HITEC UNIVERSITY

Taxila Cantt

SELF ASSESSMENT REPORT

Department of Mathematics

MS Mathematics

Faculty of Sciences

Heavy Industries Taxila Education City (HITEC) University

2022-2023

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Reviewed by:	**QEC, Chairman, Dean, Vice-Chancellor**
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Executive Summary

This self-assessment report is being prepared for MS Mathematics from the Department of Mathematics and Faculty of Sciences as prescribed by Higher Education Commission. Quality Enhancement Cell was formed in HITEC University in 2011. Program Team and Assessment Team of mathematics department were formulated by university to collaborate with QEC to accomplish the following report in line with HEC guidelines with the support of Vice Chancellor and Department Heads.

This self-assessment report provides an analysis and evaluation of the academic standards followed and implemented by MS Mathematics Program. HEC prescribed Self-Assessment Manual is used as a reference and the program is being evaluated based on 8 criteria and 31 standards of quality improvement. First Program teams of Mathematics Department made the report and then further assessed by the assessment team. The report finds the prospects of maintaining and continually enhancing academic standards and student's learning.

This report also investigates the strong and weak areas and other improvements needed by the department. Feedback is then provided in the form of corrective actions and implementation plan for quality assurance and improvement of academic programs in the future.

Objectives

- To document the entire program into one report for the purpose of accountability, quality enhancement and accreditation.
- To make aware all the stake-holders their rights and duties as per the Self-Assessment Manual.
- To be eligible for HEC funding proportionate to our ranking.
- To be a preference for HEC scholarships for students and faculty.
- To be eligible for evaluation by external evaluators

Execution

The hierarchy of the execution tree was fundamental to the efficient working of all the stake-holders. Formulation of PT and AT was the very first step towards the goal.

Self-Assessment Manual was distributed to all the faculty members for awareness and especially to the Program and Assessment Teams for SAR. Lectures and workshops were arranged for senior faculty members along with the Registrar, Treasurer, Controller of Examination, Deans and Vice-Chancellor where qualified professionals of their fields taught the role of Quality and Accountability in education and especially in Higher Education.

The senior faculty members then became mentors for the junior faculty members and the knowledge of the subject spread to each and every faculty member along with supporting individuals/groups, until all were on the same page.

Following the lecturing and mentoring, a task distribution seminar was arranged by the chair of the Program Team. In this seminar, 8 criteria with 31 standards in total were distributed as tasks to various faculty members. An internal deadline of one month was given to all the task holders.

All task holders were instructed on the procedure of procurement of information for the completion of tasks. The information from various concerned departments of the university was to be obtained in written form along with initials of the information provider.

Once the criteria were ready, the task holder sent the soft copy for review and proof reading to the chair of the Program Team. The chair reviewed and proof read in company with the Quality Representative of the respective Department. Once all the corrections and revisions were done in line with the Self-Assessment Manual, the task holders sent a signed hard copy and a soft copy to the chair of the Program Team who then incorporated the finished criteria into a single report and the report was given a draft shape.

This draft was then sent as a soft copy and as a hard copy to the Quality Enhancement Cell, Chairman Mathematics Department, Dean and Vice-Chancellor who gave their valuable inputs.

Once the draft was finalized, QEC arranged for the Self-Assessment Report of the MS Mathematics Program to be assessed by the Assessment Team in the third week of May 2022.

The findings of the Assessment Team (AT) are given in the annexure-G. It outlines the improvements required in the infrastructure, syllabi and training of the faculty and support staff. The implementation plan (annexure-H) was prepared after discussion with all the stake-holders and it indicates the resources required to improve the Quality. Responsible bodies, timelines and goals were set for the execution of the implementation plan.

Self-Assessment Report

Introduction

Heavy Industries Taxila Education City (HITEC) University is a private sector university. It was established in 2007 and chartered in 2009 by the Government of Punjab. The University is sponsored by Heavy Industries Taxila Education Welfare Trust (HITEWT). The university was established with a vision to produce skilled, moral, ethical and patriotic professionals who can serve the society and who will be guardians of national, social and religious values.

University Mission Statement

HITEC University will be a center of excellence in teaching, learning and research. We shall instill and inspire intellectual curiosity, lifelong quest of knowledge and a keen urge for social and moral responsibility. The University will establish strong linkages with industry ensuring innovative research leading to economic prosperity of Pakistan.

Department of Mathematics

Department of Mathematics is currently running following 13 intakes of the MS Mathematics Program.

a.	MS Mathematics	2010
b.	MS Mathematics	2011
c.	MS Mathematics	2012
d.	MS Mathematics	2013
e.	MS Mathematics	2014
f.	MS Mathematics	2015
g.	MS Mathematics	2016
h.	MS Mathematics	2017
i.	MS Mathematics	2018
j.	MS Mathematics	2019
k.	MS Mathematics	2020
l.	MS Mathematics	2021
m.	MS Mathematics	2022

Program Selected

HITEC University has selected the **MS Mathematics Program** as first model program for Self-Assessment Report (SAR) under the directives of Higher Education Commission (HEC).

Program Evaluation

The program is being evaluated based on 8 criterion and 31 standards as given in the Self-Assessment Manual provided by Higher Education Commission (HEC).

Criterion 1: Program Mission, Objectives and Outcomes

Standard 1-1The program must have documented measurable objectives that support institution mission statements.

Program Mission Statement

MS Mathematics Program endeavors to instill higher level knowledge in such specialized areas such as analytical and numerical schemes, fluid mechanics, and rheology for solving complex engineering problems. The program also influences potential to seek new avenues of using advanced mathematics in addressing newly emerging challenges.

Program Objectives

To produce MS qualified Mathematics with following attributes:

1. Possessing wider and deeper knowledge in Mathematics.
2. To be able to solve the mathematical problems and practices in vogue in the industry/academia they have joined.
3. To be able to create innovative solutions to complex engineering problems in their respective organizations keeping in view societal and environmental concerns.
4. To be able to pursue Doctoral level education and research if desired.

Curriculum Design

Curriculum of MS Mathematics is carefully designed for a two-year degree program requires a course work of 24 credit hours and 6 additional credit hours are dedicated for research and submission of thesis. MS Mathematic comprises of 21 courses to choose from, followed by research thesis, fully adhering to the Higher Education Commission's

guidelines and requirements. Research topics for MS students pertain to numerical analysis, analytical and numerical techniques for ordinary and partial differential equations, and finite element analysis. Research opportunities are also available in numerical linear algebra, mechanics of fluids (Newtonian and Non-Newtonian), computational fluid dynamics, and computational rheology etc.

Program Objectives Assessment

Objective	How Measured	When Measured	Improvement Identified	Improvement Made
1	Student Exit Survey	At the end of the MS Program	Some new topics have been added	Yes
2	Alumni Survey Employer Survey	Every two years	Survey questions have been improved	Yes
3	Alumni Survey Employer Survey	Every two years	Survey questions have been improved	Yes
4	Alumni Survey	Every semester	Mathematics course has been introduced	Yes

Table 1: Program Objectives Assessment

Standard 1-2The program must have documented outcomes for graduating students. It must be demonstrated that the outcome support the program objectives and that graduating students are capable of performing these outcomes.

Program Outcomes

1. Students shall possess required pre-requisites for admission to higher degrees in reputable universities.
2. Students shall have required applied and practical knowledge and skills to pursue professional jobs in industries, laboratories, consultancy firms and government sectors.
3. Students shall be well-rounded not only in the discipline of Mathematics but also in related inter-disciplinary fields of science and technology.

4. Students shall possess sufficient knowledge to pursue an academia job.
5. Students shall be well-versed in modern day technologies in the field of Mathematics and in related disciplines. They shall be able to apply probabilistic/statistical tools to not only solve technical problems but also to design new solutions and be innovative.
6. Students shall be able to become entrepreneurs in their fields of interest. They shall possess leadership, decision making and risk-taking qualities necessary to compete, lead and succeed in a hugely competitive market. They shall possess problem solving skills and innovative ideas to be unique.
7. Students shall treat fairly all persons regardless of race, religion, gender, disability, age or regional origin. Students shall avoid conflicts at work places.

Program Objectives	Program Outcomes						
	1	2	3	4	5	6	7
1	x	x	x				
2			x	x	X	x	
3				x	X	x	x
4	x						

Table 2 : Outcomes versus Objectives

Standard 1-3The results of Program's assessment and the extent to which they are used to improve the program must be documented.

The program assessment has been done by students evaluating the courses and the respective teachers as per the HEC Performa.

Course Evaluation

The course evaluation was suspended of the last two years due to covid-19. It will resumed from Spring-23.

Teachers Evaluation

See Annexure D (Teachers Evaluation Survey) for teacher's evaluation Performa and the standards against which the students have evaluated them. Updated form is also attached as some changes are being made to the form. The total graded marks are 5.

HITEC University and especially the Mathematics department have a strong tradition of quality enhancement through students' feedback. The teachers' and courses' evaluation are given the due respect, analysis and direction. Teachers with strong feedback are appreciated and teachers with poor feedback are counseled, heard and encouraged. The course feedback is a major source of inspiration for curriculum and syllabi revision.

Program strengths

- Capable 9 PhD faculty members.
- Amongst them, they cover all essential domains of applied mathematics.
- The department has a blooming research culture.

Standard 1-4The department must assess its overall performance periodically using quantifiable measures.

Graduates/Undergraduates enrolled in last three years

Program	2016-17	2017-18	2018-19	2019-2020	2020-2021	2021-2022	2022-2023
MS Mathematics	15	18	19	11	7	6	1

Student Faculty Ratio:

MS Mathematics has 13-1 ratio

Average GPA per semester:

Average GPA per semester for the batch enrolled in year 2021 is as under:

Average GPA: 3.67

Average CGPA: 3.35

Average Completion time

The average completion time for Masters Program is 1.5 years and the maximum permitted time is 4 years.

Employer Satisfaction

No Employer survey of MS program has been conducted yet.

Students Course Evaluation Rate

Average student evaluation for all courses is 4.17 which is very good by any measure.

Students Faculty Evaluation

Students Evaluated faculty. The feedback was taken by QEC staff in the absence of faculty members. 100% teachers are above average grades which mean none of the teacher is below average. All the teachers are above 3.5 which is the topmost tier of the grading hierarchy.

Research

The program faculty published research papers in different journals. List attached in Annexure A.

Community Service

HITEC university's students and faculty actively partakes in social welfare and community services. Be it floods or earthquakes or be it blood donation, HITEC University is always at the fore-front of giving back to the community.

Criterion 2: Curriculum Design and Organization

Title of Degree Program

MS Mathematics

Definition of credit hour:

One credit hour is 3 hours of theory lecture in a week.

Degree plan

Following is the list of courses taught in the selected program. Section 4.5 shows the details about these courses including pre-requisites.

Sr. #	Course Name	Code
1	Perturbation Methods-I	MTH-701
2	Mathematical Modeling	MTH-705
3	Mathematical Essentials for Cryptography	MTH-706
4	Relativistic Astrophysics	MTH-707

5	Advanced Ordinary Differential Equations with Applications	MTH-708
6	Advanced Numerical Analysis	MTH-709
7	Numerical Linear Algebra	MTH-710
8	Computational Fluid Dynamics	MTH-712
9	Boundary Value Problems-I	MTH-715
10	Integral Equations & Applications	MTH-717
11	Advanced Partial Differential Equations and Applications	MTH-718
12	Variational Inequalities and Applications	MTH-720
13	Numerical Solution of Partial Differential Equations	MTH-721
14	Finite Element Analysis-I	MTH-723
15	Advanced Numerical Linear Algebra	MTH-724
16	Advanced Mathematical Physics	MTH-726
17	Advanced Cryptography	MTH-728
18	Fractional Calculus & Applications	MTH-729
19	Numerical Solution of Boundary Value Problems for ODEs	MTH-731
20	Advanced Fluid Mechanics	MTH-732
21	Integral Transform and Applications	MTH-835
22	Thermal and Concentration Boundary Layer	MTH-837
23	Non-Newtonian Fluid Mechanics	MTH-733
24	Mathematical Theory of Liquid Chromatography	MTH-840
25	Thesis (MS level)	MTH-769
26	Ph.D. Thesis	MTH-786

Table 3: Courses and their Respective Course Codes

Courses Information

MTH-801: Perturbation Methods- I

Introduction, order symbols and Gauga functions, asymptotic series and expansions, asymptotic expansion of integrals, integration by parts, Laplace's method and Watson's lemma, method of stationary phase and method of steepest descent, straight forward expansions and sources of non-uniformity, the Doffing equation, small Reynolds number flow past a sphere, small parameter multiplying the highest derivative, the method of strained coordinates, Lindstedt Poincare method, renormalization method, variation of parameters and method of averaging, method of multiple scale with examples.

