Academic Programs Booklet

College of Science

2021

Prepared By: VP For Academic Programs and Graduate Studies Office

College of Science

College of Science

List of B.Sc. Programs

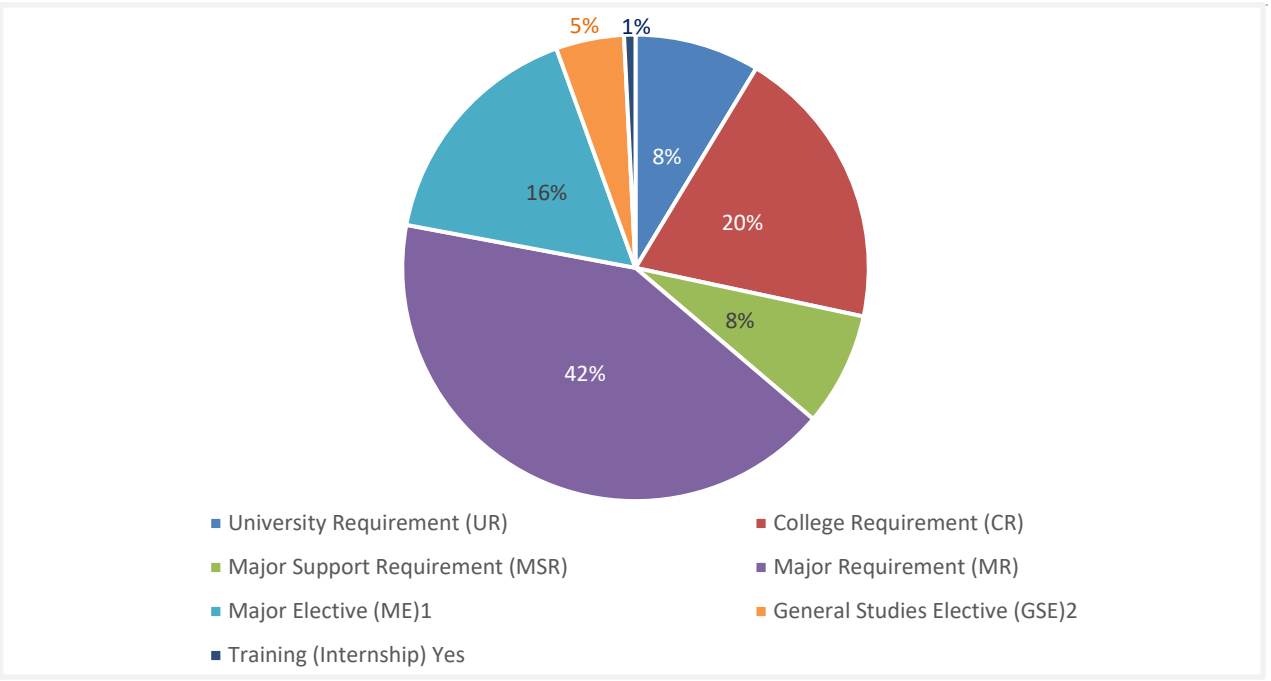
1- B.Sc. in Mathematics
2- B.Sc. in Actuarial Science
3- B.Sc. in Statistics and Data Science

List of College Requirement Courses

Course Code	Course Title	Course Hours			Course Type	Pre-requisite	Major GPA
		LEC	PRAC	CRD			
ENGL 125	English For Science I (SCI.)	3	0	3	CR	None	No
ENGL 126	English For Science II (SCI.)	3	0	3	CR	ENGL 125	No
ITCS 113	Computer Programming I	3	2	3	CR	NONE	No
MATHS 131	Calculus I	4	0	4	CR	None	No
PHYCS 101	General Physics I	3	2	4	CR	None	No
CHEMY 101	General Chemistry I	3	2	4	CR	None	No
BIOLS 102	General Biology I	3	2	4	CR	None	No
Total		**22**	**8**	**25**			

B.Sc. in Mathematics

Program Components



University Requirement (UR)	11
College Requirement (CR)	25
Major Support Requirement (MSR)	10
Major Requirement (MR)	53
Major Elective (ME)[1]	21
General Studies Elective (GSE)[2]	6
Training (Internship) Yes	1
Total Credit (CRD)	127

Teaching Language: **English**

[1] Student must select five (3XX & 4XX) courses from Major Elective (ME) List. Additional to this, two courses must be selected from ME list as Job Placement Courses. This needs consultation and approval of the department.

