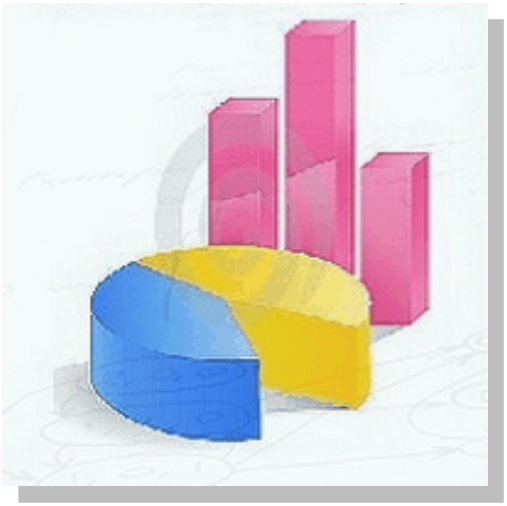
King Saud University
College of Science
Vice Dean Academic Affairs
Study Plans

Research Operation Study Plan



Statistics and Research Operation Department

2013-1434H

King Saud University
College of Science
Vice Dean Academic Affairs
Study Plans

Research Operation Study Plan

1st Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect.- Exre.-Pract.)**
CI 140	Learning, Thinking and Research Skills	-	-	3 (3+0+0)
CHS 150	Health and Fitness (2)	-	-	1 (1+0+0)
ENG 140	English Language (1) **(E)**	-	-	8 (8+0+0)
MATH 140	Introduction to Mathematics **(E)**	-	-	2 (1+1+0)
Total of Credit Hours				**14**

2nd Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect.- Exre.-Pract.)**
CT 140	Computer Skills **(E)**	-	-	3 (0+0+3)
MC 140	Communication Skills	-	-	2 (2+0+0)
ENG 150	English Language (2) **(E)**	ENG 140	-	8 (8+0+0)
MATH 150	Differential Calculus **(E)**	MATH 140	-	3 (2+1+0)
ENT 101	Entrepreunership	-	-	1 (1+0+0)
Total of Credit Hours				**17**

3rd Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. - Exre. – Pract.)**
OPER 100	Introduction to Operations Research	MATH 150	STAT 100	4(3+1+0)
STAT 100	Introduction to Statistics		-	3(2+1+0)
MATH 111	Integral Calculus (E)		-	4(3+1+0)
CSC 201	Computer Programming (E)	-	-	4(3+1+0)
Elective University requirement course			-	2(2+0+0)
Total of Credit Hours				**17**

4th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. - Exre. – Pract.)**
OPER 213	Linear Programming	OPER 100	MATH 244	4(3+1+0)
STAT 105	Statistical Methods (E)	STAT 100	-	4(3+1+0)
MATH 244	Linear Algebra (E)	MATH 111	-	3(3+0+0)
CSC 202	Computer Programming Using MATLAB (E)	CSC 201	-	3(2+1+0)
Elective University requirement course			-	2(2+0+0)
Elective University requirement course			-	2(2+0+0)
Total of Credit Hours				**18**

5th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. - Exre. – Pract.)**
OPER 351	Network Analysis	OPER 213 + CSC 202	MATH 207	3(2+1+0)
OPER 382	Decision and Game Theory	OPER 213	-	4(3+1+0)
STAT 215	Probability I	STAT 100+ MATH 111	-	4(3+1+0)
STAT 328	Statistical Packages	STAT 105	-	3(2+1+0)
MATH 207	Advanced Integral and Differential Calculus (E)	MATH 111	-	3(2+1+0)
Total of Credit Hours				**17**

6th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. - Exre. – Pract.)**
OPER 322	Inventory Control	OPER 213 + MATH 207	-	3(2+1+0)
OPER 331	Non-Linear Optimization	OPER 213 + MATH 207	-	4(3+1+0)
STAT 223	Theory of Statistics I	STAT 215	-	3(2+1+0)
STAT 332	Regression Analysis	STAT 328 + MATH 244	-	3(2+1+0)
Optional course outside the Department			-	3
Elective University requirement course			-	2(2+0+0
Total of Credit Hours				**18**