MTH-805: Mathematical Modeling

Classification of mathematical models, deductive, inductive, floating models. Modeling methodology, modeling skills, use of difference equations for mathematical modeling, matrix models, consistency of models, discrete models, population growth model; linear models; logistic models. Continuous models: One variable models; equilibrium and

stability; multivariable models. Mathematical modeling using random numbers: stochastic models: Discrete probabilistic models and continuous probabilistic models.

MTH-806: Mathematical Essentials for Cryptography

Congruences, Fermat's little theorem and Euler's theorem, primitive roots, algebraic preliminaries, groups, fields, field extensions, finite fields, elliptic curves, time estimate for doing arithmetic, computational complexity and number-theoretical algorithms, mathematics for stream ciphers, Minimal polynomial and families of recurring sequences, characterizations and properties of linear recurring sequences, Boolean functions.

MTH-807: Relativistic Astrophysics

Static stellar structure and the equilibrium conditions, introduction to stellar modeling, The Hertzprung-Russel diagram and stellar evolution, gravitational collapse and degenerate stars, white dwarfs, neutron stars and black holes, systems of stars, irregular and globular clusters, galaxies super clusters and filaments, astrophysical dark matter and galactic haloes.

MTH-808: Advanced Ordinary Differential Equations with Applications

Applications of first and second order ODEs; systems of first order ODEs, Eigenvalue method for first order systems, variation of parameters for first order systems, nonlinear ODEs, Lotka-Voltera predator-prey model; Series Solution of ODEs, Legendre's differential equation, Bessel's differential equation, hypergeometric differential equation, Chebyshev differential equation, Laguerre differential equation, Hermite Differential Equation.

MTH-809: Advanced Numerical Analysis

Aitken's and Neville's iterated interpolation, Hermite interpolation. Cubic spline interpolation, parametric curves, Bivariate interpolation. Errors in polynomial interpolation: Dirichlet Function, Runge Function, orthogonal systems and Chebyshev Polynomials, SVD least-squares theorem, numerical integration: adaptive Simpson's scheme, adaptive Newton-Cotes integration, adaptive scheme of O'Hara and Smith, Romberg integration, Euler-Maclaurin's formula. Gaussian quadrature: Weighted Gaussian quadrature theorem, Gauss-Legendre quadrature, Gauss-Hermite quadrature, Gauss-Laguerre quadrature, Gauss-Chebyshev quadrature. Multiple integrals: Simpson's double integral, Gaussian double integral, Gaussian triple integral, improper integrals.

MTH-810: Numerical Linear Algebra

Direct methods for solving linear systems (Algorithmic approach), sparse matrices, solution of tridiagonal system, solution of pentadiagonal system, Stone's strongly implicit procedure (SIP), stability and conditioningof linear systems, perturbation of linear systems, iterative methods for solving sparse systems(Algorithmic approach), convergence of iterative methods, pre-conditioning, conjugate gradient method, Eigenvalues and Eigenvectors (algorithmic approach),diagonalization of matrices, Schur's theorem, Sourian-Frame theorem, Bocher's Formula, Gerschgorin's theorems, ovals of Cassini, Eigenvalues by iterations (Power method), Wielandt deflation, Householder's method, QR method.

MT-812: Computational Fluid Dynamics

Thermodynamic properties of a fluid, basic flow analysis techniques, review of governing equations, integral conservation laws, differential conservation laws, Bernoulli equation, boundary conditions for basic equations, stream functions, vorticity and Irrotaionality, mathematical classification of flows, discretization approaches, finite difference methods, finite volume methods, solution of the Navier-Stokes equations, grid generation.

MTH-815: Boundary Value Problems-I

Introduction to boundary value problems, linear and nonlinear models, Adomian's decomposition method, modification in decomposition methods, applications of ADM and MADMs for IV and BVPs, variational iteration method, Adomian's polynomials and Padé approximation, comparison of VIM, ADM and other techniques, Homotopy perturbation method (HPM), modifications in HPM, applications in HPM and its modified versions, modification of variation of parameters method (VPM), differential transform method and its applications, introduction of Homotopy analysis method.

MTH-817: Integral Equations and Applications

Linear integral equations: preliminaries, introductory concepts of integral equations, Volterra integral Equations, Fredholm integral equations, Volterra integro-differential equations, Fredholm integro-differential equations, Abel's integral equation and singular integral equations, systems of Volterra equations and Fredholm equations, systems of singular integral equations, nonlinear integral Equations, nonlinear singular integral equations, applications of integral equations.

MTH-818: Advanced Partial Differential Equations and Applications

Introduction, linear and nonlinear PDEs, homogeneous and inhomogeneous PDEs, solutions of PDEs, boundary and initial conditions, well -posed PDEs, method of characteristics, method of separation of variables, Laplace's equations, D'Alembert's

solution, solution of physical models, solitons and compactons, solitary wave theory, types of travelling wave equations, Pade approximation, various techniques to find travelling wave solutions.

MTH-820: Variational Inequalities and Applications

Basic concepts, minimization problems, existence and uniqueness of solutions of different classes of variational inequalities, fixed point formulations, Wiener-Hopf equations, iterative methods, auxiliary principle technique, convergence analysis, variational inclusions, resolvent Equations.

MTH-821: Numerical Solution of Partial Differential Equations

Parabolic equations, finite-difference representation for parabolic equation, classical explicit method, Laasonen fully implicit method, Crank-Nicolson method, weighted average approximation method, DuFort-Frankel method, Keller Box method, convergence, consistency and stability of finite difference scheme, stability criterion (matrix method, Fourier method), von Neumann polynomial, hyperbolic equations: finite difference schemes for the first-order wave equation, finite-difference representation for second order hyperbolic equation, Explicit methods and Courant-Friedrichs-Lewy (C.F.L), implicit difference methods, elliptic equations: five-point and nine-point difference approximation, Laplacian operator in skewed and polar coordinates, Poissonian operator in triangular coordinates, Applications.

MTH-823: Finite Element Analysis-I

Calculus of variations, Hamilton's principle. One dimensional shape functions, integral formulations and variational methods: Integral formulations, weighted-integral and weak formulations, linear and bilinear forms and quadratic functionals, variational methods, the Ritz Method, approximation functions, method of weighted residuals. Galerkin and weighted residual methods, finite elements in one dimension, weak form with linear trial functions, second order equations, linear elements of second order equation, local and global matrices, quadratic element of second order linear Problems, mixing two different elements.

MTH-824: Advanced Numerical Linear Algebra

Iterative matrices and preconditioning, Chebyshev acceleration and Symmetric SOR (SSOR), projection methods, Krylov subspace methods, Arnoldi's iteration, incomplete orthogonalization method (IOM), generalized minimal residual (GMRES) method, The Lanczos Iteration, incomplete LU (ILU) factorization preconditioners, conjugate gradient (CG) method, incomplete modified Gram-Schmidt, multigrid methods, weighted Jacobi iteration, Gauss-Seidel iteration, nested iteration, algebraic multigrid (AMG), smoothness in AMG, interpolation in AMG.

MTH-826: Advanced Mathematical Physics

Nonlinear ordinary differential equations, Bernoulli's equation, Riccatiequation, Lane Emden equation, Nonlinear Pendulum, Duffing's equation, Pinney's equation, Perturbation theory, Bogoliubov-Krilov method. Linear partial differential equations: Heat equation, wave equation, Laplace equation, integral equations, Wiencr-Hopf equations, Fredholmtheory,variational methods, Sturm-Liouville problem and variational principles, Rayleigh-Ritz methods for partial differential equations, matrix algebra, method of Faddeev.

MTH-828: Advanced Cryptography

Introduction and classical cipher systems, block ciphers, DES, AES cipher, correlations and Walsh transforms, cryptographic criteria, generalization to S-Boxes, pseudo-random-sequence generators and stream ciphers, linear feedback shift registers, public key cryptography, Elliptic curve cryptography, digital signature and authentications threats, challenge-response algorithms, zero knowledge protocols and oblivious transfer, lattice based cryptography.

MTH-829: Fractional Calculus and Applications

Special functions of the fractional calculus, gamma function, Mittag-Leffler function, Wright function, functional derivatives and integrals, GrundwaldLetnikov fractional derivatives and applications, ReimannLiouville fractional derivatives, properties of fractional derivatives, Caputo's fractional derivatives, Laplace and Fourier transforms of fractional derivatives, existence and uniqueness theorems, Leibniz rule, techniques in fractional calculus, fractional Green's function, one-term, two-term, three-term, four-term and n-term equations, Numerical evaluation of fractional derivatives, approximation of fractional derivatives, finite part integrals and fractional derivatives, Abel's integral equations, solution of Bessel's equation, applications to diffusion problems.

MTH-831: Numerical Solution of Boundary Value Problems for ODEs

The Taylor-Series method, The Euler method and its modifications, Runge-Kutta methods and Butcher's theory, Runge-Kutta-Fehlberg method, multistep methods, higher order equations and systems, stiff differential Equations. Boundary-value problems, shooting methods, The Riccati method. Finite difference methods, finite element/spectral methods: Fundamental Lemma of calculus of variations, Euler-Lagrange equations, equivalence of variational and weak formulations of BVPs, Rayleigh-Ritz method, collocation method, Galerkin method, pseudospectralGalerkin method, pseudospectralGalerkin collocation method.

MTH-832: Advanced Fluid Mechanics

Physical and thermodynamical properties of fluids, kinematics of the flow field, dynamics of the flow field, flow of a uniform incompressible fluid, steady unidirectional flow, unsteady unidirectional Flow, Ekman layer, flow with circular streamlines, dynamical similarity, flow at small Reynolds number, flow at large Reynolds numbers:
Effects of viscosity, vorticity dynamics: Kelvin's circulation Theorem, source of vorticity, boundary layers, separation of boundary layers, jets, free shear layers, wakes, oscillatoryboundary layers, flows with a free surface potential flow: Theory and applications, Theory of an inviscid fluid flow, properties of irrotational flows, steady flow, applications.

MTH-833: Non-Newtonian Fluid Mechanics

Classification of non Newtonian fluids, Rheological formulae (Time independent fluids, Thixotropic fluids and viscoelastic fluids), variable viscosity fluids, the deformation rate, viscoelastic equation, materials withshort memories, The Rivlin-Ericksen fluid, basic equations of motion in rheological models. The linear viscoelastic liquid, axial oscillatory tube flow, angular oscillatory motion, periodic transients, basic equations in boundary layer theory, truncated solutions for viscoelastic flow, Similarity solutions.

MTH-834: Numerical Optimization and Applications

Classical optimization, single-variable optimization, multivariable optimization, linear programming, duality and post-optimal analysis, Karmarkar's interior method, parametric linear programming, nonlinear programming (one-dimensional minimization methods): elimination methods, interpolation methods, nonlinear programming (unconstrained optimization methods): direct search methods, indirect search methods.

MTH-835: Integral Transforms and their Applications

Fourier transforms, application of Fourier transform, Fourier sine transform, Fourier cosine transform, double Fourier transform, double Fourier sine transform, double Fourier cosine transform, application of Fourier sine and cosine transform, Hartley transform, Laplace transform, applications of Laplace transform, Mellin transform, applications of Mellin transform, Weiestrass transform, Hankel transform, applications of Hankel transform, Abel transform, Hilbert transform, applications of Hilbert transform, Hermite transform, Legendre transform, applications of Legendre transform, Jacobi and Gegenbauer transform, application of Jacobi transform, applications of Gegenbauer transform, Laguerre transform, applications of Laguerre transform.

MTH-836: Turbulence Modelling

Turbulent scales, vorticity gradient interaction, energy spectrum, Boussinesq assumption, algebraic models, exact k equation, k-ε, k-ω and k-τ models, low-Re- k-ε model, Launder-Sharma low-Re k-ε model, The two layer k-ε model, Reynold stress models, Reynolds stress models vs Eddy viscosity model, curvature effects, acceleration and retardation effects, modeled k equations, modeled equation, one and two equation model, some physical examples of turbulence flows. non-linear eddy viscosity models and algebraic stress models, Reynolds stress transport models, large eddy simulations, detached eddy simulations and other hybrid models, direct numerical simulations.

MTH-837: Thermal and Concentration Boundary Layer

Thermal conduction mechanism, modes of heat transfer, derivation of steady state heat equation, derivation of unsteady heat equation, derivation of steady and unsteady heat equation, boundary layer equation, thermal boundary layer, convective transfer constants from boundary layer analysis. application of heat transfer in engineering problems, mass diffusivity mechanism, derivation of mass diffusion equation, derivation of mass diffusion equation, application of mass diffusion in engineering problems, mass diffusion between parallel surfaces, flow in circular passages, mass diffusion in an inclined channel, mass diffusion over s stretching surface, heat conduction and mass diffusion analogies.

