HITEC UNIVERSITY

Taxila Cantt

SELF ASSESSMENT REPORT

Department of Mathematics

PhD 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 PhD 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 PhD Mathematics Program. HEC prescribed Self-Assessment Manual is used as a reference and he 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. A 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 PhD Mathematics Program to be assessed by the Assessment Team in the third week of May, 2023.

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 nine intakes of the PhD Mathematics Program.

a.	PhD Mathematics	2010
b.	PhD Mathematics	2012
c.	PhD Mathematics	2013
d.	PhD Mathematics	2014
e.	PhD Mathematics	2017
f.	PhD Mathematics	2018
g.	PhD Mathematics	2019
h.	PhD Mathematics	2021
i.	PhD Mathematics	2022

Program Selected

HITEC University has selected the **PhD 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 1-1 The program must have documented measurable objectives that support institution mission statements.

Program Mission Statement

The Doctor of Philosophy (PhD) in Mathematics is the highest degree awarded by the Department. The program comprises 18 credit hours of course work and 30 credit hours of research thesis. The courses are selected in consultation with the thesis supervisor. The progress of student is continuously monitored through the Guidance and Evaluation Committee (GEC).

The program necessitates two years of residency in HITEC University. The PhD thesis is evaluated by one local and two foreign experts from technologically more advanced countries, as per requirement of the HEC after positive evaluation from these experts. The PhD Scholar is required to undertake an open defense to fulfill the degree requirements.

The degree is awarded in recognition of high level of scholarship, the ability to carry out independent research, and the publication of research in national and international journals of repute. The Department sponsors research activities involving analytic and numerical solutions of Ordinary & Partial Differential Equations, Finite Element Analysis, Numerical Linear Algebra, Newtonian and Non-Newtonian Fluid Mechanics and Computational Fluid Dynamics etc. Our PhD program is the most vibrant and extensive as compared to other universities of Pakistan.

Program Objectives

To produce PhD 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 post doctorate level education and research if desired.

Curriculum Design

Curriculum of PhD Mathematics is carefully designed for a two year degree program requires a course work of 18 credit hours and 30 additional credit hours are dedicated for research and submission of thesis. PhD Mathematic comprises of 29 courses to choose from, followed by research thesis, fully adhering to the Higher Education Commission's guidelines and requirements. Research topics for PhD 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, Liquid Chromatography 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 PhD 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 1-2 **The 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 1-3 The 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 of the last two years was suspended due to covid-19. It will be resumed in 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 before pandemic. 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 is 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 five PhD faculty members.
- Amongst them, they cover all essential domains of applied mathematics.
- The department has a blooming research culture.

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

Graduates/Undergraduates enrolled in last three years

Program	2016-17	2017-18	2019-20	2021-22	2022-23
PhD Mathematics	2	2	1	6	2

Student Faculty Ratio:

PhD Mathematics has 5-1 ratio

Average GPA per semester:

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

Average GPA: 3.05

Average CGPA: 3.05

Average Completion time

The average completion time for PhD Program is 3 to 7 years and the maximum permitted time is 7 years.

Employer Satisfaction

No Employer survey of PhD program has been conducted yet. Employer survey will be conducted in Fall 2023.

Students Course Evaluation Rate

No evaluation has been conducted in the past year of the MS/PhD program.

Students Faculty Evaluation

No evaluation has been conducted in the past year of the MS/PhD program.

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

PhD 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 course including pre-requisites.

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

21	Non-Newtonian Fluid Mechanics	MTH-833
22	Numerical Optimization and Applications	MTH-834
24	Turbulence Modeling	MTH-836
25	Thermal and Concentration Boundary Layer	MTH-837
26	Mathematical Theory of Elastodynamics	MTH-838
27	Advanced Numerical Techniques	MTH-839
28	Mathematical Theory of Liquid Chromatography	MTH-840
29	Statistical Mechanics	MTH-841
30	Topics of Engineering for Mathematicians	EM-501
31	Thesis (MS level)	MTH-769
32	Ph.D. Thesis	MTH-786

Table 3: Courses and their Respective Course Codes

Courses Information

MTH-801 Perturbation Methods-I

Objective

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 steppest 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

Objective

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

Objective

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

Objective

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

Objective

Applications of first and second order ODE; 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, leguerre differential equation, hermite's differential equation.