[2] Student must select three General Studies Electives, one of them must be from Humanities and Social Science.

Note:

- Free Elective Courses any UOB course excluding:(1) courses offered for special students, (2) courses covered in the B.Sc. curriculum, (3) courses equivalent or lower than those already taken in the curriculum and should not be a science course prepared by College of Science for other colleges.

- HU/SS Courses - Humanities and Social Science Component: Any course from the following:
  Humanities: Fine Arts, History, American Studies, Classics, Communications, English, (Foreign Language) French, Music, Philosophy, Theatre, Literature (Arabic), Religion (comparative).
  Social Science: Anthropology, Economics, Education, Geography, History, Psychology, Sociology, Women's Studies, Political Science.

Detailed Study Plan

Year 1 – Semester 1

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ISLM 101	Islamic Culture	3	0	3	UR	NONE	No
ENGL 125	English for Science I (SCI)	3	0	3	CR	NONE	No
ITCS 113	Computer Programming I	3	2	3	CR	NONE	No
MATHS 131	Calculus I	4	0	4	CR	NONE	Yes
PHYCS 101	General Physics I	3	2	4	CR	NONE	No
Total		**16**	**4**	**17**			

Year 1 – Semester 2

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ENGL 126	English for Science II (SCI)	3	0	3	CR	EMGL 125	No
PHYCS 102	General Physics II	3	2	4	MSR	PHYCS 101	No
ARAB 110	Arabic Language Skills	3	0	3	UR	NONE	No
MATHS 132	Calculus II	4	0	4	MR	MATHS 131	Yes
ITCS 114	Computer Programming II	3	2	3	MSR	ITCS 113	No
Total		**16**	**4**	**17**			

Year 2 – Semester 3

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
ITCS 214	Data Structures	3	2	3	MSR	ITCS 114	No
MATHS 233	Calculus III	4	0	4	MR	MATHS 132	Yes
MATHS 205	Differential Equations	3	0	3	MR	MATHS 132	Yes
BIOLS 102	General Biology I	3	2	4	CR	NONE	No
HIST 122	Modern History of Bahrain and Citizenship	3	0	3	UR	NONE	No
Total		**16**	**4**	**17**			

Year 2 – Semester 4

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEMY 101	General Chemistry I	3	2	4	CR	NONE	No
MATHS 210	Linear Algebra I	3	0	3	MR	MATHS 132	Yes
MATHS 254	Introduction to Abstract Mathematics	3	0	3	MR	MATHS 132	Yes
STAT 271	Introduction to Probability	3	0	3	MR	MATHS 131	Yes
GSE XXX	Free Elective Course 1	X	X	3	GSE	NONE	No
Total		**X**	**X**	**16**			

Year 3 – Semester 5

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 301	Analysis I	3	0	3	MR	MATHS 254 MATHS 233	Yes
MATHS 331	Numerical Analysis I	3	2	3	MR	MATHS 132 ITCS 114	Yes
STAT 371	Probability and Statistics I	3	0	3	MR	MATHS 132 STAT 271	Yes
MATHS 310	Linear Algebra II	3	0	3	MR	MATHS 254 MATHS 210	Yes
MATHS 3XX	Major Elective 1 - List 1	3	0	3	ME	As per ME list	Yes
Total		**15**	**2**	**15**			

Year 3 – Semester 6

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 311	Abstract Algebra I	3	0	3	MR	MATHS 210 MATHS 254	Yes
MATHS 383	Methods of Applied Mathematics I	3	0	3	MR	MATHS 233 MATHS 205	Yes
MATHS 343	Complex Analysis	3	0	3	MR	MATHS 233	Yes
MATHS 4XX	Major Elective 2 - List 2	3	0	3	ME	As per ME list	Yes
HRLC 107	Human Rights	2	0	2	UR	NONE	No
Total		**13**	**2**	**14**			