7th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. - Exre. – Pract.)**
OPER 435	Numerical Methods in Operations Research (E)	231 OPER + OPER 351	-	3(2+1+0)
OPER 441	Modelling and Simulation (E)	STAT 215 + CSC 202	-	4(3+1+0)
OPER 472	Stochastic Processes and Queuing Theory (E)	OPER 213 + STAT 215	-	4(3+1+0)
OPER 497	Graduation Project (1) (E)	OPER 351	OPER 435 + OPER 441 + OPER 472	1(1+0+0)
Optional course from the Department			-	3
Optional course outside the Department			-	3
Total of Credit Hours				**18**

8th Semester				
Course Code	**Course Title**	**Pre-Req.**	**Co-Req.**	**Credits (Lect. - Exre. – Pract.)**
OPER 498	Graduation Project (2)(E)	OPER 497	-	2(2+0+0)
STAT 436	Time Series and Forecasting	STAT 332	-	3(2+1+0)
Optional course from the Department			-	3
Optional course from the Department			-	3
Optional course from the Department			-	3
Total of Credit Hours				**17**

(Lect. – Exer. – Pract.) = (Lecture – Exercise – Practical)

List of the Elective Courses of the University Requirements

(Student elects 8 credit hours)

Course Code	Course Title	Pre-requisite	Credits (Lect. – Exer. - Pract.)
IC 100	Studies in the Biography of the Prophet	-	2 (2+0+0)
IC 101	Introduction of Islamic Culture	-	2 (2+0+0)
IC 102	Islam and Building up the Society	-	2 (2+0+0)
IC 103	Economic System in Islam	-	2 (2+0+0)
IC 104	Political system in Islam	-	3 (2+0+1)
IC 105	Human Rights	-	3 (2+0+1)
IC 106	Islamic Jurisprudence	-	2 (2+0+0)
IC 107	Ethics of Occupation	-	2 (2+0+0)
IC 108	Contemporary Issues	-	2 (2+0+0)
IC 109	Woman and Her Developmental Role	-	2 (2+0+0)

List of the Elective Courses

Elective courses *from* the Department: (Student elects 12 credit hours)				
Course Code	**Course Title**	**Pre-requisite**	**Co-requisite**	**Credits (Lect - Exer- Pract)**
OPER 313	Integer Programming	OPER 213	-	3(2+1+0)
OPER 453	Scheduling and Sequencing (E)	OPER 213	-	3(2+1+0)
OPER 490	Special Applications in Operations Research (E)	OPER 331+ OPER 351	-	3(2+1+0)
OPER 492	Prices and Revenue Management (E)	OPER 331+ STAT 215	-	3(2+1+0)
STAT 315	Probability (2) (E)	STAT 215+ MATH 207	-	3(2+1+0)
STAT 319	Theory of Statistics (2) (E)	STAT 223 + MATH 207	STAT 315	3(2+1+0)
STAT 325	Decisions Theory (E)	STAT 223	-	3(2+1+0)
STAT 333	Nonparametric Statistical Methods	STAT 105	-	3(2+1+0)
STAT 331	Sampling Techniques	STAT 223	-	3(2+1+0)
STAT 362	Reliability Theory	STAT 223	-	3(2+1+0)
STAT 401	Econometrics (E)	STAT 332	-	3(2+1+0)
STAT 430	Insurance Methods (E)	STAT 319	-	3(2+1+0)
STAT 434	Linear Models	MATH 244	-	3(2+1+0)
STAT 437	Design and Analysis of Experiments	STAT 328	-	3(2+1+0)
STAT 441	Quality Control	STAT 319	-	3(2+1+0)