MTH-809 Advanced Numerical Analysis

Objective

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 leaset-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 quardrature: weighted gaussian quardrature 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

Objective

Direct methods for solbing linear systems (algorithmic approach), sparse matrices, solution of tridiagonal system, solution of pentadiagonal system, stone's strongly implicit

procedure (SIP), stability and conditioning of 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, saurian-frame theorem, bocher's formula, gerschgorin's theorems, ovals of cassini, eigenvalues by iterations (power method), wielandt deflation, householder's method, QR method.

MTH-812 Computational Fluid Dynamics

Objective

Thermodynamic properties of a fluid, basic flow analysis techniques, review of governing equations, intergral conversation laws, differential conversation laws, Bernoulli equation, boundary conditions for basic equations, stream functions, vorticity and irrotationality, mathematic 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

Objective

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 pade 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

Objective

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

Objective

Introduction, linear and nonlinear PDEs, homogenous 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

Objective

Basic concepts, minimization problems, existence and uniqueness of solutions of different classes of variational inequalities, fixed points formulations, wiener-hopf equations, iterative methods, auxillary principle technique, convergence analysis, variational inclusions, resolvent equations.

MTH-821 Numerical Solution for Partial Differential Equations

Objective

Parabolic equations, finite-difference representation for parabolic equation, classical explicit method, lassonen 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

Objective

Calculus of variations, hamilton's principle, one dimensional shape functions, integral formulations and variational methos: 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

Objective

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, conjugae 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

Objective

Nonlinear ordinary differential equations, bernoulli's equation, riccati equation, laneemden 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, fredholm theory, variational methods, strum-liouville problem and variational principles, Rayleigh-ritz methods for partial differential equations, matrix algebra, method of faddeev.

MTH-828 Advanced Cryptography

Objective

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

Objective

Special functions of the fractional calculus, gamma function, mittag-leffler function, wright function, functional derivatives and integrals, grundwald letnikov fractional derivatives and applications, reimann liouville 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, 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

Objective

The Taylor-series method, the euler method and its modifications, kunge-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, pseudospectral galerkin collocation method.

MTH-832 Advanced Fluid Mechanics

Objectives

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, oscillatory boundary 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

Objective

Classification of non-Newtonian fluids, rheological formulae (time independent fluids, thixotropic fluids and viscoelastic fluids), variable viscosity fluids, the deformation rate, viscoelastic equation, materials with short memories, the riviln-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

Objective

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

Objective

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 Modeling

Objective

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

Objective

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

Objective

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

Objective

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

Objective

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's transformation, Moment analysis.

MTH-841 Statistical Mechanics

Objective

Thermodynamics (review): Introduction to the second law of thermodynamics, Microstates, Multiplicity (two-state problem), Microcanonical ensemble, Macrostates, 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

Objective

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.

Sr. #	Course Name	Code
1	Perturbation Methods-I	MTH-801
2	Mathematical Modeling	MTH-805
3	Mathematical Essentials for Cryptography	MTH-806
4	Relativistic Astrophysics	MTH-807

5	Advanced Ordinary Differential Equations with Applications	MTH-808
6	Advanced Numerical Analysis	MTH-809
7	Numerical Linear Algebra	MTH-810
8	Computational Fluid Dynamics	MTH-812
9	Boundary Value Problems-I	MTH-815
10	Integral Equations & Applications	MTH-817
11	Advanced Partial Differential Equations and Applications	MTH-818
12	Variational Inequalities and Applications	MTH-820
13	Numerical Solution of Partial Differential Equations	MTH-821
14	Finite Element Analysis-I	MTH-823
15	Advanced Numerical Linear Algebra	MTH-824
16	Advanced Mathematical Physics	MTH-826
17	Advanced Cryptography	MTH-828
18	Fractional Calculus & Applications	MTH-829
19	Numerical Solution of Boundary Value Problems for ODEs	MTH-831
20	Advanced Fluid Mechanics	MTH-832
21	Non-Newtonian Fluid Mechanics	MTH-833
22	Numerical Optimization and Applications	MTH-834
23	Turbulence Modeling	MTH-836
24	Thermal and Concentration Boundary Layer	MTH-837
25	Mathematical Theory of Elastodynamics	MTH-838
26	Advanced Numerical Techniques	MTH-839
27	Mathematical Theory of Liquid Chromatography	MTH-840
28	Statistical Mechanics	MTH-841
29	Topics of Engineering for Mathematicians	EM-501
30	Thesis (MS level)	MTH-869
31	Ph.D. Thesis	MTH-886