Training Requirement

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 398	INTERNSHIP	0	0	0	MR-Training	Passes 85 credit hours	Yes
Total		**0**	**0**	**1**			

Year 4 – Semester 7

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 483	Methods of Applied Mathematics II	3	0	3	MR	MATHS 383	Yes
MATHS 312	Abstract Algebra II	3	0	3	MR	MATHS 311	Yes
MATHS 302	Analysis II	3	0	3	MR	MATHS 301	Yes
MATHS 4XX	Major Elective 3 - List 3	3	0	3	ME	As per ME list	Yes
MATHS 3/4XX	Major Elective 4 - List 4	3	0	3	ME	As per ME list	Yes
Total		**15**	**0**	**15**			

Year 4 – Semester 8

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 3/4XX	Major Elective 5 - List 4	3	0	3	ME	As per ME list	Yes
MATHS 3/4XX	Major Elective 6 - List 4	3	0	3	ME	As per ME list	Yes
MATHS 3/4XX	Major Elective 7 - List 4	3	0	3	ME	As ME per list	Yes
MATHS 498	Senior Project	0	6	3	MR	Pass 85 credits	Yes
GSE XXX	Free Elective Course 2	X	X	3	GSE	NONE	No
Total		**X**	**X**	**15**			

Major Elective Courses

Course Code	Course Title	Course Hours			Course Type	Pre-requisite	Major GPA
		LEC	PRAC	CRD			
MATHS 353	Introduction to Mathematical Cryptography	3	0	3	MR	MATHS 254	Yes
MATHS 354	Introduction to Graph Theory	3	0	3	MR	MATHS 254 MATHS 210	Yes
MATHS 445	Introduction to Dynamical Systems	3	0	3	MR	MATHS 205 MATHS 210	Yes
MATHS 462	Partial Differential Equations	3	0	3	MR	MATHS 205 MATHS 233	Yes
MATHS 454	Elementary Differential Geometry	3	0	3	MR	MATHS 301 MATHS 310	Yes
MATHS 455	Metric and Topological Spaces	3	0	3	MR	MATHS 205 MATHS 210	Yes
MATHS 305	History of Mathematics	3	0	3	MR	ENGL 126 MATHS 233	Yes
MATHS 307	Introduction to Lie Group for Differential Equations	3	0	3	MR	MATHS 205	Yes
MATHS 332	Numerical Analysis II	3	0	3	MR	MATHS 331 MATHS 210	Yes
MATHS 352	Number Theory	3	0	3	MR	MATHS 254 MATHS 210	Yes
MATHS 403	Analysis of Functions of Several Variables	3	0	3	MR	MATHS 302	Yes
MATHS 405	Theory of Differential Equations	3	0	3	MR	MATHS 205	Yes
MATHS 453	Euclidean and Non-Euclidean Geometries	3	0	3	MR	MATHS 254 MATHS 310	Yes
MATHS 462	Partial Differential Equations	3	0	3	MR	MATHS 205 MATHS 233	Yes
MATHS 371	Theory of Interest	3	0	3	MR	MATHS 132	Yes
MATHS 377	Fundamentals of Data Science	3	0	3	MR	STAT 371	Yes
MATHS 488	Mathematics of Signal Representations	3	0	3	MR	MATHS 383 MATHS 310	Yes
STAT 372	Probability and Statistics II	3	0	3	MR	STAT 371	Yes

General Studies Elective (GSE)