Elective courses *from outside* the Department: (Student elects 9 credit hours)				
Course Code	**Course Title**	**Pre-requisite**	**Co-requisite**	**Credits (Lect - Exer- Pract)**
MATH 160	Computational Mathematics	CT 140 + MATH 111		2(2+0+0)
MATH 225	Introduction to Differential Equations	MATH 207		4(3+1+0)
MATH 352	Numerical Analysis (1)	MATH 160 + MATH 244		4(3+1+0)
MATH 382	Real Analysis I	MATH 207		4(3+1+0)
MGT 101	Principles of Management and Business			3(2+1+0)
MGT 102	Human Resources Management	MGT 101		3(2+1+0)
MGT 103	Entrepreneurship	MGT 101		3(2+1+0)
MGT 104	Principles of Public Administration			3(2+1+0)
MGT 319	Management of Small and Medium Size Businesses	MGT 101		3(2+1+0)
MGT 371	Operations Management	MGT 101		3(2+1+0)
MIS 201	Management Information Systems	MGT 101		3(2+1+0)
ACCT 201	Principles of Accounting and Financial Reporting			3(2+1+0)
ACCT 202	Principles of Cost Managerial Accounting	ACCT 201		3(2+1+0)
ACCT 311	Accounting for Government and Non-Profit Organizations	ACCT 201		3(2+1+0)
ACCT 317	Intermediate Accounting (1)	ACCT 201		3(2+1+0)
ACCT 318	Intermediate Accounting (2)	ACCT 317		3(2+1+0)
ECON 101	Principles of Microeconomics			3(2+1+0)
ECO N 102	Principles of Macroeconomics	ECON 101		3(2+1+0)
ECO N 201	Microeconomics Analysis	ECON 102		3(2+1+0)
ECON 202	Macroeconomics Analysis	ECON 102		3(2+1+0)
ECON 211	Money and Banking	ECON 102		3(2+1+0)
ECON 314	Islamic Economics	ECON 102		3(2+1+0)
ECON 317	Managerial Economics	ECON 102		3(2+1+0)
ECON 318	Transportation and Insurance Economics	ECON 102		3(2+1+0)
MKT 201	Principles of Marketing	MGT 101 + Econ 101		3(2+1+0)
FIN 200	Principles of Finance	ACCT 201		3(2+1+0)
FIN 210	Corporate Finance	FIN 200		3(2+1+0)
FIN 220	Investment Essentials	FIN 200		3(2+1+0)
FIN 230	Financial markets and institutions	FIN 200		3(2+1+0)
FIN 240	Principles of Risk & Insurance	FIN 200		3(2+1+0)
FIN 250	International Finance	FIN 200		3(2+1+0)
QUA 127	Mathematics of Finance	MATH 140		3(2+1+0)

List of service courses to Another Departments and collages.

Course Code	Course Title	Credits (Lect. – Exer.- Pract.)	Department / College of
STAT 100	Introduction to Operations Research	4 (3+1+0)	STAT - Agriculture
STAT 122	Introduction to Operations Research	3 (2+1+0)	Computer Sciences

Short Courses Description

I) Compulsory courses *from* the Department [credit hours (Lect. – Exer. – Pract).]

OPER 100: Introduction to Operations Research 4 (3+1+0)
History and nature of Operations Research. Introduction to system analysis. Problem investigation and formulation. Linear programming models and graphical solutions . Sensitivity analysis. Transportation problem. Assignment problem. Introduction to graph theory and optimization in networks: The shortest path problem . Introduction to stochastic models in operations research.

OPER 213: Linear Programming 4 (3+1+0)
Definitions and formulation of linear programs . Graphical solution. Review of linear algebra and convex analysis. Algebra of the simplex method. The simplex method. The revised simplex method. Duality theory and economic interpretation of duality. Sensitivity analysis. Some applications of linear programming.

OPER 322: Inventory Control 3 (2+1+0)
Definitions and models of inventory control. The simple economic order quantity (EOQ) model. The EOQ model with shortages. The economic production quantity (EPQ) model. The (EPQ) model with shortages. Single or multiple items constrained inventory control models. Some dynamic inventory control models with deterministic or probabilistic demand. Inventory control models with continuous demand rate. Some probabilistic inventory control models.