Table 4: Courses and their respective Course Codes

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
	MTH-840	Mathematical Theory of Liquid Chromatography
	MTH-841	Statistical Mechanics
	MTH-838	Mathematical Theory of Elastodynamics
Problem	MTH-808	Advanced Ordinary Differential Equations with

Analysis		Applications
	MTH-809	Advanced Numerical Analysis
	MTH-810	Numerical Linear Algebra
	MTH-812	Computational Fluid Dynamics
	MTH-817	Integral Equations & Applications
	MTH-818	Advanced Partial Differential Equations & Applications
	MTH-829	Fractional Calculus & Applications
	MTH-831	Numerical Solution of Boundary Value Problems for ODEs
	MTH-832	Advanced Fluid Mechanics
	MTH-834	Numerical Optimization and Applications
	MTH-837	Thermal and Concentration Boundary Layer
	MTH-839	Advanced Numerical Techniques
Solution Design	MTH-820	Variational Inequalities and Applications
	MTH-821	Numerical Solution of Partial Differential Equations
	MTH-823	Finite Element Analysis-I
	MTH-824	Advanced Numerical Linear Algebra
	MTH-828	Advanced Cryptography
	MTH-833	Non-Newtonian Fluid Mechanics
	MTH-836	Turbulence Modeling
	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.

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

Program	Theory Courses	Research Thesis
PhD Mathematics	18	30

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 4th 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 PhD 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 PhD degree in three 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:

- MS/M.Phil degree in the relevant discipline from an HEC recognized university.
- Minimum CGPA 3.00/4.00 or 50% marks.
- GAT Subject conducted by NTS with minimum 60% 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 PhD 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 3.00 out of 4.00. The minimum duration for PhD Program is 3 years and the maximum permitted time is 7 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 nine PhD faculty members, specialist in the fields of numerical analysis, analytical and numerical techniques for ordinary and partial differential equations, applied mathematics and finite element analysis. Including these following ranks are available in the mathematics department:

- Associate Professor – 2 (1 Head of Department)
- Assistant Professor – 2
- Lecturer – 7

Program Area of Specialization	**Elective Courses**			**Number of PhD faculty**
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 & 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 & Applications	*
	23.	MTH-836	Turbulence Modeling	*
	24.	MTH-837	Thermal and Concentration Boundary Layer	*
	25.	MTH-838	Mathematical Theory of elastodynamics	-
	26.	MTH-839	Advanced Numerical Techniques	*
	27.	MTH-840	Mathematical Theory of Liquid Chromatography	*
	28.	MTH-841	Statistical Mechanics	-
	29.	MTH-869	Thesis (MS level)	
	30.	MTH-886	Ph.D. Thesis	

* Faculty teaching other courses can also teach these courses

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 7 for 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

Standard 7-1 The 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.

Standard 7-2 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.

Standard 7-3 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 PhD 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 five teachers of the program ranged from 4.26 and 4.54 with a mean of 4.40. Students' course evaluation score ranged between 4.05 to 4.32 with a mean of 4.18 points in 0-5 scale. 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 seven 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, PhD 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:

Strong Areas

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

Weak Areas

- There is a need to create research topics in collaboration with other engineering departments.
- The department should induct faster PCs and having more memory.

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 4	**W**	**2022**	4.05 + 3
6.	R. Tabassum , **R. Mehmood** , M. Y. Malik	Arabian Journal for Science and Engineering **2191-4281,2193-567X**	Crosswise Radiative Convective Transport of Viscoplastic Type Nanofluid with Influence of Lorentz Force and Viscosity Variation	**47**, 16319–16330	**W**	**2022**	2.80 + 0
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, Aneela Bibi, **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 under zero 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 in Atherosclerotic 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 South University **2227-5223,2095-2899**	Swimming of motile gyrotactic microorganismsand 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 South University **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,** R Tabassum	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 Chemical Reaction	**8, 94-102**	**Y**	**2019**	N/A + 29
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,** R Tabassum	Indian Journal of Physics **0973-1458,0974-9845**	Transverse transport of	92 (10), 1271-1280	**X**	**2018**	1.77+04
31.	**R Mehmood,** S Rana,E N Maraj	Communications in Theoretical 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 of Hydrogen 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-B fluid 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-Newtonianfluid 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 for Science and	Thermal slip in oblique radiative nanopolymer gel	**44**,1525–1541	**W**	**2018**	2.80 + 12