Course Code	Course Title	Course Hours			Course Type	Pre-Requisite
		LEC	PRAC	CRD		
ARAB 141	Modern Arabic Lit.	3	0	3	GSE	------
ARAB 242	Arabic Poetry In The Renaissance Period	3	0	3	GSE	------
ART 133	Fundamentals of Music and Its Appreciation	3	0	3	GSE	------
ART 141	Drawing and Painting	2	1	3	GSE	------
ART 221	Traditional Music of Bahrain and Its Application	3	0	3	GSE	------
CHL 101	Introduction to Chinese Language	3	0	3	GSE	------
CHL 102	Basic Chinese Language	3	0	3	GSE	CHL 101
EDAR 126	Playing on Piano and Org 1	3	0	3	GSE	------
EDPS 144	Psychology of Learning and Memory	3	0	3	GSE	------
EDTC 100	Teaching and Learning Technology	3	0	3	GSE	------
ENGL 130	Introduction to Literature	3	0	3	GSE	------
FREN 141	French I	3	0	3	GSE	------
FREN 142	French II	3	0	3	GSE	FREN 141
GERM 101	Introduction to German	3	0	3	GSE	------
HISTO 212	Contemporary History of The Arab World	3	0	3	GSE	------
HISTO 281	Landmarks of Islamic Civilisation	3	0	3	GSE	------
ISLM 114	Quranic Sciences	3	0	3	GSE	------
ISLM 136	Biography of The Prophet	3	0	3	GSE	------
ISLM 141	Introduction to Shari'A	3	0	3	GSE	------
ISLM 252	Islamic Doctrine	3	0	3	GSE	------
JAPN 101	Japanese Level I	3	0	3	GSE	------
JAPN 102	Japanese Level II	3	0	3	GSE	JAPN 101
KL 101	Korean Language I	3	0	3	GSE	------
KL 102	Korean Language II	3	0	3	GSE	KL 101
LAW 101	Introduction to Legal Studies	3	0	3	GSE	------
LAW 102	History of Law	3	0	3	GSE	------
LAW 106	Constitutional Law I	3	0	3	GSE	------
PHEDE 214	Principles of Educational Statistics	3	0	3	GSE	------
PSYC 103	Introduction to Psychology	3	0	3	GSE	------
PSYC 120	Psychology of Marriage	3	0	3	GSE	------
PSYC 211	Educational Psychology	3	0	3	GSE	------

Course Code	Course Title	Course Hours			Course Type	Pre-Requisite
		LEC	PRAC	CRD		
PSYC 281	Thinking Skills	3	0	3	GSE	PSYC 103 or EDPS 241
SOCIO 161	Introduction to Sociology	3	0	3	GSE	-----
SOCIO 181	Introduction to Anthropology	3	0	3	GSE	-----
SOCIO 191	Citizenship, Identity and Globalization	3	0	3	GSE	-----
SOCIO 224	Sociology of Health	3	0	3	GSE	-----
SOCIO 226	Sociology of Arabian Gulf	3	0	3	GSE	-----
TL 101	Turkish Language	3	0	3	GSE	-----
SPAN 101	SPANISH I	3	0	3	GSE	-----
GSE XXX	Other Electives	X	X	E	GSE	Department Approval

University Requirements Courses Descriptions

Course Code:	**HRLC 107**	Course Credits:	(2-0-2)	Course Title:	**Human Rights**
Course Description:	This course deals with the principles of human rights in terms of the definition of human rights, scope, sources with a focus on the International Bill of Human Rights; The Charter of the United Nations; Universal Declaration of Human Rights; The International Covenant on Economics, Social and Culture rights; Convention against Torture and other Cruel, Inhuman or Degrading Treatment or Punishment; Mechanics and the Constitutional Protection of Rights and Public Freedoms in Kingdom of Bahrain.				
Course Code:	**HIST 122**	Course Credits:	(3-0-3)	Course Title:	**Modern History of Bahrain and Citizenship**
Course Description:	Spatial identity of Bahrain: Brief history of Bahrain until the 18th century; the historical roots of the formation of the national identity of Bahrain since the 18th century; the modern state and evolution of constitutional life in Bahrain; the Arabic and Islamic dimensions of the identity of Bahrain; the core values of Bahrain's society and citizenship rights (legal, political, civil and economic); duties; responsibilities and community participation; economic change and development in Bahrain; Bahrain's Gulf, Arab and international relations.				
Course Code:	**ARAB 110**	Course Credits:	(3-0-3)	Course Title:	**Arabic Language Skills**
Course Description:	This course focuses on basic Arabic skills including form, function, and meaning. It also helps the student to appreciate and understand structures and approach them from a critical point of view, through various genres in literature.				
Course Code:	**ISLM 101**	Course Credits:	(3-0-3)	Course Title:	**Islamic Culture**
Course Description:	An introduction to the general outline and principles of Islamic culture, its general characteristics, its relationships with other cultures, general principles of Islam in beliefs, worship, legislation and ethics.				