MTH-838: Mathematical Theory of Elastodynamics

Analysis of strain and stress, body and surface forces, stress tensor, maximum normal and shear stress, homogenous isotropic bodies, elastic moduli of isotropic bodies, equilibrium equations for an isotropic elastic solid, dynamical equations for an isotropic elastic solid, Saint-Venant's principle, waves in infinite media, longitudinal waves, surface waves, Rayleigh waves, transverse waves, plane wave solutions, propagation in waveguides, waves propagation in elastic solids, Helmholtz theorem, generalized Hooke's law, reflection and transmission at plane interface, reflection at free surface, refraction, dispersive media, diffraction, scattering due to irregular structures.

MTH-839: Advanced Numerical Techniques

Direct and iterative methods for linear systems, numerical solution of ODEs: initial-value problems, boundary-value problems, shooting method, finite difference method, Galerkin method, numerical solution of PDEs: parabolic equation Crank-Nicolson scheme, DuFort-Frankel scheme, stability of finite difference scheme (matrix method, Fourier method), hyperbolic equation, Euler, upstream, Lax, leap frog and Lax-Wendroff schemes, elliptic equation, five-point scheme for Poisson equation, curved boundary.

MTH-840: Mathematical Theory of Liquid Chromatography

Basic concepts and terminology in chromatography, Formulation of different one-dimensional (1D) and two dimensional (2D) mathematical models (Equilibrium

Dispersive Model, Lumped Kinetic Model, General Rate Model), Existence and uniqueness of solution, Appropriate initial and boundary conditions, Theoretical introduction to principles and techniques for the solution of liquid chromatographic models, Analytical solution of 1D and 2D models using Laplace and Hankel transformation, Moment analysis.

MTH-841: Statistical Mechanics

Thermodynamics (review): Introduction to the second law of thermodynamics, Microstates, Multiplicity (two-state problem), Microcanonical ensemble, Macro states, Indistinguishability, Free energy and chemical potential, Gibbs free energy, Chemical potential dilute solutions and chemical equilibrium. Quantum mechanics (review): Systems of many particles, Schoedinger equation, Angular momentum, Gibbs Factor, Bosons and Fermions, Grand canonical ensemble, Degenerate Fermi, Distribution functions, Boltzmann statistics, Boltzmann factor, Average, Canonical ensemble, Equipartion theorem, Maxwell Speed distribution, Partition functions, Free energy, Composite systems and Ideal gas phenomena. Quantum statistics: Systems of interacting particles, weakly interacting gases, Partition function, Configuration integral, Cluster expansion and Second virial coefficient. Applications are Blackbody radiation, Debye theory of solids, Bose-Einstein condensation, Non-Equilibrium systems and Chaos, Application of Degeneracy to White Dwarfs and Neutron stars.

EM-501: Topics of Engineering for Mathematicians

Energy, Energy Transfer, and General Energy Analysis, Evaluating Properties – Properties of a Pure, Simple Compressible Substance, The Second Law of Thermodynamics, Introduction to Fluid Mechanics, Properties of Fluids , Fluid Statics , Introduction to Fluid's Motion, Introduction of Heat Transfer, Heat Conduction, Heat Convection, Heat Radiation, Mass Transfer, ANSYS Software. Introduction to Mechanics of Materials, Special topics in Mechanics of Materials, Stochastic and Control Systems, Optical Fiber Communication, Special Topics in Wireless Communications and Antennas, Advanced Engineering Electromagnetics.

Standard 2-1The curriculum must be consistent and supports the program's documented objectives.

Table 4: Courses and their respective Course Codes

Sr. No.	Course Code	Course Title	Credit Hours
1.	MTH-801	Perturbation Methods-I	3+0
2.	MTH-805	Mathematical Modeling	3+0
3.	MTH-806	Mathematical Essentials for Cryptography	3+0
4.	MTH-807	Relativistic Astrophysics	3+0

5.	MTH-808	Advanced Ordinary Differential Equations with Applications	3+0
6.	MTH-809	Advanced Numerical Analysis	3+0
7.	MTH-810	Numerical Linear Algebra	3+0
8.	MTH-812	Computational Fluid Dynamics	3+0
9.	MTH-815	Boundary Value Problems-I	3+0
10.	MTH-817	Integral Equations and Applications	3+0
11.	MTH-818	Advanced Partial Differential Equations and Applications	3+0
12.	MTH-820	Variational Inequalities and Applications	3+0
13.	MTH-821	Numerical Solution of Partial Differential Equations	3+0
14.	MTH-823	Finite Element Analysis-I	3+0
15.	MTH-824	Advanced Numerical Linear Algebra	3+0
16.	MTH-826	Advanced Mathematical Physics	3+0
17.	MTH-828	Advanced Cryptography	3+0
18.	MTH-829	Fractional Calculus & Applications	3+0
19.	MTH-831	Numerical Solution of Boundary Value Problems for ODEs	3+0
20.	MTH-832	Advanced Fluid Mechanics	3+0
21.	MTH-833	Non-Newtonian Fluid Mechanics	3+0
22.	MTH-834	Numerical Optimization and Applications	3+0
23.	MTH-835	Integral Transforms and their Applications	3+0
24.	MTH-836	Turbulence Modeling	3+0
25.	MTH-837	Thermal and Concentration Boundary Layer	3+0
26.	MTH-838	Mathematical Theory of Elastodynamics	3+0
27.	MTH-839	Advanced Numerical Techniques*	3+0
28.	MTH-840	Mathematical Theory of Liquid Chromatography	3+0
29.	MTH-841	Statistical Mechanics	3+0
30.	EM-501	Topics of Engineering for Mathematicians	3+0
31.	MTH-869	Thesis (MS level)	6+0

32.	MTH-886	PhD Thesis	30+0

Standard 2-2 Theoretical backgrounds, problem analysis and solution design must be stressed within the program's core material.

Elements	Courses	
Theoretical Background	MTH-801	Perturbation Methods-I
	MTH-806	Mathematical Essentials for Cryptography
	MTH-807	Relativistic Astrophysics
	MTH-826	Advanced Mathematical Physics
Problem Analysis	MTH-808	Advanced Ordinary Differential Equations with Applications
	MTH-809	Advanced Numerical Analysis
	MTH-810	Numerical Linear Algebra
	MTH-812	Computational Fluid Dynamics
	MTH-817	Integral Equations & Applications
	MTH- 835	Integral Transform and Applications
	MTH-818	Advanced Partial Differential Equations & Applications
	MTH-805	Mathematical Modeling
	MTH-837	Thermal and Concentration Boundary Layer
	MTH-829	Fractional Calculus & Applications
	MTH-831	Numerical Solution of Boundary Value Problems for ODEs
	MTH-832	Advanced Fluid Mechanics
Solution Design	MTH-820	Variational Inequalities and Applications
	MTH-821	Numerical Solution of Partial Differential Equations
	MTH-823	Finite Element Analysis-I
	MTH-840	Mathematical Theory of Liquid Chromotography
	MTH-824	Advanced Numerical Linear Algebra
	MTH-828	Advanced Cryptography
	MTH-833	Non-Newtonian Fluid Mechanics
	MTH-869	Thesis (MS level)
	MTH-886	Ph.D. Thesis

Table 5: Standard 2-2 Requirement (table 4.5)

Standard 2-3 The Curriculum must satisfy the core requirements for the program as specified by the respective accreditation body.

MS Mathematics program is recognized by Higher Education Commission (HEC). Minimum Requirements for each program (Program Semester Credit Hours):

Program	Theory Courses	Research Thesis

MS Mathematics	24	6

Table 6: Program Credit Hours

Standard 2-4 The curriculum must satisfy the major requirements for the program as specified by the respective accreditation body.

Same as Standard 2-3.

Standard 2-5 The curriculum must satisfy general education, arts and professional and other discipline requirements for the program as specified by the respective accreditation body.

Same as standard 2-3 and Standard 2-1 (table 4.4) as defined above.

Standard 2-6 Information technology component of the curriculum must be integrated throughout the program

Not applicable.

Standard 2-7 Oral and written communication skills of the student must be developed and applied in the program.

Students go through course presentations and research methodology, which develop the oral and written communication skills of the students. Students have to write a thesis and present their work in thesis defense in 4^{th} semester.

Criterion 3: Laboratories and Computing Facilities

Standard3-1 Laboratory manuals/documentation/instructions for experiments must be available and easily accessible to faculty and students.

Not applicable.

Standard 3-2 There must be support personal for instruction and maintaining the laboratories.

Not applicable.

Standard 3-3 The University computing infrastructure and facilities must be adequate to support program's objectives.

Not applicable.

Criterion 4: Student Support and Advising

Since the launch of HITEC University in year 2007, all its programs have started and finished on schedule. The beauty of the HITEC culture is that teachers and students have facility of frequent interaction, even after classes, for any professional and academic advice. This aspect is even highlighted and indicated by the students in the feedback on HEC Performa number 10, taken by the Quality Enhancement Cell (QEC) in the university.

Standard 4-1 Courses must be offered with sufficient frequency and number for students to complete the program in a timely manner.

The department circulates a list of postgraduate courses to be offered by the PhD qualified faculty. A student registers in one, two or at the most three courses. The minimum number of the students needed for offering a course is 6. The practice is followed in all the teaching semesters. Over the years, our experience shows that this scheme gives ample opportunities to complete the MS coursework in three semesters quite comfortably. The fourth semester is meant for research and writing a thesis. Thus, an average student cannot complete all requirements for the MS degree in two years' time frame.

Standard 4-2 Courses in the major area of study must be structured to ensure effective interaction between students, faculty and teaching assistants.

The department ensures that postgraduate courses are offered in well-considered chronological sequences, leading towards the assigned research projects of the students.

Standard 4-3 Guidance on how to complete the program must be available to all students and access to qualified advising must be available to make course decisions and career choices.

The department has dedicated a senior faculty member as the postgraduate advisor. He advises the students to select courses and in doing so, he consults the HOD as well as the PhD faculty. This ensures a smooth process of course selection. During the research phase, each student has a dedicated supervisor as well. He keeps guiding the students regularly till the end of the research defense.

Criterion 5: Process Control

Standard 5-1 The process by which students are admitted to the program must be based on quantitative and qualitative criteria and clearly documented. This process must be periodically evaluated to ensure that it is meeting its objectives.

Our university has a clearly defined and well documented admission process. It is as given below. The prospective candidate should have:

- Bachelor degree in the relevant discipline from an HEC recognized university.
- Minimum CGPA 2.00/4.00 or 50% marks.
- GAT General conducted by NTS with minimum 50% cumulative score.

Additionally, the candidates are also interviewed. For this purpose, the department has an Admission Committee comprising HOD and at least two senior faculty members. So far, this process of admission is working to our satisfaction. However, we remain conscientious of reviewing it whenever the need would arise.

Standard 5-2 The process by which students are registered in the program and monitoring of students' progress to ensure timely completion of the program must be documented. This process must be periodically evaluated to ensure that it is meeting its objectives.

As mentioned earlier, the postgraduate program supervisor keeps track of the performance of each student and HOD also, individually, keeps a check on the progress as well. The controller of examinations department keeps in custody all the results and raises an alarm whenever a student is likely to get into difficulties situation

Standard 5-3 The process of recruiting and retaining highly qualified faculty members must be in place and clearly documented. Also processes and procedures for faculty evaluation, promotion must be consistent with institution mission statement. These processes must be periodically evaluated to ensure that it is meeting with its objectives.

Vacant and newly created positions are advertised on the university website and also in the national newspapers, applications are received by the Registrar office, scrutinized by the respective Deans, and call letters are issued to the short-listed candidates on the basis of experience, qualification, publications and other qualities/activities as determined by the University in the light of HEC guidelines.

The candidates are interviewed by the University Selection Board. Selection of candidates is approved by the BOG. Induction of new candidates depends upon the number of approved vacancies.

Faculty members are retained by giving them good remuneration, favorable teaching environment, research facilities and management support.

On semester basis faculty performance is evaluated basing on HEC Performa number 10 by the students, HOD recommendations and with the counter signature of Dean and Vice Chancellor. The additional annual increment is based on the recommendations of the HOD, Dean and the Vice Chancellor.

Standard 5-4 The process and procedures used to ensure that teaching and delivery of course material to the students emphasizes active learning and that course learning outcomes are met. The process must be periodically evaluated to ensure that it is meeting its objectives.