	Kuharat, O. Anwar Bég and M. Babaie,	Engineering **2191-4281,2193-567X**	dependent viscosity: solar simulation				
39.	Iqbal, Z; **Mehmood, R;** Mehmood, Zaffar	Journal of Molecular Liquids **1873-3166,0167-7322**	Thermal deposition on 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-aligned MHD 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;**	Communications in Theoretical	Numerical Investigation of	Vol. 67 pp. 443-447	**X**	**2017**	2.87 + 51

	Iqbal, Z	Physics **0253-6102**	Internal Heating				
46.	**Mehmood, Rashid;** Rana, S; Akbar, NS; Nadeem	Alexandria Engineering Journal **1110-0168**	Non-aligned stagnation point flow of radiating Casson fluid over a stretching surface	Vol. 57 pp. 939-946	**W**	**2017**	6.62 + 32
47.	**Mehmood, Rashid;** Nadeem, S; Saleem, S; Akbar, Noreen Sher	Journal of the Taiwan Institute of Chemical Engineers **1876-1070**	Flow and heat transfer analysis of Jeffery nano fluid impinging obliquely over a stretched 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

				1056/24/1/0 14702			
58.	Noreen Sher Akbar, **Rashid Mehmood,** S. Nadeem	Journal of Magnetism and Magnetic Materials **0304-8853**	Combined effects 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 Ur Rehman, **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 oblique stagnation-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 and Theoretical 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
Attach separate sheets of the same format, if required.							

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
9. N. Ahmed, Adnan, Umar Khan, S. T. Mohyud-Din, I. Khan and K. S. Nisar, "Heat and Mass Transfer in Magneto-Newtonian Fluid Past a Paraboloid of Revolution with Internal Heat Source" Journal of Magnetics, Vol. 25, no. 2, pp. 254-261, 2020. Impact Factor=0.873
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12. Adnan, S. Z. A. Zaidi, Umar Khan, N. Ahmed, S. T. Mohyud-Din and I. Khan, "Heat Transfer Enhancement in H2O Suspended by Aluminum Alloy Nanoparticles Over a Convective Stretching Surface". Advances in Mechanical Engineering Accepted 24-June-2020. Impact Factor=1.161
13. A. M. Alqahtani1, Adnan, Umar Khan, N. Ahmed, S. T. Mohyud-Din, I. Khan, "Numerical Investigation of Heat and Mass Transport in the Flow over a Magnetized Wedge by Incorporating the Effects of Cross-Diffusion Gradients: Applications in Multiple Engineering Systems". Mathematical Problems in Engineering Accepted 30-June-2020. Impact Factor=1.009
14. Umar Khan, Adnan, N. Ahmed and S. T. Mohyud-Din, "Surface Thermal Investigation in Water Functionalized Al2O3 and γAl2O3 Nanomaterials based Nanofluid over a Sensor Surface" Applied Nanoscience, Accepted 23 July 2020. Impact Factor=2.88
15. Adnan, Umar Khan, N. Ahmed, S. T. Mohyud-Din, I. Khan and E. S. M. Sherif, "Novel Analytical Thermal Performance Rate Analysis in ZnO-SAE50 Nanolubricant: Nonlinear Mathematical Model" CMC-Computers Materials and Continua, Accepted 2 Aug. 2020. Impact Factor=4.89
16. N. Ahmed, F. Saba, Umar Khan, ST Mohyud-Din, ESM Sherif, I Khan Nonlinear Thermal Radiation and Chemical Reaction Effects on a Cu-CuO/NaAlg Hybrid Nanofluid Flow Past a Stretching Curved Surface, Processes, 7 (12) 2019, 962. Impact Factor=1.963.
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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

Statements	**Score**
1. The Class Room facilities and overall environment were conducive to learning.	
2. The recommended Textbook was student-friendly i.e. a student can easily follow it after attending the class lecture.	
3. The library resources, i.e. other books, internet facility, magazines etc. were adequate in supporting the learning.	
4. The concepts were clearly explained.	
5. The course created interest in me to know more about it.	
6. Quizzes, Sessionals and Assignments etc. were helpful in learning this course.	
7. The lab experiments were synchronized with the theory classes.	
8. The lab experiments were helpful in learning the subject.	
9. The lab support was satisfactory.	
10. The course workload was manageable.	
11. I had the knowledge of pre-requisite subjects and mathematics for this course.	Yes/No

Additional Comments:

No evaluation has been conducted in the past year of the MS/PhD program.