OPER 331: Nonlinear Optimization 4 (3+1+0)
Models of nonlinear optimization. Basic concepts of optimization. Optimality conditions for unconstrained problems. Optimality conditions for constrained problems: Lagrange Multipliers, KKT conditions. Quadratic Programming: Wolf's method. Computational methods for unconstrained problems: Optimal search algorithms for univariate and multivariate problems. Computational methods for constrained problems: Graphical method, Feasible directions methods, Gradient projection methods, Penalty and Barrier function methods.

OPER 351: Network Analysis 3 (2+1+0)
Introduction to Graph theory. Network models. Mathematical formulation of network problems. Shortest path problem: Bellman algorithm, Dijkstra's algorithm, Bellman-Ford algorithm. Maximum Flow Problem: Ford and Fulkerson algorithm, Max-flow min-cut theorem. Minimum cost flow problem. Project scheduling: CPM and PERT.

OPER 382: Decision and Game Theory 4 (3+1+0)

Introduction to Decision theory. Utility and expected utility. Decision under risk seeking and risk averse. Dynamic Programming (Principle of Optimality, Dynamic Programming and Decision Theory, various applications). Concepts and terminology of Game theory. Zero sum games. Solutions of two persons zero sum games. Two persons nonzero sum games. Solutions of two persons nonzero sum games. N-person games.

OPER 435: Computational Methods in Operations Research 3 (2+1+0)

This course provides a comprehensive introduction to the standard numerical techniques commonly used in obtaining solutions to operations research problems such as: Using EXCEL in solving Differential and Integral Equations. Monte Carlo Integration. Parameter and curve fitting. Using EXCEL SOLVER, WinQSB, LINDO, LINGO to solve Mathematical Programming problems. Case studies with LINGO.

OPER 441: Modeling and Simulation 4 (3+1+0)

Introduction to Systems and Modelling. Hand Simulation. Spreadsheet modelling and simulation using EXCEL. Random Numbers and Variables properties and generation. Input Analysis. Introduction to SIMAN.Introduction to GPSS. Time advancing mechanisms. List processing. GPSS Commands and Blocks. System Numerical Attributes (SNA). Case studies.

OPER 472: Stochastic Processes and Queuing Models 4 (3+1+0)

Definition of stochastic processes. Finite Markov chains. One step and multi-steps transition probability matrices. Chapman-Kolmogorof equation. State classification. Long run distribution of Markov chains. Continuous-time Markov processes (Birth-and-death processes, Poisson process). Queuing theory and models: Cumulative diagrams of queues. Performance measures. Basic Markovian queuing models (single server queue, multi-server queue, finite capacity queues). Some Non-Markovian queues. Some Non-Markovian queues with bulk arrival and service.

OPER 497: Graduation Project (1) 1 (1+0+0)

Recognition of the problem, chosen from real- world problems, under study. Gathering references and collecting data needed to investigate the problem under the supervision of a faculty member.

OPER 498: Graduation Project (2) 2 (2+0+0)

Under the supervision of a faculty member, the student studies and models a solution to the problem previously investigated in OPER 497, and presents a report of his work.

STAT 100: Introduction to Statistics 3 (2+1+0)

Descriptive statistics - Measures of central tendency - Measures of dispersion - Basic probability concepts - Conditional probability, Expectation - Variance - Bayes law- Random variables - Probability distribution - Binomial distribution - Poisson distribution - Hypergeometric distribution - Normal distribution – Applications by Excel.

STAT 105: Statistical Methods 4 (3+1+0)

Some Statistical distributions - Sampling distributions - Central limit theorem - Chebychev's inequality - Interval estimation - Testing hypotheses (two populations case) - Introduction to experimental designs (CRD and RBD)- Analysis of variance (one and two ways) - Regression (simple) - Correlation (Pearson and Spearman) - Chi square tests and application - Some nonparametric tests.

