Pakistan, 2012.

COM-2405

PROGRAMMING FUNDAMENTALS

Credit Hrs: 03

Computer programming, principles of structured and modular programming, overview of structured programming languages, algorithms and problem solving, program development, analyzing problem, designing algorithm/solution, testing designed solution, translating algorithms into programs, fundamental programming constructs, data types, basics of input and output, selection and decision (If, If-else, Nested If-else, Switch statement, and Condition operator), repetition (While and For Loop, Do-while Loops), break statement, continue statement, control structures, functions, arrays, pointers, records, files, (Input/Output), testing and debugging.

RECOMMENDED BOOKS

1. C how to program, Paul Deitel and Harvey Deitel, Prentice Hall; 7th Ed. (2012)
2. Programming in C, Stephen G. Kochan, Addison-Welley Professional; 4th Ed. (2013)
3. Java how to program, Paul Deitel and Harvey Deitel, Prentice Hall; 9th Ed. (2011)
4. C++ how to program, Paul Deitel and Harvey Deitel, Prentice Hall; 9th Ed. (2013).

ENG-2301

ENGLISH-II

Credit Hrs. 03

Objectives: To enable the students to write a research paper / technical report in a succinct manner according to a specified format.

Presentation skills, Essay writing, Descriptive, narrative, discursive, argumentative, Academic writing
How to write a proposal for research paper/ term paper. How to write a research paper/term paper
(emphasis on style, content, language, form, clarity, consistency), Technical Report writing, Note:
Extensive reading is required for vocabulary building

Recommended Books:

1. R. White, Writing. Advanced, Oxford Supplementary Skills. Third Impression 1992. (Particularly suitable for discursive, descriptive, argumentative and report writing).
2. J. Langan. College Writing Skills, McGraw-Hill Higher Education. 2004.
3. L. G. Kirszner and S. R. Mandell. Patterns of College Writing, 4th edition St. Martin's Press.
4. The Mercury Reader. A Custom Publication. Compiled by northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruelus and Maurice Scharon.