Annexure – D: Student's Teacher Evaluation

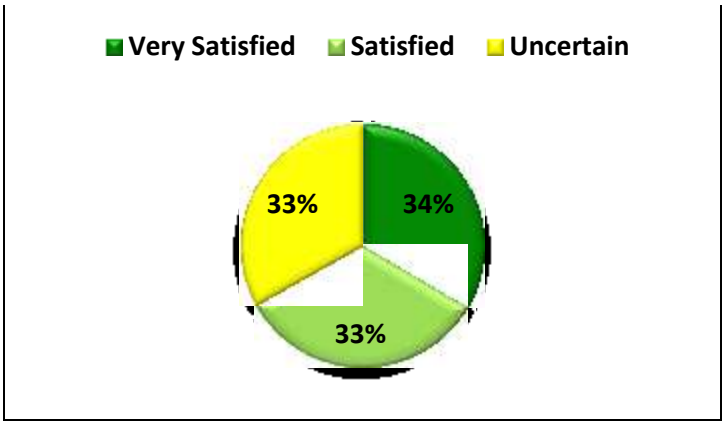
Statements	Score
1. The teacher distributed the course plan well in time for the current semester.	
2. The course plan contained objectives, topics, Course Learning Outcomes (CLOs), Grading policy etc.	
3. The teacher was punctual.	
4. The teacher communicated the subject matter clearly and effectively and solved sufficient examples.	
5. The teacher encouraged class participation.	
6. The teacher was fair in marking exam papers.	
7. The teacher returned all marked quizzes, assignments, sessionals etc. in reasonable amount of time.	
8. The teacher was available for consultation during the specified visiting hours.	
9. The teacher encouraged use of Library resources to supplement learning of course topics.	
10. The teacher covered all topics as given in the course plan.	
11. The teacher clearly indicated those questions which were meant for CLOs evaluation.	
12. The teacher encouraged innovative thinking.	
13. You want to be taught by this teacher in the next semester	

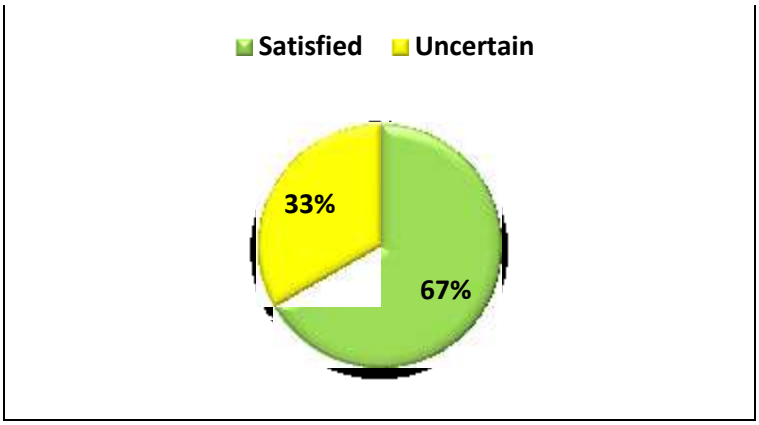
Additional Comments:

No evaluation has been conducted in the past year of the MS/PhD program.