STAT 215: Probability (1) 4 (3+1+0)

Random variables and probability distributions (Discrete and continuous) - Famous discrete and continuous probability distributions – Random vectors - Expectation and variation - Discrete bivariate probability distributions - Marginal and conditional probability distributions - Independence, correlation and covariance - Moments and moment generating function - Distributions of Function of one and two random variable.

STAT 223: Theory of Statistics (1) 3 (2+1+0)

Sampling distributions - Central limit theorem - Point Estimation - Properties of estimator: unbiasedness, mean square error - consistency - sufficiency, minimal sufficiency - Exponential family - Uniformly Minimum Variance Unbiased Estimator - Cramer-Rao inequality - Fisher's information - Rao-Blackwell theorem - sufficiency and completeness - Lehmann-Sheffe theorem - Methods of Estimation: Method of Moments - Maximum Likelihood estimators and their properties including asymptotic properties - The Baysian Approach: Use of a prior density - Bayes estimators - Bayes estimators with mean square error loss function - invariant methods: Location invariant and scale invariant classes of estimators - Interval estimation (one population case): Confidence interval estimators, Pivotal methods - Bayesian credible intervals.

STAT 328: Statistical Packages 3 (2+1+0)

Using program code in a statistical software package (Excel – Minitab – SAS – SPSS - R - Maple - Matlab) to write a program for data and statistical analysis. Topics include creating and managing data files, graphical presentation - and Monte Carlo simulations.

STAT 332: Regression Analysis 3 (2+1+0)

Simple linear regression model - Multiple linear regression - Analysis of residuals and predictions. - Stepwise regression - Some nonlinear regression models and data transformations - Student will use statistical computer packages such as SAS, SPSS, Minitab, etc.

STAT 436: Time Series and Forecasting 3 (2+1+0)

Data sources: Historical data- the Web. Checking time series components: trend – seasonality - cyclical. Transformation: Differences method - Seasonal adjustment. Forecasting: How to forecast future - adequacy of a forecast - regression forecasting against time series forecasting - some adequacy measures (MAD, MSE, MAPE). Decomposition and smoothing of times series: moving averages - exponential smoothing. Box-Jenkins models ARIMA(p,d,q): Autocorrelation and partial autocorrelation functions - identification of appropriate model - dealing with seasonal time series - fitting models to real and simulated data sets. Diagnostic checks on the residuals. Case studies: training on how to analyze real life data sets using the statistical package MINITAB - write reports.

II) Compulsory courses *from outside* the Department [credit hours (Lect. – Exer. – Pract).]

MATH 111: Integral Calculus 4 (3+1+0)

Definition of Definite Integral and its Properties, The Anti-derivative, Indefinite Integral and the Fundamental Theorem of Calculus. Change of Variables. Integrals of natural and general exponential functions. Integrals of natural and general Logarithmic functions. Derivatives and Integrals of Hyperbolic and Inverse-Hyperbolic functions. Techniques of Integration: by parts, Trigonometric substitutions, Completing the square, Integrals of rational functions,

Miscellaneous Substitutions. Indeterminate forms, Improper Integrals. Applications of Integration: Area, Solids of Revolutions, Arc length and Surface of Revolution, Linear Motion, Work, Momentum and Center of Mass. Numerical Integration. Polar coordinates, relation between polar and Cartesian coordinates, Graphs of polar curves, Area in polar coordinates. Parametric Equations.

MATH 140: Introduction to Mathematics 2 (2+0+0)

Linear equations and applications, linear inequalities, absolute value in equations and inequalities, complex numbers, quadratic equations and applications, functions, odd and even functions, operations on functions, inverse functions, exponential and logarithmic functions, trigonometric functions, conic sections, systems of equations and inequalities, matrices, matrix operations.