Students are the recipient of the delivery of course material, through their teachers. The program is actively evaluated by HOD, Dean, In Charge program and QEC. The feedback of the taught course is best instrument to measure that the course learning outcomes are met. The students give feedback on Performa number 1 regarding course contents and how it was delivered. Through Performa number 10, students evaluate and comment on teacher's efforts, put in to deliver the course contents, his general conduct in the class, the environment, he/she, maintains and extra efforts, he/she makes to satisfy students, thirst for knowledge.

Faculty feedback is also taken on HEC Performa number 2 (Faculty Course Review Report – Annexure C) and Performa number 5 (Faculty Survey – Annexure - E) which is a very useful activity to evaluate the course contents, learning and teaching environments and overall teachers' satisfaction level. Course evaluation by teachers also indicates what percentage of desired outcome has been achieved by the course contents and what needs to be improved or changed.

This exercise is done twice a year. The feedback is discussed with HOD, Dean and In-charge program, who focus on making improvements in the weak areas, identified by the students. Teacher's evaluation Performa's are fed to the computer and bar charts are made. Each teacher is graded out of 5 marks. The comparative bar charts indicate level of performance of teachers, as visualized by the students. QEC formally submits these bar charts to HOD, Dean and Vice Chancellor for their information and taking of necessary corrective actions.

Standard 5-5 The process that ensures that graduates have completed the requirements of the program must be based on standards, effective and clearly documented procedures. This process must be periodically evaluated to ensure that it is meeting its objectives.

HEC criteria for enduring the fulfillment of all the requirements are strictly followed in the University for the Award of MS degree. It consists of either passing 10 postgraduate courses or 8 courses and a research thesis. Also, our requirement is that a student must achieve a minimum CGPA of 2.5 out of 4.00. The minimum duration for Master'sProgram is 1.5 years and the maximum permitted time is 4 years. The complete process is well documented and well publicized. The appropriateness of this process is reviewed through faculty and student feedback forms by the QEC Directorate.

Criterion 6: Faculty

Standard 6-1 There must be enough full time faculties who are committed to the program to provide adequate coverage of the program areas/courses with continuity and stability. The interests and qualifications of all faculty members must be sufficient to teach all courses, plan, modify and update courses and curricula. All faculty members must have a level of competence that would normally be obtained through graduate work in the discipline. The majority of the faculty must hold a Ph.D. in the discipline.

There are 9 PhD faculty members, specialist in the fields of numerical analysis, analytical and numerical techniques for ordinary and partial differential equations, and finite element analysis. Including these following ranks are available in the mathematics department:

- Associate Professor – 1(Head of Department)
- Assistant Professor – 3

Program Area of Specialization	Elective Courses		
Mathematics	1.	MTH-801	Perturbation Methods-I
	2.	MTH-805	Mathematical Modeling
	3.	MTH-806	Mathematical Essentials for Cryptography
	4.	MTH-807	Relativistic Astrophysics
	5.	MTH-808	Advanced Ordinary Differential Equations with Applications
	6.	MTH-809	Advanced Numerical Analysis
	7.	MTH-810	Numerical Linear Algebra
	8.	MTH-812	Computational Fluid Dynamics
	9.	MTH-815	Boundary Value Problems-I
	10.	MTH-817	Integral Equations and Applications
	11.	MTH-818	Advanced Partial Differential Equations and Applications
	12.	MTH-820	Variational Inequalities and Applications
	13.	MTH-821	Numerical Solution of Partial Differential Equations
	14.	MTH-823	Finite Element Analysis-I
	15.	MTH-824	Advanced Numerical Linear Algebra
	16.	MTH-826	Advanced Mathematical Physics
	17.	MTH-828	Advanced Cryptography
	18.	MTH-829	Fractional Calculus & Applications
	19.	MTH-831	Numerical Solution of Boundary Value Problems for ODEs
	20.	MTH-832	Advanced Fluid Mechanics
	21.	MTH-833	Non-Newtonian Fluid Mechanics

	22.	MTH-834	Numerical Optimization and Applications
	23.	MTH-835	Integral Transforms and their Applications
	24.	MTH-836	Turbulence Modeling
	25.	MTH-837	Thermal and Concentration Boundary Layer
	26.	MTH-838	Mathematical Theory of Elastodynamics
	27.	MTH-839	Advanced Numerical Techniques*
	28.	MTH-840	Mathematical Theory of Liquid Chromatography
	29.	MTH-841	Statistical Mechanics
	30.	EM-501	Topics of Engineering for Mathematicians
	31.	MTH-869	Thesis (MS level)
	32.	MTH-886	PhD Thesis

Table 7: Courses Taught vs. Availability of Faculty

The ratio of faculty courses being taught is satisfactory. The present faculty is in position to take up all courses of post graduate students. Each faculty member is assigned subjects along with approved syllabus at the beginning of the semester. The faculty member prepares lecture plans and delivers to his / her students. Remaining restricted to the approved syllabus, the faculty member can update the already taught subject material according to the current developments in the field. Thus students are kept updated to the latest developments. Each faculty member is assigned access to the internet. Time table is scheduled in such a way so as to provide enough time to each teacher for research work. The courses being taught and commitment of the faculty is shown in the Table 7for prescribed regular courses.

Standard 6-2 All faculty members must remain current in the discipline and sufficient time must be provided for scholarly activities and professional development. Also, effective programs for faculty development must be in place. Effective Programs for Faculty Development

University has an efficient and committed faculty. Each faculty member is assigned to teach subjects according to the syllabus prescribed in the light of HEC and PEC directives. Every faculty member is provided an opportunity at the end of semester through faculty satisfaction report to evaluate his/her performance and comment on the suitability of the contents of curriculum being taught by him according to the latest trends / developments. If deemed necessary, suitable changes to the curricula are made by a board in the light of the suggestions of the concerned faculty member.

University encourages the researchers by providing them a nominal amount after publication of research paper enough time is provided to the faculty members for devoting their time to research in their fields. The faculty members are assisted by university through provision of internet facility and library.

Standard 6-3 All faculty members should be motivated and have job satisfaction to excel in their profession.

Students' feedbacks about their teachers are received after termination of each semester. Basing on these feedbacks, faculty members graded best by their students are awarded with appreciation letters. Letter of caution is served to the faculty member with whom students are not satisfied.

The faculty survey as per Performa prescribed by HEC is evaluated and basing on the inputs of the Performa, the system is further improved to provide beneficial teaching / learning environment. Faculty Surveys results are attached as per Annexure G.

Criterion 7: Institutional Facilities

Standard7-1The institution must have the infrastructure to support new trends in learning such as e-learning.

The university has provided e-learning facilities to faculty members and students. Students have been provided a number of computer systems in the library to access e-

learning section. Every student has been provided with user ID to access the e-learning resources from within the university library. Our library hosts over 12,000 e-books on all relevant subjects.

The support staff to look after the e-learning resources is sufficient in number, trained and responsive. The university has provided enough funding to support the e-learning.

Standard7-2 The library must possess an up-to-date technical collection relevant to the program and must be adequately staffed with professional personnel.

Our library holds more than 21,000 titles on all relevant engineering, sciences, mathematics, and humanities subjects. We add nearly 2,000 titles every year. Our library staff members are all duly qualified in library science subjects and also help the students for searching the required material. The library also provides 22 dedicated computers which students use for web browsing.

Standard7-3 Class-rooms must be adequately equipped and offices must be adequate to enable faculty to carry out their responsibilities.

The department has ample classrooms. These are very well furnished and also contain electric heaters and air conditioners. At most every classroom has installed multimedia projector. Similarly, faculty offices are well-equipped and well-furnished.

Criterion 8: Institutional Support

Standard 8-1 There must be sufficient support and financial resources to attract and retain high quality faculty and provide the means for them to maintain competence as teachers and scholars.

University allocates enough financial resources each year to hire competent faculty as required.

As already listed in standard 5-3, Faculty members are retained by giving them favorable teaching environment and management support. Most important point is that our pay scales for faculty are highly competitive and better than most of our competing institutions, including NUST.

As listed in standard 6-2, Faculty members are provided with adequate resources for research and academic activities to maintain their competence. Faculty members have access to the internet and library materials for academic and research activities. Professional training is also provided to faculty if required to enhance their capabilities. The university has schemes in place to reward faculty for each published research paper, chapter of a book, or the complete book. Similarly, travel grants up to 1,000/- rupees are available for attending a conference.

Standard 8-2 There must be an adequate number of high quality graduate students, research assistants and Ph.D. students.

The university follows the guidelines of HEC for admission in MS programs. The department has very vibrant postgraduate and doctoral programs. The university provokes its students to enhance their academic qualification. Also, all T/As and R/As are selected from our under study postgraduate students.

Standard 8-3 Financial resources must be provided to acquire and maintain Library holdings, laboratories and computing facilities.

The library holds more than 21,000/- titles and 12,000/- e-books. Sufficient numbers of computers are available for students. A computerized online search facility is also available.

Our laboratories are very well-equipped with the latest equipment and facilities. The university takes pride in the fact that our laboratories have been replicated by a number of other universities.

Conclusion

The self-assessment report of the Faculty of Mathematics, HITEC University, Taxila is an important document, which gives strengths and weaknesses of the program. The management is striving hard to improve infrastructure for establishment of conducive environment for studies. The faculty is focused on imparting quality education, introduction of new and innovative techniques and conduct of quality research to produce competent engineers. The report has been prepared after evaluating the program in the light of 8 criterion and 31 standards given in HEC’s Self-Assessment Manual. The program mission objectives and outcomes are assessed and strategic

plans are presented to achieve the goal, which are again measurable through definite standards. Teachers' evaluation revealed satisfactory standards, the score of 3 teachers of the program ranged from 3.87 and 4.38. Alumni surveys revealed variable results with regards to knowledge, interpersonal skills, management and leadership skill. Weaknesses are identified which are related to space, laboratories and equipment. Improvements in curriculum design and infrastructure are suggested which are based upon set, well defined and approved criteria. Pre-requisites are fully observed, examinations are held on schedules, academic schemes are prepared well in advance, transparent admission, registration and recruiting policy are some of the strong areas of this program. The number of courses along with titles and credit hours for each semester, course contents for degree program, is thoroughly planned. Their efficacy was measured through different standards and it was found to be satisfactory.

Proper steps are taken to guide the students for program requirements, research work, meetings, and students-teacher interaction etc. Some improvements have been suggested. As regards the process control covering admission, registration, recruiting policy, courses and delivery of material, academic requirements, performance and grading, university, PEC as well as Higher Education Commission has set forth proper rules, which are properly followed. At present there are five faculty members who are highly qualified in their fields. However, faculty members need motivation for advanced knowledge, research and external training.

Institutional facilities were measured through Criterion 3; infrastructure, library, class room and faculty offices and in each case, short comings and limitation are highlighted. Institutional facilities need to be strengthened. Accordingly, institutional support will greatly promote and strengthen academic, research, management and leadership capabilities.

In conclusion, MS Mathematics program is designed to educate students to meet the challenges of the modern world and present market needs. During the execution of the program several observations were made that can be categorized as strong and weak points of the program. These points are listed below:

Annexure – A: Research Papers List

FACULTY PUBLICATIONS

Dr. Rashid Mehmood
Journals Publications

S #	Name of Author	Complete Name of Journal and Address with ISSN (Print) No.	Title of Publication	Vol. No. &Page No.	HEC Category W/X/Y/Z	Year Published	Impact Factor + Citation (excluding self-citation)
1.	S. Rana, **R. Mehmood,** M. R. Gorji et al.	Journal of the Taiwan Institute of Chemical Engineers **1876-1070**	Interaction of nanoparticles with micro-organisms under Lorentz force in a polymer liquid with zero mass flux	**143, 104683**	**W**	**2023**	5.47 + 0
2.	**R. Mehmood,** R. Tabassum et al.	Nanomaterials	Crosswise stream of Cu-H_2O Nanofluid with Micro rotation effects: Heat transfer analysis	**2023**, ***13*(3), 471**	**W**		5.71 + 0
3.	F. Ahmed, **R. Mehmood**, A. J. Chamkha	Waves in Random & Complex Media **1745-5049,1745-5030**	Simulation of forced convective power law fluid by using Darcy–Brinkman–Forchheimer flow model field	**DOI: 10.1080/17455030.2022.2125596**	**W**	**2022**	4.05 + 0
4.	S. Rana, **R. Mehmood,** M. R. Gorji	International Communications in Heat& Mass Transfer **0735-1933**	Interaction of Lorentz force with cross swimming microbes in couple stress nano fluid past a porous Riga plate	**138, 106347**	**W**	**2022**	6.78 + 3
5.	H. Sadaf , S. Ijaz, N. Nasir, **R. Mehmood**	Waves in Random & Complex Media **1745-5049,1745-5030**	Biomechanics of cilia-assisted flow with hybrid nanofluid phenomena impulses by convective conditions	doi.org/10.1080/17455030.2022.208534	**W**	**2022**	4.05 + 3
6.	R. Tabassum, **R. Mehmood,** M. Y. Malik	Arabian Journal for Science and Engineering **2191-4281,2193-**	Crosswise Radiative Convective Transport of Viscoplastic Type Nanofluid with Influence of Lorentz Force and	**47**, 16319–16330	**W**	**2022**	2.80 + 0