College Requirement Courses Descriptions

Course Code:	**ENGL 125**	Course Credits:	(3-0-3)	Course Title:	**English for Science I** (**SCI**)
Course Description:	This is the first of two integrated language courses designed specifically for science majors. Special attention is given to scientific vocabulary and the unique features of technical writing. The course includes an extensive reading programme via a self-access lab.				
Course Code:	**ENGL 126**	Course Credits:	(3-0-3)	Course Title:	**English for Science II** (**SCI**)
Course Description:	English for Science is the second of two integrated language courses designed specifically for Science majors. Special attention is given to scientific vocabulary and the unique features of technical writing.				
Course Code:	**ITCS 113**	Course Credits:	(3-2-3)	Course Title:	**Computer Programming I**
Course Description:	This course introduces problem solving and fundamental programming concepts and techniques implemented by a high-level programming language. Topics include primitive and compound data types, syntax, semantics, expressions, assignment, input, output, conditional and iterative control structures, and functions.				
Course Code:	**MATHS 131**	Course Credits:	(4-0-4)	Course Title:	**Calculus I**
Course Description:	Limits, Derivatives of Algebraic and Transcendental Functions, Related Rates, the Mean Value Theorem, Graphing Techniques, Optimization, Integrals, and the Fundamental Theorem of Calculus.				
Course Code:	**CHEMY 101**	Course Credits:	(3-2-4)	Course Title:	**General Chemistry I**
Course Description:	Atomic structure; formulas and names of chemical molecules; Avogadro's number and the mole; stoichiometry of chemical reactions; acid-base and redox reactions, solutions, concentration units, and colligative properties; gases and gas laws; electronic structure and the electron configuration; periodic properties and chemical bonding: ionic and covalent; Lewis structures and formal charge; molecular geometry and hybridization. Related practical work.				
Course Code:	**PHYCS 101**	Course Credits:	(3-2-4)	Course Title:	**General Physics I**
Course Description:	Units and Measurements. Brief Review of Vectors. Newton's Laws of Motion. Projectile Motion. Work and Energy. Impulse and Momentum. Rotational Dynamics. Equilibrium of a Rigid Body. Periodic Motion.				
Course Code:	**BIOLS 102**	Course Credits:	(3-2-4)	Course Title:	**General Biology I**
Course Description:	Properties of life; atoms, molecules, and chemical bonds; biomolecules; cell structure and function; bioenergetics (intermediary metabolism); cell reproduction; Mendelian genetics; structure of DNA; RNA and protein synthesis; molecular genetics.				