MATH 150: Differential Calculus 3 (3+0+0)

The concept of limit, computation of limits, continuity and its consequences, limits involving infinity, formal definition of limit, the concept of derivative, computation of derivatives (power rule, higher order derivatives, acceleration), the product and quotient rules, the chain rule, derivatives of exponential and logarithmic functions, implicit differentiation and inverse trigonometric functions, the mean value theorem, indeterminate forms and L'Hopital's rule, maximum and minimum values, increasing and decreasing functions, concavity and the second derivative test, optimization, related rates.

MATH 207: Advanced Differential and Integral Calculus 3 (2+1+0)

Cartesian coordinates, functions of two or several variables, limits and continuity, partial derivatives, chain rule, maxima and minima for functions of two and several variables, Lagrange multipliers, double integrals and their applications, triple integrals and their applications, sequences, infinite series, geometric series, convergence tests, alternative series, absolute convergence, conditional convergence, functions representation by power series, Taylor' series, Maclaurin' series, Binomial series, first order differential equations.

MATH 244: Linear Algebra 3 (3+0+0)

Matrices and their operations, types of matrices. Elementary transformations. Determinants, elementary properties. Inverse of a matrix. Linear systems of equations. Vector spaces, linear independence, finite dimensional spaces, linear subspaces. Inner product spaces. Linear transformations, kernel and image of a liner transformation. Eigen values and Eigen vectors of a matrix and of a linear operator.

CSC 201: Computer Programming 4 (3+1+0)

Introduction to C programming, Arithmetic in C, Algorithms, Selection Statements: if, if-else, switch-case statements, Counter-Controlled Repetition for, while, do-while-statements, Operators in C, Functions and Recursion, Arrays, Pointers, structures, Unions, Bitwise Operators, Enumeration, Characters and Strings, C Formatted Input/Output.

CSC 202: Computer Programming Using MATLAB 3 (2+1+0)

Interacting with MATLAB, program design and algorithm development, M-files, designing GUI (graphical user interface), calculus with MATLAB, vectors and matrices, strings, functions, 2-D and 3-D graphics, MATLAB programming, data analysis operations, errors, applications: (randomness, simulation, Markov process, linear equations, some numerical methods), integrating MATLAB based algorithms with external applications and languages, such as C, C++, Fortran, Java, COM, and Microsoft Excel.

III- Elective Courses *from* the Department [credit hours (Lect. – Exer. – Pract).]

OPER 313: Integer Programming 3 (2+1+0)
Introduction to integer programming. Examples of integer programming problems. Some applications of integer programming. Optimality of integer programming. Branch and bound methods. Implicit enumeration methods. Cutting plane method.

OPER 453: Sequencing and scheduling 3 (2+1+0)
Introduction to sequencing and scheduling: concepts and examples. Optimality in sequencing and scheduling. Basic results of single machine sequencing and scheduling. Algorithms for general Job-Shop and Flow-Shop problems. Dynamic programming models for sequenced decisions using the principle of optimality. Use of dynamic programming in solving sequencing and scheduling problems.

OPER 490: Special Applications in Operations Research 3 (2+1+0)
Topics in Supply Chain Management. Traveling Salesman Problem. Vehicle Routing Problem. Facility Location Problem. Multi-objective Programming. Goal Programming.

OPER 492: Pricing and Revenue Management 3 (2+1+0)
Pricing and revenue management concepts. Basic price optimization. Price differentiation. Pricing with constrained supply. Revenue management. Capacity allocation. Network management. Overbooking. Markdown management. Customized pricing.

STAT 315: Probability (2) 3 (2+1+0)
Sequence of Events – Continuous random vector - Joint probability distribution - marginal and conditional probability functions - Conditional expectation and variation - Joint probability distributions of functions of random variables- Joint moment generating functions - Order statistics- Probability inequalities- Sequences of random variables and modes of convergences - Central limit theorem and proof - normal approximation.