		567X	Viscosity Variation				
7.	R. Tabassum, A. Al-Zubaidi, S. Rana, **R. Mehmood**	International Communications in Heat & Mass Transfer **0735-1933**	Slanting transport of hybrid (MWCNTs-SWCNTs/H_2O) nanofluid upon a Riga plate with temperature dependent viscosity and thermal jump condition	**135, 106165**	**W**	**2022**	6.78 + 3
8.	A. Butt, N. Akbar, **R. Mehmood,** S. Farooq	Frontiers in Materials **2296-8016**	Thermally conductive electro-osmotic propulsive pressure-driven peristaltic streaming flow study with a suspended	doi.org/10.3389/fmats.2022.105981	**W**	**2022**	3.98 + 0

			nanomaterial in a micro-ciliated tube	6			
9.	**R. Mehmood,** Y. Tufail, S. Rana, A. U. Khan, S. Ijaz	International Journal of Modern Physics B **0217-9792,1793-6578**	Non-Fourier Pseudoplastic nanofluidic transport under the impact of momentum slip and thermalradiation	doi.org/10.1142/S0217979223501357	**X**	**2022**	1.40 + 0
10.	SI E. N. Maraj, AneelaBibi, **R Mehmood**	Arabian Journal for Science and Engineering **2191-4281,2193-567X**	MHD Carbon Nanotubes Gravity-Driven FlowAlong a Thermal Sensitive Porous Surface	**47,15875–15885**	**W**	**2022**	2.80 + 0
11.	AAZ K. Mahmud, **R. Mehmood,** Siddra Rana	Journal of Molecular Liquids **1873-3166,0167-7322**	Flow of magnetic shear thinning nano fluid underzero mass flux and hall current	**352, 118732**	**W**	**2022**	6.63 + 2
12.	E. N. Maraj, Zobia Khatoon, **R. Mehmood,** S. Ijaz	International Communications in Heat and Mass Transfer Transfer **0735-1933**	Effect of Arrhenius activation energy and medium porosity on mixed convective diluted ethylene glycol nanofluid flow towards a curved stretching surface	**129, 105691**	**W**	**2021**	6.78 + 5
13.	S. Shaiq, E. N. Maraj, **R. Mehmood,** S. Ijaz	Journal of Process Mechanical Engineering:Part E. **2041-3009,0954-4089**	Magneto hydrodynamics radiative dissipative slip flow of hydrogen-oxide (H2O) infused with various shape tungsten, tin, titanium (nanometer) particles over a nonlinear radial stretching surface	**236(3):953-963.**	**X**	**2021**	1.82 + 1
14.	S. Ijaz, M. Batool, **R. Mehmood,** Z. Iqbal, E. N. Maraj	Arabian Journal for Science and Engineering **2191-4281,2193-567X**	Biomechanics of Swimming Microbes inAtherosclerotic Region with Infusion of Nanoparticles	**47**, 6773–6786	**W**	**2021**	2.80 + 2
15.	R. Mehmood, S. Khan, E. N. Meraj, S. Ijaz	Journal of Process Mechanical Engineering:Part E. **2041-3009,0954-4089**	Heat transport mechanism via ion-slip and hall current in Viscoplastic flow along a porous elastic sheet	**;236(3):907-914.**	**X**	**2021**	1.82 + 3
16.	M.K. Nayak, **Rashid Mehmood,** S. Mishra, A. Misra & Taseer Muhammad	Waves in Random and Complex Media**1745-5049,1745-5030**	Thermal and velocity slip effects in mixed convection flow of magnetized ceramic nanofluids over a thin needle with variable physical properties	doi.org/10.1080/17455030.2021.1983231	**W**	**2021**	4.05 + 7
17.	S. Rana, **R. Mehmood**, M. M. Bhatti	Chinese Journal of Physics	Bioconvection oblique motion of magnetized Oldroyd-B fluid through an elastic surface with	**73, 314-330**	**W**	**2021**	3.95 + 22

		0577-9073	suction/injection				
18.	M.K. Nayak, **R. Mehmood**, T. Muhammad, A. U.Khan, H. Waqas	Case Studies in Thermal Engineering **2214-157X**	Entropy minimization in mixed convective Falkner-Skan flow of ZnO-SAE50 Nano lubricant over stationary/moving Riga plate	**26, 101176**	**W**	**2021**	6.26+14
19.	S. Rana, **R Mehmood,** T. Muhammad	Thermal Science **0354-9836**	On Homogenous-Heterogeneous reactions in oblique stagnation-point flow of Jeffery fluid involving Cattaneo-Christov Heat flux	**25, 165-172**	**X**	**2021**	1.97+1
20.	**S. Rana**, R Mehmood, M. M. Bhatti, M.Hassan	Journal of Central SouthUniversity **2227-5223,2095-2899**	Swimming of motile gyrotactic microorganisms and suspension of nanoparticles in a rheological Jeffery fluid with Newtonian heating alongelastic surface	**28, 3279-3296**	**W**	**2021**	2.39+3
21.	R. Tabassum, **R Mehmood**	Arabian Journal for Science and Engineering **2191-4281,2193-567X**	Crosswise Transport Mechanism of Micro-rotating Hybrid (Cu–Al2O3/H2O) Nanofluids Through Infusion of Various Shapes of Nanoparticles	**45, 5883-5893**	**W**	**2020**	2.80 + 4
22.	MS Alqarni, R Tabassum, MY Malik, **R Mehmood**	Physica Scripta **0031-8949**	Shape effects of molybdenum disulfide (nm) micro-rotating particles in crosswise transport of hydrogen oxide:(MoS2–H2O) nano polymer gel	**95** 035002	**W**	**2020**	3.08 + 2
23.	S. Rana, **R Mehmood,** S. Nadeem	Journal of Thermal analysis and Calorimetry**1588-2926,1388-6150**	Bio convection through interaction of Lorentz force and gyrotactic microorganisms in transverse transportation of rheological fluid	**145**,2675–2689	**W**	**2020**	4.75 + 15
24.	M.K. Nayak, **R Mehmood,** O.D. Makinde, O. Mahian &A J Chamkha	Journal of Central SouthUniversity **2227-5223,2095-2899**	Magnetohydrodynamic flow and heat transfer impact on ZnO-SAE50 nanolubricant flow over an inclined rotating disk	**26**, **1146–1160**	**W**	**2019**	2.39+32
25.	**R Mehmood,** RTabassum	Part E: Journal of Process Mechanical Engineering **2041-3009,0954-4089**	Crosswise stream of methanol–iron oxide (CH3OH–Fe3O4) with temperature-dependent viscosity and suction/injection effects	**233, 1013-1023**	**X**	**2019**	1.82 + 8
26.	**R Mehmood,** M.K. Nayak, N S Akbar , OD Makinde	Journal of Nanofluids **2169-432X**	Effects of Thermal-Diffusion and Diffusion- Thermo on Oblique Stagnation Point Flow of Couple Stress Casson Fluid Over a Stretched Horizontal Riga Plate with Higher Order	**8, 94-102**	**Y**	**2019**	N/A + 29

			Chemical Reaction				
27.	**R Mehmood,** R Tabassum, E N Maraj	Communications in	Impact of Internal Heat Convective Transverse Transport of Viscoplastic	**70 (4), 423-429**	**X**	**2018**	2.87 + 6

		Theoretical Physics **0253-6102**	Material under Viscosity Variation				
28.	R Tabassum, **R Mehmood,** O Pourmehran	European Physical Journal Plus **2190-5444**	Velocity slip in mixed convective oblique transport of titanium oxide/water (nano-polymer) with temperature-dependent viscosity	**133 (361), 12180-191**	**W**	**2018**	3.75 + 12
29.	R Tabassum, **R Mehmood,** O Pourmehran, NS Akbar,M Gorji Bandpy	Part E: Journal of Process Mechanical Engineering **2041-3009,0954-4089**	Impact of viscosity variation on oblique flow of$Cu–H_2O$ nanofluid	**232 issue: 5, 622-631**	**X**	**2018**	1.82+19
30.	**R Mehmood,** RTabassum	Indian Journal of Physics **0973-1458,0974-9845**	Transverse transport	92 (10), 1271-1280	**X**	**2018**	1.77+04
31.	**R Mehmood,** S Rana,E N Maraj	Communications inTheoretical Physics **0253-6102**	Transverse Transport of Polymeric Nanofluid under Pure Internal Heating: Keller Box Algorithm	Volume 70, 106–118	**X**	**2018**	2.87 + 6
32.	**R Mehmood,** S Rana	Pramana – J. Phys. **0973-7111**	Thermal transport of rate-type fluid impingingobliquely over a heated sheet	Volume 91, (71)	**N/A**	**2018**	2.66 + 3
33.	**R Mehmood,** R Tabassum, O Pourmehran, DD Ganji	International Journal ofHydrogen Energy **0360-3199**	Crosswise Stream of Hydrogen-Oxide (H2O) through a Porous Media Containing Copper Nanoparticles	43 (15), 7562-7569	**W**	**2018**	7.13 + 16
34.	**R Mehmood**, S Rana,S Nadeem	Results in Physics **2211-3797**	Transverse Thermophoretic MHD Oldroyd-Bfluid with Newtonian heating	8, 686-693	**W**	**2018**	4.56 + 25
35.	**R Mehmood,** Tabassum, NS Akbar	Heat Transfer Research **1064-2285**	Oblique stagnation point flow of non-Newtonian fluid with variable viscosity	49 (16), 1585-1601	**X**	**2018**	2.44 + 02
36.	**Rashid Mehmood;** S.Rana	Canadian Journal of Physics **0008-4204,1208-6045**	Magnetic Field Effects on a nonlinear Radioactive Rate-Type Fluid Impinging Obliquely over a Heated Stretched Plate	96 (12), 1384-1394	**X**	**2018**	1.35 + 02
37.	**Rashid Mehmood**, S. Rana, O. Anwar Bég, Ali Kadir	Journal of the Brazilian Society of Mechanical Sciences and Engineering **1678-5878,1806-3691**	Numerical study of chemical reaction effects in magnetohydrodynamic Oldroyd -B: oblique stagnation flow with a non-Fourier heat flux model	40:526	**W**	**2018**	2.36 + 18

38.	**R. Mehmood**, Rabil Tabassum, S.	Arabian Journal forScience and	Thermal slip in oblique radiative nano polymer gel transport	**44**,1525–1541	**W**	**2018**	2.80 + 12

	Kuharat, O. Anwar Bég and M. Babaie,	Engineering **2191-4281,2193-567X**	dependent viscosity: simulation				
39.	Iqbal, Z; **Mehmood,R;** Mehmood, Zaffar	Journal of Molecular Liquids **1873-3166,0167-7322**	Thermal deposition Viscoplastic fluid with micro rotations	Vol. 243, pp. 341- 347	**W**	**2017**	6.63 + 3
40.	Tabassum, Rabil; **Mehmood, R**; Akbar, NS	European Physical Journal Plus **2190-5444**	Magnetite micropolar nanofluid non-alignedMHD flow with mixed convection	Vol. 132 (275)	**W**	**2017**	3.75 + 18
41.	Mehmood, Rashid; Mukhtar, Sadaf; Akbar, Noreen Sher	Part E: Journal of Process Mechanical Engineering **2041-3009,0954-4089**	Nanoparticle analysis of non-Newtonian fluid with slip and multiple convective boundary conditions	232(3):369-379	**X**	**2018**	1.82 + 3
42.	Rehman, Aziz Ur; **Mehmood, Rashid;** Nadeem, S; Akbar, NS; Motsa	Advanced Powder Technology **1568-5527,0921-8831**	Effects of single and multi-walled carbon nanotubes on water and engine oil based rotating fluids with internal heating	Vol. 28 (9), 1991-2002	**W**	**2017**	4.96 + 30
43.	Tabassum, Rabil; **Mehmood, R**; Nadeem, S;	Journal of Colloid and Interface Science **1095-7103,0021-9797**	Impact of viscosity variation and micro rotation on oblique transport of Cu-waterfluid	Vol. 501, pp. 304-310	**W**	**2017**	9.96 + 35
44.	Iqbal, Z.; **Mehmood,R.;** Azhar, Ehtsham; Mehmood, Zaffar	European Physical Journal Plus **2190-5444**	Impact of inclined algorithm	Vol. 132,175	**W**	**2017**	3.75 + 32
45.	Mehmood, Zaffar; **Mehmood, R;** Iqbal, Z	Communications in Theoretical Physics **0253-6102**	Numerical Investigation Internal Heating	Vol. 67 pp. 443-447	**X**	**2017**	2.87 + 51
46.	**Mehmood, Rashid;** Rana, S; Akbar, NS; Nadeem	Alexandria EngineeringJournal **1110-0168**	Non-aligned stagnation point surface	Vol. 57 pp. 939-946	**W**	**2017**	6.62 + 32
47.	**Mehmood, Rashid;** Nadeem, S; Saleem, S; Akbar, Noreen Sher	Journal of the TaiwanInstitute of Chemical Engineers **1876-1070**	Flow and heat transfer analysis of Jeffery nano fluid impinging obliquely over astretched plate	Vol. 74 pp. 49-58	**W**	**2017**	5.47 + 88
48.	Rehman, Aziz Ur; **Mehmood, Rashid**;	Applied Thermal	Entropy analysis of radioactive rotating nanofluid with thermal slip	Vol. 112 pp. 832-840	**W**	**2017**	6.46 + 55