Major Requirement Courses Descriptions

Course Code:	**STAT 271**	Course Credits:	(3-0-3)	Course Title:	**Introduction to Probability**
Course Description:	Descriptive Statistics. Sample Spaces. Probability Functions. Conditional Probability. Independence. Combinatorics. Random Variables and their Distributions. Distribution Functions. Geometric. Binomial. Poisson and other Discrete Distributions. Uniform. Normal and other Continuous Distributions. Some Limit Theorems.				
Course Code:	**STAT 371**	Course Credits:	(3-0-3)	Course Title:	**Probability and Statistics I**
Course Description:	Random Variables and Probability Distributions. Moment Generating Functions. Joint Probability Distributions. Normal. Gamma. Chi Square and other Distributions. Central Limit Theorem.				
Course Code:	**MATHS 132**	Course Credits:	(4-0-4)	Course Title:	**Calculus II**
Course Description:	Applications of Definite Integrals, L'Hopital's Rule, Integration Techniques, Infinite Series, Taylor and Maclaurin Series, Parametric Equations and Polar Coordinates.				
Course Code:	**MATHS 205**	Course Credits:	(3-0-3)	Course Title:	**Differential Equations**
Course Description:	Differential equations of first order and their solution. Separable and exact equations. Equations convertible to separable type. Higher order linear equations with constant coefficients (homogeneous and nonhomogeneous). Variation of parameters. Laplace transform technique. Applications of differential equations.				
Course Code:	**MATHS 210**	Course Credits:	(3-0-3)	Course Title:	**Linear Algebra I**
Course Description:	Matrices and systems of linear equations, determinants, real vector spaces, linear independence, basis and dimension, rank and nullity of matrices.				
Course Code:	**MATHS 233**	Course Credits:	(4-0-4)	Course Title:	**Calculus III**
Course Description:	Vectors. Vector-valued functions. Partial differentiation. Optimization. Multiple integrals, Change of variables, line and surface integrals, Green's and Stokes' theorems.				
Course Code:	**MATHS 254**	Course Credits:	(3-0-3)	Course Title:	**Introduction to Abstract Mathematics**
Course Description:	Elementary Logic. Methods of proof. Sets, relations and functions. Cardinality.				
Course Code:	**MATHS 301**	Course Credits:	(3-0-3)	Course Title:	**Analysis I**
Course Description:	Basic properties of real numbers. Sequences of real numbers. Limits, continuity and differentiation of functions of one real variable.				
Course Code:	**MATHS 302**	Course Credits:	(3-0-3)	Course Title:	**Analysis II**
Course Description:	Riemann integral. Series of real numbers. Pointwise and uniform convergence of sequences and series of Functions. Introduction to topology.				
Course Code:	**MATHS 310**	Course Credits:	(3-0-3)	Course Title:	**Linear Algebra II**
Course Description:	Vector spaces and inner product spaces, linear transformations and linear operators, eigenvalues, eigenvectors and diagonalization.				
Course Code:	**MATHS 311**	Course Credits:	(3-0-3)	Course Title:	**Abstract Algebra I**
Course Description:	Groups. Homomorphisms. Subgroups. Cyclic Groups. Permutation Groups, Groups of Symmetries. Lagrange's Theorem. Normal Subgroups. Quotient Groups. Direct Products. Isomorphism theorems. Conjugacy. Sylow's Theorems.				
Course Code:	**MATHS 312**	Course Credits:	(3-0-3)	Course Title:	**Abstract Algebra II**
Course Description:	Rings. Homomorphisms. Ideals. Quotient rings. Isomorphisms theorems. Integral domains. Fields. Prime and maximal ideals. Polynomials ring. Euclidean and principal ideal domains. Irreducibility Criterion. Field Extension.				

Course Code:	**MATHS 331**	Course Credits:	(3-0-3)	Course Title:	**Numerical Analysis**
Course Description:	Floating point computations, solution of equations and systems of equations (linear and nonlinear), interpolation, numerical differentiation and integration. The course emphasizes practice on computer software.				
Course Code:	**MATHS 343**	Course Credits:	(3-0-3)	Course Title:	**Complex Analysis**
Course Description:	Complex numbers. Analytic functions. Power series. Cauchy integral theorem and formula. Residues. Contour integration.				
Course Code:	**MATHS 383**	Course Credits:	(3-0-3)	Course Title:	**Methods of Applied Mathematics I**
Course Description:	Separation of variables. Power series solutions for ordinary differential equations with variable coefficients. Sturm-Liouville problems, Orthogonal polynomials and special functions (Legendre, Hermite, Gamma, Beta, Bessel). Fourier series.				
Course Code:	**MATHS 398**	Course Credits:	(0-0-1)	Course Title:	**Internship**
Course Description:	The Internship course is designed to provide an opportunity to gain work experience related to the student's specified field of science, in a supervised workplace environment for a period of 8 consecutive weeks. The student shall submit a report upon completion.				
Course Code:	**MATHS 483**	Course Credits:	(3-0-3)	Course Title:	**Methods of Applied Mathematics II**
Course Description:	Green's functions, Fourier transforms, Fourier analysis techniques for PDEs, Linear integral equations.				
Course Code:	**MATHS 498**	Course Credits:	(3-0-3)	Course Title:	**Senior Project**
Course Description:	Undergraduate research project under supervision of a member of the academic staff on a mathematical topic that is not covered in the regular curriculum. An oral exam with a submission of a written report are compulsory.				