STAT 319: Theory of Statistics (2) 3 (2+1+0)
Interval estimation (two population cases): Confidence interval estimators, Pivotal methods - Hypotheses Testing: Type I and Type II error, power of the tests - Most powerful test, Neymann-pearson lemma, asymptotic tests - unbiased test - uniformly most powerful test. Monotone tests – Neymann Pearson theorem - power curves - Likelihood ratio tests - asymptotic distribution of likelihood ratio statistics - The Sequential Probability Ratio Test - Goodness of-fit Tests - Bayesian testing hypotheses.

STAT 325: Decision Theory 3(3+0+0)
The elements of making decision problem without data: Utility, Actions Space, State of nature space- Pure actions - MinMax and Bayes actions - MinMax mixed actions - Using data for making decisions (Decision Rule)- MinMax pure and mixed decision rules- Bayes decision rule - Estimation as a decision problem: for instance Bayes Estimate - Testing hypothesis as a decision problem: for instance - Most powerful - MinMax and Bayes tests - Comparing between tests.

STAT 331: Sampling Techniques 3 (2+1+0)
Definition of Population and sample - Types of surveys - sampling methods - Parameters estimation- Estimation of (population mean - Estimation of population ratios - Population total). Confidence intervals for population parameters - Selecting the sample size for estimating population mean and total number.

STAT 333: Nonparametric Statistics Methods 3 (2+1+0)

Concept of nonparametric statistics -Statistical tests based on the binomial distribution (binomial test and estimation of ratio - quantile test - tolerance limits) - Contingency tables in (median tests - measures of dependence - chi-square tests - Cochran test for related observations) - Some nonparametric tests that depend on ranks (two independent samples - several independent samples -test for equal variances - measures of rank correlations- nonparametric regression methods - several related samples - tests of randomization) -Tests of the Kolmogorov-Smirnov type (the Kolmogorov goodness of fit tests - goodness of fit tests for families of distributions).

STAT 362: Theory of reliability 3 (3+0+0)

Concept of reliability - structural properties of Coherent systems - Reliability of coherent systems, Joint Structural and Reliability importance - Some parametric lifetime models (continuous and discrete) - Classes of lifetime distributions (notions of aging) - Reliability operation, Specialized models (competing risks, accelerated models, ..) - Life data analysis.

STAT 401: Econometrics 3 (3+0+0)

Simple and Multiple regression models - Non-Linear regression models - Dummy Variables - Multicollinearity Problem-Identification Errors - Generalized Least Square Method – Heteroscedasticity Problem - Autocorrelation Problem - Time series models- Simultaneous Equations-Errors in variables.

STAT 430: Insurance Methods 3(2+1+0)

Survival Distributions: Future lifetime, life tables; fundamental theorems for calculating moments of actuarial functions - Other actuarial functions; 3 assumptions for fractional ages; analytical laws of mortality - Net Single Premiums for Life Insurance Contracts: Definition using a stochastic approach - distribution of the actuarial - present value function for different insurance contracts - Life Annuities: Actuarial accumulation function; aggregate payment and current payment techniques - life annuities with monthly payments - complete annuities (immediate), apportionable annuities (due) - recursive equations - Net Annual Premiums: Actuarial equivalence principle; basic contracts; monthly premiums; life insurance with accumulation type benefits - Reserves: Definition of prospective loss - basic contracts - monthly premiums reserves: recursive equations for discrete reserves, reserves at fractional durations, allocation of the loss to the policy years.

STAT 434: Linear Models 3 (3+0+0)

Review of necessary concepts of matrix algebra - Normal distribution with n-variables - Quadratic forms and their distributions - The general linear model of full rank - Estimation and hypothesis testing in the full rank model-Estimation and hypothesis testing in the less than full rank model - Computational methods - Applications in regressions, experimental design and ANOVA using statistical packages.