	Nadeem, S	Engineering **1359-4311**					
49.	Rana, S; **Mehmood, Rashid**; Akbar, Noreen Sher	Journal of Molecular Liquids	Mixed convective oblique flow of a Cassonfluid with partial slip, internal heating and homogeneous–heterogeneous reactions	Vol. 222 pp. 1010-1019	**W**	**2016**	6.63 + 61
50.	S. Rana, **R. Mehmood,** PV S. Narayana and N.S. Akbar	Communications in Theoretical Physics **0253-6102**	Free Convective Nonaligned Non-Newtonian Flow with Non-linear Thermal Radiation	Vol. 66 pp. 687-693	**X**	**2016**	2.87 + 29
51.	**Mehmood, R;** Nadeem, S; Akbar, NSher	Journal Applied Fluid Mechanics 1735-3572	Non-aligned ethylene glycol 30% based stagnation point fluid over a stretching surface with hematite nano particles	10.18869/ACADPUB.JAFM.68.228.24458	**N/A**	**2016**	N/A+ 32
52.	**Mehmood, Rashid;** Nadeem, S; Masood,S	Journal of Magnetism and Magnetic Materials **0304-8853**	Effects of transverse magnetic field on a rotating micropolar fluid between parallel plates with heat transfer	Vol. 401 pp. 1006-1014	**W**	**2016**	3.09+ 61
53.	Nadeem, Sohail; Masood, Sadaf; **Mehmood, Rashid;** Sadiq, M. Adil	PLOS ONE **1932-6203**	Optimal and numerical solutions for an MHD micropolar nanofluid between rotating horizontal parallel plates	doi.org/10.1371/journal.pone.0124016	**W**	**2015**	3.75+ 43
54.	Nadeem, S; **Mehmood, Rashid;** Akbar, Noreen Sher	Journal of Computational and Theoretical Nanoscience **1546-1955,1546-1963**	Oblique stagnation point flow of carbon nano tube based fluid over a convective surface	Vol. 12 pp. 605-612	**Y**	**2015**	0.45+ 19
55.	Nadeem, S; **Mehmood, Rashid;** Akbar, Noreen Sher	Journal of Computational and Theoretical Nanoscience**1546-1955,1546-1963**	Oblique stagnation point flow of a Casson-Nano fluid towards a stretching surface with heat transfer	Vol. 11 pp. 1422-1432	**Y**	**2015**	0.45+ 47
56.	Nadeem, S; **Rashid Mehmood;** S S Motsa	International Journal of Thermal Sciences **1290-0729**	Numerical investigation on MHD oblique flow of a Walter's B type nano fluid over a convective surface	Vol. 92 pp. 162-172	**W**	**2015**	4.77+ 63

57.	S. Nadeem, **Rashid Mehmood,** Noreen Sher Akbar	Chinese Physics B **1674-1056**	Partial slip effect on non-aligned stagnation point nanofluid over a stretching convective surface	Vol. 24 **DOI** 10.1088/ 1674-	**X**	**2015**	1.65+ 42

				1056/24/1/014702			
58.	Noreen Sher Akbar, **Rashid Mehmood,** S. Nadeem	Journal of Magnetism and Magnetic Materials**0304-8853**	Combined effe cts of magnetic field andpartial slip on obliquely striking rheological fluid over a stretching surface	Vol. 378 pp.457–462	**W**	**2015**	3.09+ 54
59.	S. Nadeem, **Rashid Mehmood,** Noreen Sher Akbar	International journal of numerical method for heat and fluid flow **0961-5539**	Oblique stagnation flow of Jeffery fluid over a stretching convective surface: Optimal Solution	Vol. 25(3) pp.454-471	**W**	**2015**	4.17+ 33
60.	S. Nadeem, Aziz UrRehman, **Rashid Mehmood,** M. Adil Sadiq	Current Nanoscience **1573-4137**	Partial slip effects on a rotating flow of twophase nano fluid over a stretching surface	Vol. 10, 846 - 854	**X**	**2014**	1.82+ 15
61.	Nadeem, S; **Mehmood, Rashid**; Akbar, Noreen Sher	International Journal ofThermal Sciences **1290-0729**	Optimized analytical solution for oblique flowof a Casson-nano fluid with convective boundary conditions	Vol. 78 pp. 90-100	**W**	**2014**	4.77+ 126
62.	Nadeem, S; **Mehmood, Rashid**; Akbar, Noreen Sher	Eur. Phys. J. Plus **2190-5444**	Thermo diffusion effects on MHD obliquestagnation-point flow of a viscoelastic fluid over a convective surface	Vol. 129,182	**W**	**2014**	3.75+ 14
63.	**Rashid Mehmood**, S. Nadeem, Noreen Sher Akbar	Journal of the TaiwanInstitute of Chemical Engineers **1876-1070**	Non-orthogonal stagnation point flow of a micropolar second grade fluid towards a stretching surface with heat transfer	Vol. 44, pp. 586-595	**W**	**2013**	5.47+30
64.	S. Nadeem, **R. Mehmood,** N.S.Akbar	International Journal of Heat and Mass Transfer **0017-9310**	Non-orthogonal stagnation point flow of a nano non-Newtonian fluid towards a stretching surface with heat transfer	Vol. 57 pp. 679–689	**W**	**2013**	5.43+108
65.	S. Nadeem, **Rashid Mehmood**, Noreen Sher Akbar	Heat Transfer—AsianResearch 1099-2871	Influence of Heat Order Fluid Towards a Stretching Surface	Vol. 42, pp. 319–334	**N/A**	**2013**	N/A+2

66.	S. Nadeem; **Rashid Mehmood,** Noreen Sher Akbar	Journal of Computational andTheoretical Nanoscience **1546-1955,1546-1963**	Nanoparticle Analysis for Non-Orthogonal Stagnation Point Flow of a Third Order Fluid Towards a Stretching Surface	10, pp. 2737-2747	**Y**	**2013**	0.45+23

Dr. Naveed Ahmed

Journal Papers

1. M. Rani, N. Ahmed, S. S. Dragomir, S. T. Mohyud-Din, New travelling wave solutions to (2+1)-Heisenberg ferromagnetic spin chain equation using Atangana's conformable derivative, Physica Scripta, https://doi.org/10.1088/1402-4896/ac07b9, 2021 Impact Factor=1.902.
2. M. Rani, N. Ahmed, S. S. Dragomir, S. T. Mohyud-Din, I. Khan, K. S. Nisar "Some newly explored exact solitary wave solutions to nonlinear inhomogeneous Murnaghan's rod equation of fractional order" Journal of Taibah University for Science, 15 (1),97-110, https://doi.org/10.1080/16583655.2020.1841472, 2021.
   Impact Factor=1.863
3. N. Ahmed, Adnan, Umar Khan, S. T. Mohyud-Din, I. Khan, R. Murtaza, I. Hussain and E. S. M. Sherif. "A Novel Investigation and Hidden Effects of MHD and Thermal Radiations in Viscous Dissipative Nanofluid Flow Models" Frontiers in Physics, Section Mathematical Physics, https://doi.org/10.3389/fphy.2020.00075 2020. Impact Factor=1.895
4. Umar Khan, Adnan, N. Ahmed, S. T. Mohyud-Din, D. Baleanu, I. Khan, K. S. Nisar, "A Novel Hybrid Model for Cu-Al2O3/H2O Nanofluid Flow and Heat Transfer in Convergent/Divergent Channels" Energies, 13(7), https://doi.org:10.3390/en13071686 , 2020. Impact Factor=2.707
5. N. Ahmed, Adnan, Umar Khan, S. T. Mohyud-Din, Y. M. Chu, I. Khan, K. S. Nisar, "Radiative Colloidal Investigation for Thermal Transport by Incorporating the Impacts of Nanomaterial and Molecular Diameters (dNanoparticles, dFluid): Applications in Multiple Engineering Systems" Molecules, 25(8), https://doi.org:10.3390/molecules25081896 ,2020. Impact Factor=3.060
6. Umar Khan, Adnan, N. Ahmed, S. T. Mohyud-Din, Y. M. Chu, I. Khan, K. S. Nisar, " γ -Nanofluid Thermal Transport Between Parallel Plates Suspended by Micro-Cantilever Sensor by Incorporating the Effective Prandtl Model: Applications to Biological and Medical

Sciences" Molecules, 25(8), https://doi.org/10.3390/molecules25081777 , 2020. Impact Factor=3.060

7. Adnan, S. Z. A. Zaidi, Umar Khan, N. Ahmed, S. T. Mohyud-Din, Y. M. Chu, I. Khan, and K. S. Nisar, "Impacts of Freezing Temperature based Thermal Conductivity on the Heat Transfer Gradient in the Nanofluid: Applications for Curved Riga Surface" Molecules, 25(9), https://doi.org/10.3390/molecules25092152 ,2020. Impact Factor=3.060
8. S. T. Mohyud-Din, Adnan, Umar Khan, T. Abdeljawad, N. Ahmed and I. Khan, "Thermal Transport in Nonlinear Unsteady Colloidal Model by Considering the Carbon Nanomaterials Length and Radius" Energies, 13(10), https://doi.org/10.3390/en13102448 , 2020. Impact Factor=2.707
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2. Thermophoretic MHD free stream flow with variable internal heat generation/absorption and variable liquid characteristics in a permeable medium over a radiative exponentially stretching sheet, Journal of Materials Research and Technology, 9(3), pp. 4855-4866, 6.27, 2020.

3. A new computational technique design for EMHD nanofluid flow over a variable thicked surface with variable liquid characteristics, Frontier in Physics, 8,66, 3.56 Frontier in Physics, 8,66,(2020).

4. A simplified finite difference method (SFDM) for EMHD Powell-Eyring nanofluid flow featuring variable thickness surface and variable fluid characteristics, Mathematical Problems in Engineering, 1.3, (2020)

5. Unsteady MHD bio-nanofluid flow in a porous medium with thermal radiation near a stretching/shrinking sheet, Mathematical Problems in Engineering, 1.3, (2020).

6. Magnetohydrodynamic Time-DependentBio-Nanofluid Flow in a Porous Medium with Variable Thermophysical Properties, Mathematical Problems in Engineering, 1.3, (2021).