Major Support Requirement Courses Descriptions

Course Code:	**ITCS 114**	Course Credits:	(3-2-3)	Course Title:	**Computer Programming II**
Course Description:	This course covers key concepts of object-oriented programming. Topics include object oriented design, encapsulation, event handlers, memory management, arrays, exception handlers, searching algorithms, programming applications.				
Course Code:	**ITCS 214**	Course Credits:	(3-0-3)	Course Title:	**Data Structure**
Course Description:	This course covers data structures and their implementations in an object-oriented programming language. Topics include sub-typing, abstract base class, lists, stacks, queues, trees, graphs, hash tables, strategies for choosing appropriate data structure.				
Course Code:	**PHYCS 102**	Course Credits:	(3-2-4)	Course Title:	**General Physics II**
Course Description:	Electric charges and fields; Coulomb's and Gauss's laws, electric potential, capacitors and dielectrics, direct current circuits, Kirchhoff's rules, magnetic field and flux, Ampere's law, induced emf, Lenz's laws, mutual and self-inductance; AC circuits; RLC circuit				

Major Elective List 1: Courses Descriptions

Course Code:	**MATHS 353**	Course Credits:	(3-0-3)	Course Title:	**Introduction to Mathematical Cryptography**
	Basics of number theory, including modular arithmetic and prime numbers. Classic ciphers and accompanying attacks. DES and AES. Public key cryptography. Primality tests. Elliptic curve cryptography. Historical and social consequences with applications of cryptography. Prerequisites: MATHS 254				
Course Code:	**MATHS 354**	Course Credits:	(3-0-3)	Course Title:	**Introduction to Graph Theory**
	Graphs and digraphs. Paths. Cycles. Matrix representation. Eulerian and Hamiltonian graphs. Trees. Matchings. Connectivity. Colouring. Planar and nonplanar graphs. Application of graph theory. Prerequisites: MATHS 254 and MATHS 210				

Major Elective List 2: Courses Descriptions

Course Code:	**MATHS 445**	Course Credits:	(3-0-3)	Course Title:	**Introduction to Dynamical Systems**
	Systems of linear first-order differential equations, existence and uniqueness theorems, qualitative theory: phase plane, linearization, stability, limit cycles. Prerequisites: MATHS 205 & MATHS 210				
Course Code:	**MATHS 462**	Course Credits:	(3-0-3)	Course Title:	**Partial Differential Equations**
	First order partial differential equations, method of characteristics, linear second order partial differential equations, classifications, maximum principles, boundary and initial value problem for potential, wave, and heat equations. Prerequisites: MATHS 205 & MATHS 233				

Major Elective List 3: Courses Descriptions

Course Code:	**MATHS 454**	Course Credits:	(3-0-3)	Course Title:	**Elementary Differential Geometry**
	Parametrized curves, curvature and torsion of curves, Frenet frames and formulae, curves with prescribed curvatures, Surfaces in 3-dimensional Euclidean space: tangent plane, first and second fundamental forms, normal and principal curvatures, Gaussian and mean curvatures, Geodesics, developable and Minimal surfaces. Prerequisites: MATHS 301 & MATHS 310				
Course Code:	**MATHS 455**	Course Credits:	(3-0-3)	Course Title:	**Metric and Topological Spaces**
	Metrics and metric spaces, topological spaces, separation properties, compactness, connectedness, and continuity. Prerequisites: MATHS 205 & MATHS 210				