STAT 437: Design and Analysis of Experiments 3 (2+1+0)

Introduction: Review of statistical inference. Main principals of experimental design: Replication – Randomness – Blocks – Simple comparisons experiments: t-test and alike tests. Single Factor Experiments: Completely randomized desing – Model adequacy checking – Contrasts and orthogonal contrasts – Comparing pairs of treatment means. Block designs: Randomized complete block design – Latin square design – Graeco-Latin square design. Factorial designs : Two-Factor factorial design – Three-Factor factorial design – General

factorial designs. Designs with two-level factors: Two factors with two levels designs – Three factors with two levels designs – General two-level factors designs. Confounding. Fractional factorial designs.

STAT 441: QUALITY CONTROL 3 (2+1+0)

Historical background of Quality Control - What is Quality? - the formation of Quality Control, Quality Planning, Quality Improvement - Quality Assurance and Total Quality Management - Modeling Process Quality - Review of statistical distributions used in Quality Control - Statistical inference and test of hypotheses - Statistical Process Control (SPC) - Magnificent Seven - Introduction of Control Charts - Statistical process in Quality Improvement - Pareto Chart - Cause and Effect Diagram - Scatter Diagram - Types of control charts - Control Charts for Variables - Process Capability Ratios - Process Capability Cpk - Control Charts for Attribute data - Acceptance Sampling - Operating Characteristic Curve.

IV- Elective Courses *from outside* the Department [credit hours (Lect. – Exer. – Pract).]

MATH 225: Introduction to Differential Equations (E) 4(3+1+0)

Classification of differential equations and their origin: interval of definition, Solutions, Cauchy initial value problems: Existence and Uniqueness - **Method of solving of first order differential equations:** Separable equation exact equations, special integrating factors, substitution and transformation, Linear differential equations with constants coefficients, Bernoulli equations, method of reduction of order - **Higher order linear differential equation (HOLDE):** Basic theory of HOLDE Existence-Uniqueness theorem, linearly independent and dependent functions, Wronskian - **Method of solving of HOLDE**: homogeneous linear equation with constant coefficients, method of variation of parameters, undetermined coefficient method, superposition principle, Cauchy-Euler equations, reduction of order method - **Laplace transformations:** Definitions and properties, inverse Laplace transformation, applications: solving initial value problems - **Power series solutions of linear differential equations of second order with:** Polynomial coefficients near an ordinary point - Orthogonal functions and Fourier Series - **Linear system of differential equations:** solving system by elimination, matrix methods for linear system.

MATH 352 : Numerical Analysis (1) 4(3+1+0)

Numerical methods for nonlinear equations. Error and convergence, analysis. Direct & iterative methods for linear systems. Error analysis & iterative methods convergence. Interpolation & approximation, error analysis. Numerical differentiation & numerical integration & their error analysis .

MATH 382 : Real Analysis (1) (E) 4(3+1+0)

Basic properties of the field of real numbers, completeness axiom, countable sets. Sequences and their convergence, monotone sequence, Bolzano-Weierstrass theorem, Cauchy criterion. Basic topological properties of the real numbers. Limit of a function, continuous functions and properties of continuity, uniform continuity, compact sets. The derivative of a function, mean value theorem, L'Hospital rule, Taylor theorem.

IV- Service Courses to Other Specialization and Colleges [credit hours (Lect. – Exer. – Pract).]

OPER 100: Introduction to Operations Research 4 (3+1+0)

History and nature of Operations Research. Introduction to system analysis. Problem investigation and formulation. Linear programming models and graphical solutions . Sensitivity analysis. Transportation problem. Assignment problem. Introduction to graph theory and optimization in networks: The shortest path problem . Introduction to stochastic models in operations research.

OPER 122: Introduction to Operations Research 3 (2+1+0)

History and nature of Operations Research. Introduction to system analysis. Problem investigation and formulation. Linear programming models and graphical solutions. Sensitivity analysis for Linear programming graphically. Introduction to graph theory and optimization in networks: The shortest path problem . Introduction to stochastic models in operations research.

***Important Note*: The student must review the department concerned for decisions that taught outside the college (Compulsory and Elective).**