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Dr. Yasir Mahsud

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1. Effect of generalized thermal transport on MHD free convection flows of nanofluids: A generalized Atangana-Baleanu derivative model, Authors: NA Shah, KK Asogwa, **Y Mahsud**, S Lee, S Kang, JD Chung, M Ishtiaq, Journal: Case Studies in Thermal Engineering 40, 102480, (6.268) (2022).
2. Effects of fractional derivative and heat source/sink on MHD free convection flow of nanofluids in a vertical cylinder: A generalized Fourier's law model, Authors: NA Shah, A Wakif, R Shah, SJ Yook, B Salah, **Y Mahsud**, K Hussain, Journal: Case Studies in Thermal Engineering 28, 101518, (6.268) (2021).
3. Heat transfer analysis in convective flows of fractional second grade fluids with Caputo–Fabrizio and Atangana–Baleanu derivative subject to Newtonion heating, Authors: I Siddique, I Tlili, SM Bukhari, **Y Mahsud**, Journal: Mechanics of Time-Dependent Materials 25, 291-311, (2.739) (2021).
4. Slip effect on the unsteady electroosmotic and pressure-driven flows of two-layer fluids in a rectangular microchannel, Authors: A Rauf, **Y Mahsud,** Journal: Journal of Computational Applied Mechanics 52 (1), 12-26, (2021).
5. Multi-layer flows of immiscible fractional Maxwell fluids in a cylindrical domain, Authors: A Rauf, **Y Mahsud**, I Siddique, Journal: Chinese Journal of Physics 67, 265-282, (2.544) (2020).
6. Numerical simulations of unsteady flows in a rotating channel using a novel eigenfunction expansion method, Authors: Q Rubbab, **Y Mahsud**, S Irshad, MA Imran, A Ahmadian, S Salahshour, Journal: AIP Advances 10 (6), 065035, (1.624) (2020).
7. Analytical solutions for unsteady electrohydrodynamics flows of Maxwell fluids in microchannels with circular cross section, Authors: NA Shah, **Y Mahsud**, M Aziz, I Tlili, Journal: Physics of Fluids 32 (1), 013107, (2.627) (2020).
8. Multi-layer flows of immiscible fractional Maxwell fluids with generalized thermal flux, Authors: A Rauf, **Y Mahsud**, IA Mirza, Q Rubbab, Journal: Chinese Journal of Physics 62, 313-334, (2.544) (2019).
9. Electro-magneto-hydrodynamics Flows of Burgers' Fluids in Cylindrical Domains with Time Exponential Memory, Authors: A Rauf, **Y Mahsud,** Journal: Journal of Applied and Computational Mechanics 5 (4), 577-591, (2019).
10. Effect of magnetic field on double convection flow of viscous fluid over a moving vertical plate with constant temperature and general concentration by using new trend of fractional derivative, Authors: NA Shah, A Hajizadeh, M Zeb, S Ahmad**, Y Mahsud**, IL Animasaun, Journal: Open Journal of Mathematical Sciences 2 (1), 253-265, (2018).
11. Natural convection flows and heat transfer with exponential memory of a Maxwell fluid with damped shear stress, Authors**: Y Mahsud**, NA Shah, D Vieru, Journal: Computers & Mathematics with Applications 76 (9), 2246-2261, (2.811) (2018).
12. Unsteady two-dimensional flows of a nanofluid over a vertical plate with time-exponential temperature, Autors: A Rauf, **Y Mahsud**, Journal: Arab Journal of Basic and Applied Sciences 25 (3), 150-157, 2018.
13. MHD mixed convection Poiseuille flow in a porous medium: New trends of Caputo time fractional derivatives in heat transfer problems, Authors: I Khan, N Ali Shah, N Nigar, **Y Mahsud,** Journal: The European Physical Journal Plus 133, 1-14, (2.612) (2018).

14. Insight into the natural convection flow through a vertical cylinder using caputo time-fractional derivatives, Authors: NA Shah, T Elnaqeeb, IL Animasaun, **Y Mahsud,** Journal: International Journal of Applied and Computational Mathematics 4 (3), 80, 2018.
15. Unsteady free convection flow of viscous fluids with analytical results by employing time-fractional Caputo-Fabrizio derivative (without singular kernel), Authors: N Ali Shah, **Y Mahsud**, A Ali Zafar, Journal: The European Physical Journal Plus 132, 1-18, (2.612) (2017).
16. Influence of time-fractional derivatives on the boundary layer flow of Maxwell fluids, Authors: **Y Mahsud**, NA Shah, D Vieru, Journal: Chinese journal of physics 55 (4), 1340-1351, (2.544) (2017).
17. Heat transfer analysis in a Maxwell fluid over an oscillating vertical plate using fractional Caputo-Fabrizio derivatives, Authors: I Khan, N Ali Shah, **Y Mahsud**, D Vieru, Journal: The European Physical Journal Plus 132, 1-12, (2.612) (2017).

Dr. Feroz

Journal Papers

1. Approximation of Oscillatory Bessel Integral Transforms, Mathematics & Computers in Simulation (Impact Factor-3.601), 208, 727-744, 2023.
2. On the Evaluation of Poisson Equation with Dual Interpolation Boundary Face Method, European Journal of Mechanics/Asolids (Impact Factor-4.87) 88, 0997-7538, 2021.
3. Higher Order Pathwise Approximation for the Stochastic Burgers' Equation with Additive Noise, Applied Numerical Mathematics (Impact Factor-2.994), 162 67-80, 2021.
4. Pathwise Convergence of an Efficient Scheme for SPDEs with non-globally Lipschitz nonlinearity, Applied Mathematics & Computation (Impact Factor-4.39), 353 114-133, 2019.

Dr. Dania Saleem

Journal Papers

1. Color Multiple image encryption scheme based on 3D chaotic maps, Mathematics and Computer in Simulation, Volume 178, page 646-666.

Rafay Mustafa

Journal Papers

1. G-Symplectic Integration of Many Body Problems, Bulletin of Iranian Mathematical Society (2018)
2. Symplectic Effect for the Numerical Solution of Conservative Systems, International Journal of Artificial Intelligence and Mathemtical Sciences(IJAIMS) Vol1 No 1 (2022).

Annexure – B: Faculty Resume

S. No	Name	Designation	Qualification	Institution	Specialization	Experience (yrs.)	Utilization
						Teaching	Dedicated / Shared
1	Dr. Rashid Mehmood	Chairman Associate Professor	PhD	Quaid-i-Azam University, Islamabad	Fluid Mechanics, Numerical and Series Solutions	8	D
2	Dr. Naveed Ahmed	Associate Professor	PhD	HITEC University Taxila	Fluid Mechanics, Numerical and Series Solutions	7	D
3	Dr. Farman U Khan	Assistant Professor	PhD	COMSATS Institute of Information Technology	Computational Fluid Mechanics & Process Engineering	8	D
4	Dr. Arif Ullah	Assistant Professor	PhD	Quaid-i-Azam University, Islamabad	Fluid Mechanics	1	D
5	Dr. Feroz	Lecturer	PhD	Central South University China	Numerical Analysis	2	D
6	Dr M. Irfan	Lecturer	PhD	NUST, Islamabad	Computational Fluid Mechanics	2	D
7	Dr Dania Saleem	Lecturer	PhD	Quaid-i-Azam University, Islamabad	Cryptography	2	D

8	Dr Misbah Farheen	Lecturer	PhD	Quaid-i-Azam University, Islamabad	Fixed Point Theory	4	D
9	Dr. Yasir Mahsud	Lecturer	PHD	Abdul-Salam School of Mathematics	Fluid Mechanics	0.5	D
10	Ms. Rafay Mustafa	Lecturer	MPhil	NUST	Computational Mathematics	7	D
11	Mr. Noman Alam	Lecturer	MPhil	AIOU, Islamabad	Fluid Mechanics	2	D

Annexure – C: Student Course Evaluation

Previous Form

CORE QUESTIONS

Course Content and Organization	**Strongly Agree**	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**
1. The course objectives were clear	☐	☐	☐	☐	☐
2. The Course workload was manageable	☐	☐	☐	☐	☐
3. The Course was well organized (e.g. timely access to materials, notification of changes, etc.)	☐	☐	☐	☐	☐
4. Comments					

Student Contribution					
5. Approximate level of your own attendance during the whole Course	☐ <20%	☐ 21-40%	☐ 41-60%	☐ 61-80%	☐ >81%
	Strongly Agree	**Agree**	**uncertain**	**Disagree**	**Strongly Disagree**
6. I participated actively in the Course	☐	☐	☐	☐	☐
7. I think I have made progress in this Course	☐	☐	☐	☐	☐
8. Comments					

Learning Environment and Teaching Methods	**Strongly Agree**	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**
9. I think the Course was well structured to achieve the learning outcomes (there was a good balance of lectures, tutorials, practical etc.)	☐	☐	☐	☐	☐
10. The learning and teaching methods encouraged participation.	☐	☐	☐	☐	☐

11. The overall environment in the class was conducive to learning.	☐	☐	☐	☐	☐
12. Classrooms were satisfactory	☐	☐	☐	☐	☐
13. Comments					

Learning Resources	**Strongly Agree**	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**
14. Learning materials (Lesson Plans, Course Notes etc.) were relevant and useful.	☐	☐	☐	☐	☐
15. Recommended reading Books etc. were relevant and appropriate	☐	☐	☐	☐	☐
16. The provision of learning resources in the library was adequate and appropriate	☐	☐	☐	☐	☐
17. The provision of learning resources on the Web was adequate and appropriate (if relevant)	☐	☐	☐	☐	☐
18 Comments					

Quality of Delivery	**Strongly Agree**	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**
19. The Course stimulated my interest and thought on the subject area	☐	☐	☐	☐	☐
20. The pace of the Course was appropriate	☐	☐	☐	☐	☐
21. Ideas and concepts were presented clearly	☐	☐	☐	☐	☐
22.Comments					

Assessment	**Strongly Agree**	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**
23. The method of assessment were reasonable	☐	☐	☐	☐	☐
24. Feedback on assessment was timely	☐	☐	☐	☐	☐
25. Feedback on assessment was helpful	☐	☐	☐	☐	☐
26. Comments					

Additional Core Questions

Instructor / Teaching Assistant Evaluation	**Strongly Agree**	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**
27. I understood the lectures	☐	☐	☐	☐	☐
28. The material was well organized and presented	☐	☐	☐	☐	☐
29. The instructor was responsive to student needs and problems	☐	☐	☐	☐	☐
30. Had the instructor been regular throughout the course?	☐	☐	☐	☐	☐

Tutorial	**Strongly Agree**	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**

30. The material in the tutorials was useful	☐	☐	☐	☐	☐
31. I was happy with the amount of work needed for tutorials	☐	☐	☐	☐	☐
32. The tutor dealt effectively with my problems	☐	☐	☐	☐	☐

Practical	**Strongly Agree**	**Agree**	**Uncertain**	**Disagree**	**Strongly Disagree**
33. The material in the practicals was useful	☐	☐	☐	☐	☐
34. The demonstrators dealt effectively with my problems.	☐	☐	☐	☐	☐

Overall Evaluation

35.The best features of the Course were:

36.The Course could have been improved by:

Equal Opportunities Monitoring (Optional)

37. The University does not tolerate discrimination on any irrelevant distinction (e.g. race, age, gender) and is committed to work with diversity in a wholly positive way. Please indicate below anything in relation to this Course which may run counter to this objective:

Demographic Information: (Optional)

38. Full/part time study: Full Time ☐ Part Time ☐

39.Do you consider yourself to be disabled: Yes ☐ No ☐

40. Domicile:

41.Gender: Male ☐ Female ☐

42. Age Group: less than 22 ☐ 22-29 ☐ over 29 ☐

43. Campus: Distance Learning/ Collaborative ☐

Annexure – D:
Student's Teacher Evaluation

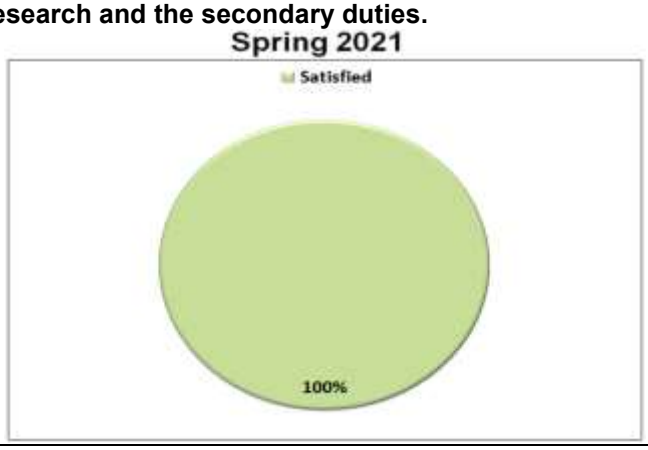
Previous Form

Points	**Instructor's Name** Course Name
1. The instructor is prepared for each class	

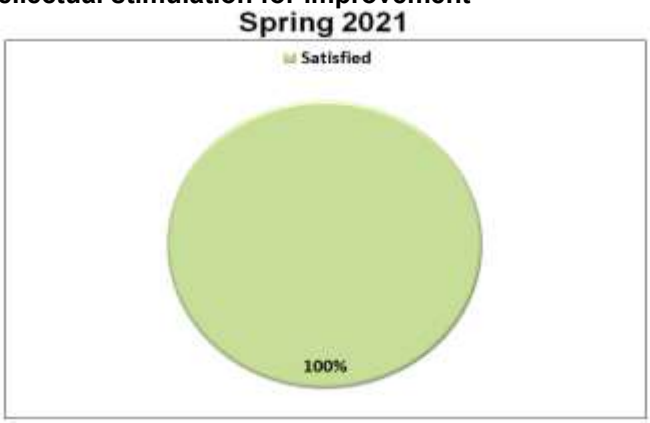
2. The instructor demonstrates knowledge of the subject	
3. The instructor provides additional material apart from the textbook	
4. The instructor communicates the subject matter effectively	
5. The instructor shows respect towards students and encourage class participation	
6. The instructor maintains an environment that is conducive to learning	
7. The instructor arrives on time	
8. The instructor leaves on time	
9. The instructor is fair in examination	
10. The instructor returns the grade scripts etc in a reasonable amount of time	
11. The instructor is available during the specified office hours and for class consultation	
12. The subject matter presented in the course has increased your knowledge of the subject	
13. The syllabus clearly states course objectives requirements, procedures and grading	
14. The course integrates theoretical course concepts with real world applications	
15. The assignment and exams covered the materials presented in the course	
16. The course material is modern and updated	
17. Do you want to be taught by this teacher in next semester?	