Major Elective List 4: Courses Descriptions

Course Code:	**MATHS 305**	Course Credits:	(3-0-3)	Course Title:	**History of Mathematics**
	Primitive Origins. Egyptian Mathematics. Mesopotamia: Babylonian Mathematics. Greek: Ionia and the Pythagorean. Euclid of Alexandria. China and India. Islamic Mathematics. Mathematics of Middle ages and Renaissance. Modern Mathematics. Prerequisites: ENGL 126 & MATHS 233				
Course Code:	**MATHS 307**	Course Credits:	(3-0-3)	Course Title:	**Introduction to Lie Group for Differential Equations**
	First integral of systems of ODEs, Symmetric form of system, Integration of PDEs, Non-homogenous equations, Transformation groups, Infinitesimal transformations, Lie equations and the exponential map, canonical variables, invariants and invariant equations, The frame of a differential equations, Extension of group actions to derivatives, Generators of prolonged groups, Symmetry groups, Calculation of infinitesimal symmetries, Lie algebras and integration of non-linear differential equations. Prerequisites: MATHS 205				
Course Code:	**MATHS 332**	Course Credits:	(3-0-3)	Course Title:	**Numerical Analysis II**
	Approximation of functions: least squares theory, adaptive approximation. Numerical solution of ordinary differential equations (initial and boundary value problems). Eigenvalues and eigenvectors of a matrix. Introduction to partial differential equations and their numerical solution. Prerequisites: MATHS 331 and MATHS 210				
Course Code:	**MATHS 352**	Course Credits:	(3-0-3)	Course Title:	**Number Theory**
	Divisibility. Primes. Linear Congruences. Fermat's Theorem. Wilson's Theorem. Power Residues. Quadratic Reciprocity. Arithmetic Functions. Dirichlet Product. Some Diophatine Equations. Irrational Numbers. Algebraic Numbers. Prerequisites: MATHS 254 and MATHS 210				
Course Code:	**MATHS 403**	Course Credits:	(3-0-3)	Course Title:	**Analysis of Functions of Several Variables**
	Sets and functions in R^n, continuity and compactness, differentiability, Jacobian matrix and gradient, inverse and implicit function theorems, extrema, Hessian matrix, Taylor's formula, integration in R^n. Prerequisites: MATHS 302				
Course Code:	**MATHS 405**	Course Credits:	(3-0-3)	Course Title:	**Theory of Differential Equations**
	Basic existence and uniqueness theorems. Linear differential equations. Systems of linear differential equations. Autonomous systems, variation of parameters. Oscillation of solutions. Characteristic functions. Stability theory. Liapunov functions. Prerequisites: MATHS 205				
Course Code:	**MATHS 453**	Course Credits:	(3-0-3)	Course Title:	**Euclidean and Non-Euclidean Geometries**
	Analytical study of Euclidean, spherical, and hyperbolic geometries. The theory of transformation groups is emphasized. Prerequisites: MATHS 254 and MATHS 310				
Course Code:	**MATHS 462**	Course Credits:	(3-0-3)	Course Title:	**Partial Differential Equations**
	First order partial differential equations, method of characteristics, linear second order partial differential equations, classifications, maximum principles, boundary and initial value problem for potential, wave, and heat equations. Prerequisites: MATHS 205 and MATHS 233				

Course Code:	**MATHS 371**	Course Credits:	(3-0-3)	Course Title:	**Theory of Interest**
	Introduction to the mathematics of interest and the evaluation of interest related products including annuities with Non-contingent payments, loans, bonds, general cash flows, portfolios, and immunization. Prerequisites: MATHS 132				
Course Code:	**MATHS 377**	Course Credits:	(3-0-3)	Course Title:	**Fundamentals of Data Science**
	Data acquisition. Data storing. Data scaling. Data visualization, Data manipulation and analysis. Problem solving using R or Python programming languages. Prerequisites: STAT 371				
Course Code:	**MATHS 488**	Course Credits:	(3-0-3)	Course Title:	**Mathematics of Signal Representations**
	Fourier series, Fourier transform, discrete and fast Fourier transforms, Shannon sampling theorem, the Haar system, multiresolution analysis and wavelets bases. Prerequisites: MATHS 383 and MATHS 310				
Course Code:	**STAT 372**	Course Credits:	(3-0-3)	Course Title:	**Probability and Statistics II**
	Point and Interval Estimation. Sampling Distributions. T-distribution. Chi-Square distribution and F-distribution. Test of Hypotheses. Likelihood Ratio Test. Neyman-Pearson Lemma. Correlation and Regression. Prerequisites: STAT 371				