Annexure – E:
Faculty Survey
Faculty Feedback Survey Results – Spring 2021

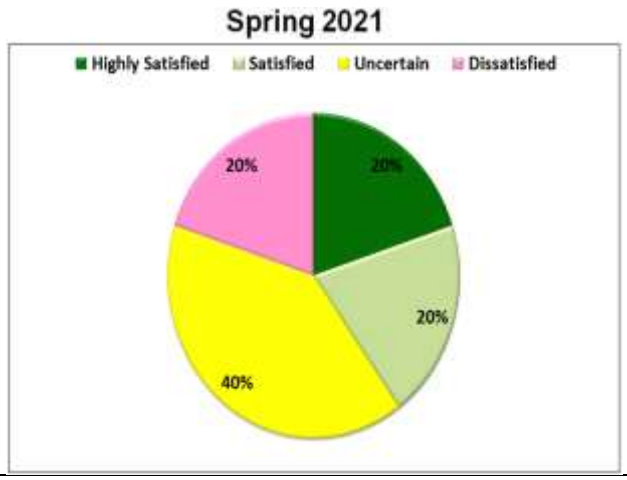
Q1. You are satisfied with your pursuits like teaching, research and the secondary duties.



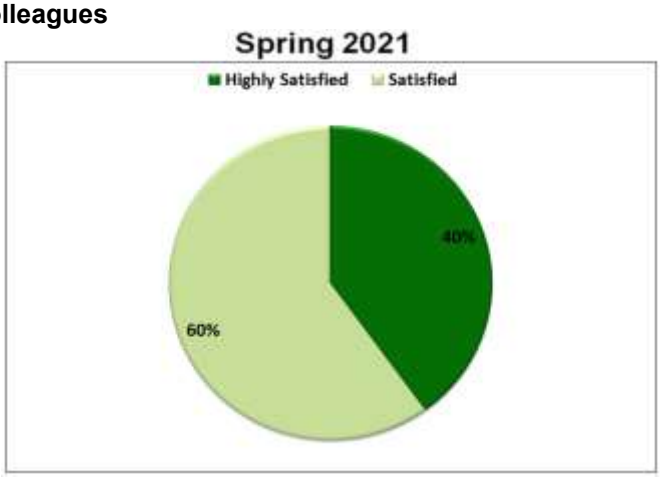
Q2. The overall environment in the department provide intellectual stimulation for improvement



Q3. The overall workload is reasonable

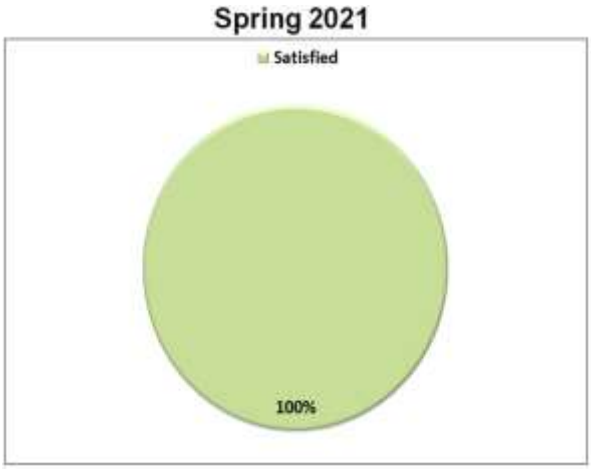


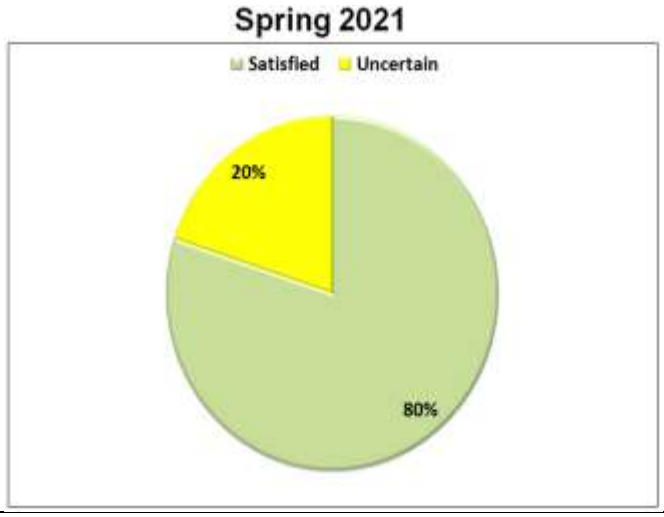
Q4. The cooperation you receive from your department / colleagues



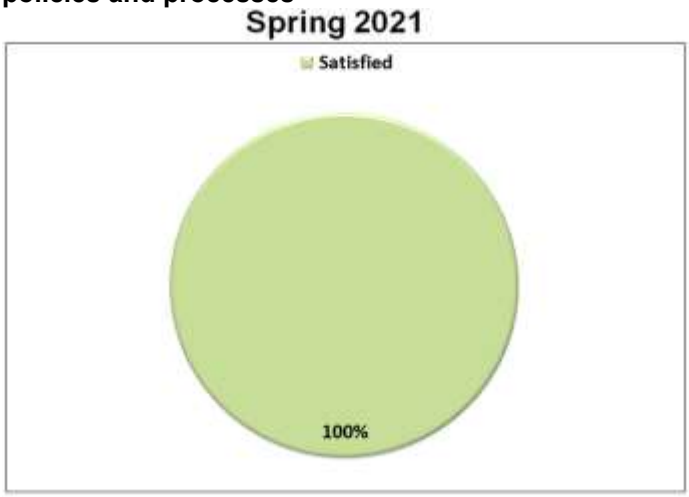
Q5. Whenever needed, the mentoring is available to you

Q6. You are satisfied with the administrative support from the University

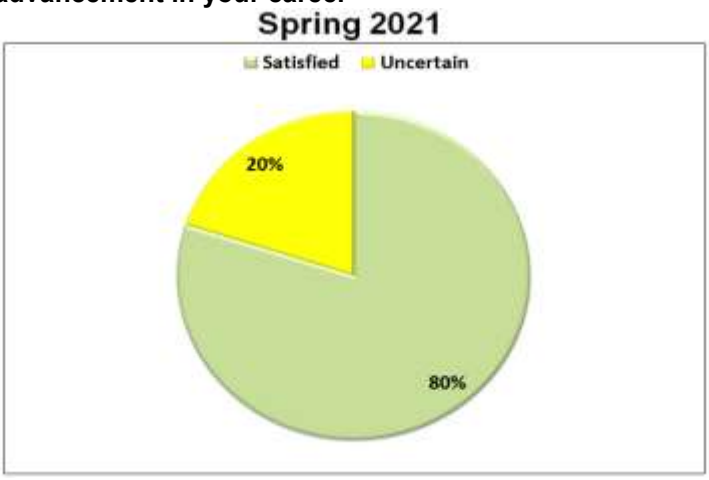




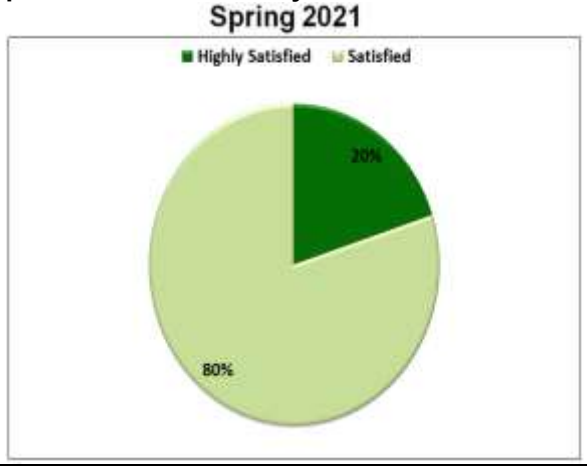
Q7. You are quite clear about the faculty promotion policies and processes



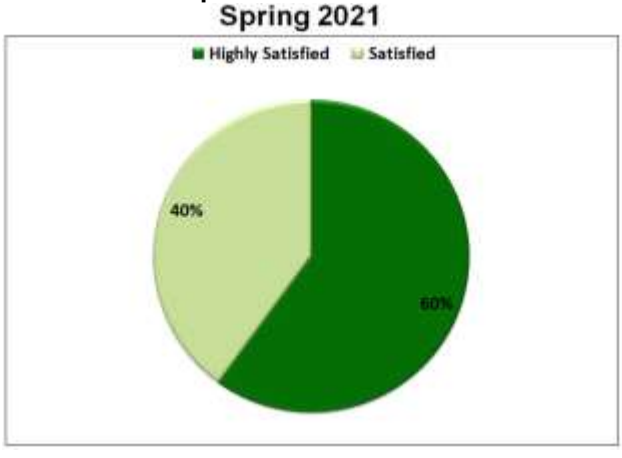
Q8. You are satisfied with the prospects for advancement in your career



Q9. You are satisfied with the speed of redressal of complaints in the University

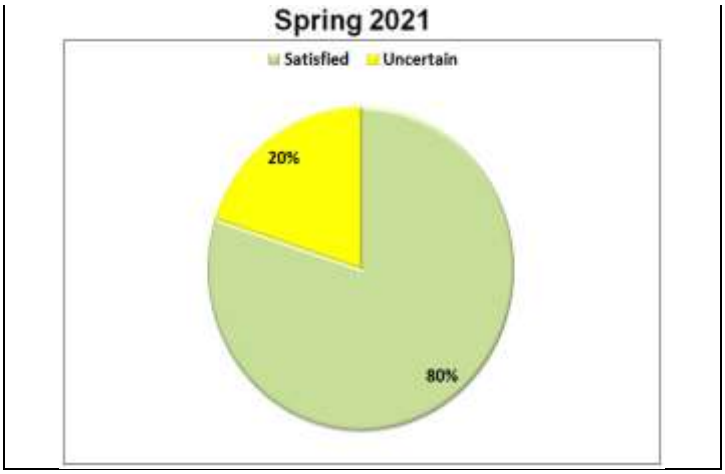


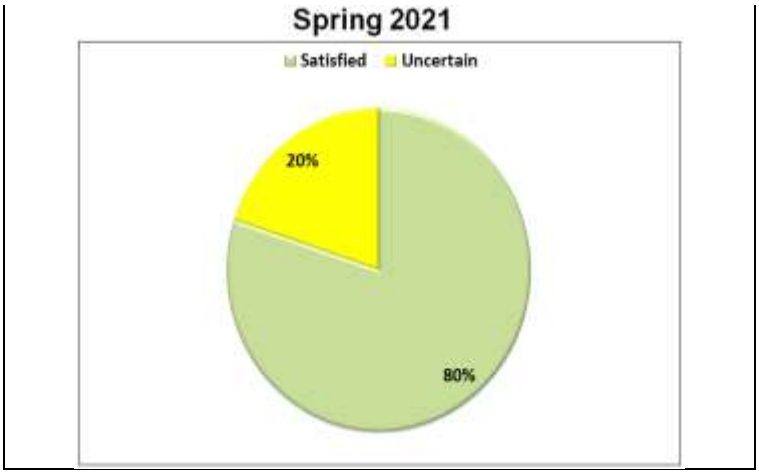
Q10. Your salary package is commensurate with your qualification and experience



Q11. Your perception about job-security in the present position

Q12. Your primary and secondary duties permit you to have sufficient quality-time for yourself and your family





Annexure – F: Faculty Course Review Report

Faculty of Mathematics is running 23 core courses for the MS Mathematics program. All courses curriculum is reviewed periodically by the faculty to assess its effectiveness and contribution in achieving program objectives. Course review also contributes towards making any changes in the syllabi and enhancements required in areas identified as a result of Alumni Survey, Employer Survey and Graduating Students Feedback.

PT members launched HEC Performa 2 (Faculty of Course Review Report) to all the faculty members, to obtain their feedback about courses.

The summary of the overall feedback of all courses identified the following improvement points:

a. More Subjects related to Practical Implementation should be introduced.
b. Refinement in course outlines.
c. Students' interest should be addressed by giving options in Elective subjects.