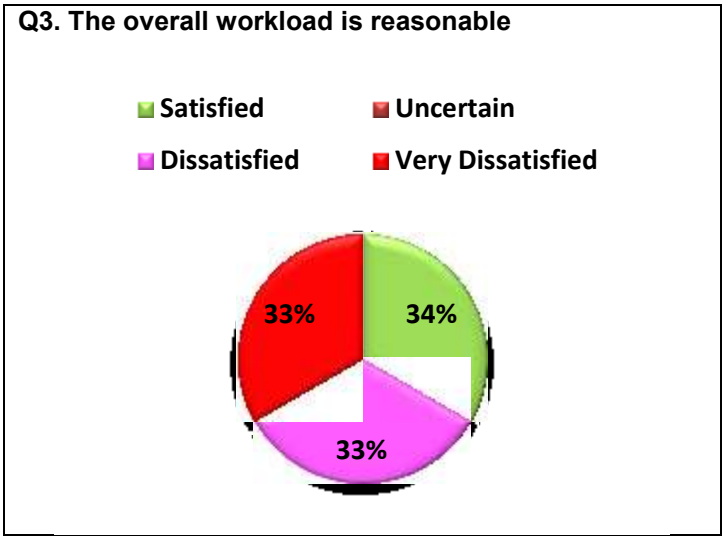
Annexure – E: Faculty Survey

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



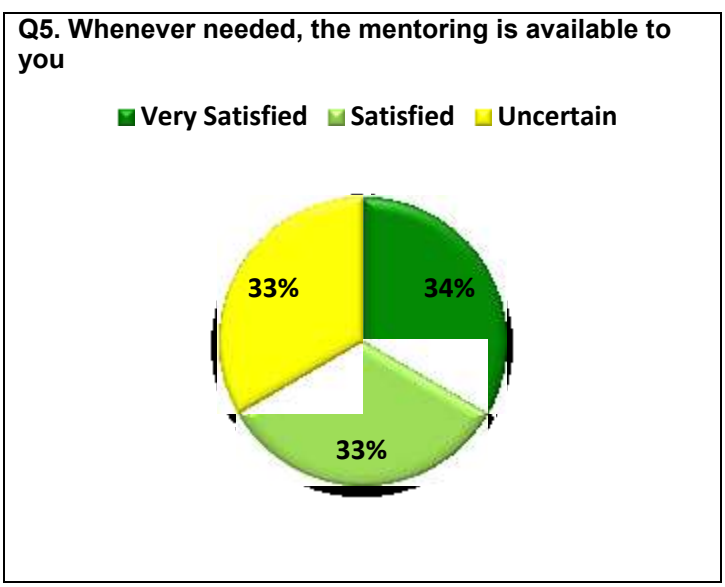


Q3. The overall workload is reasonable

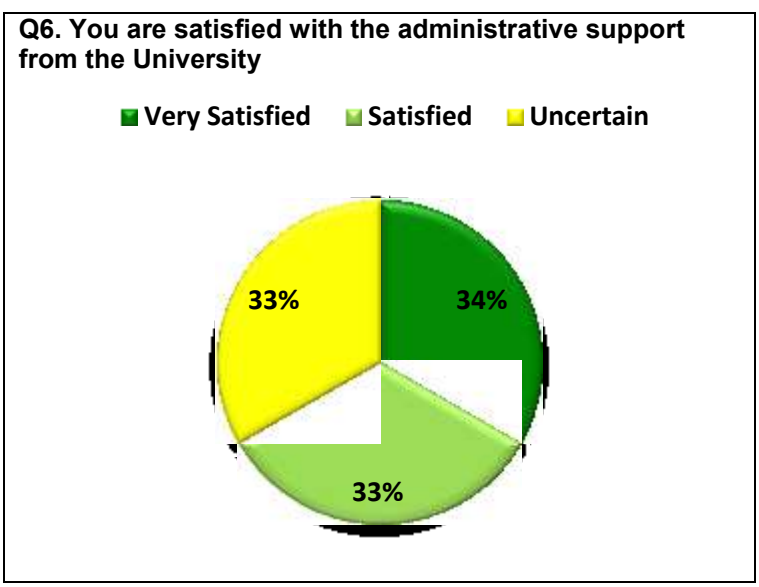


Q4. The cooperation you receive from your department / colleagues

Q5. Whenever needed, the mentoring is available to you

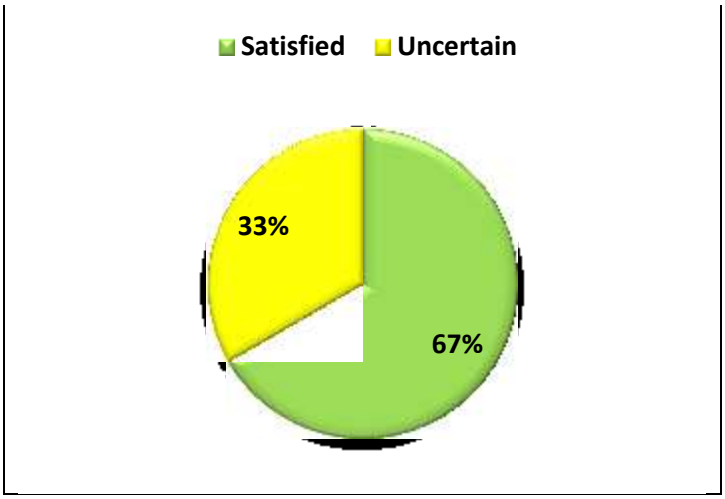


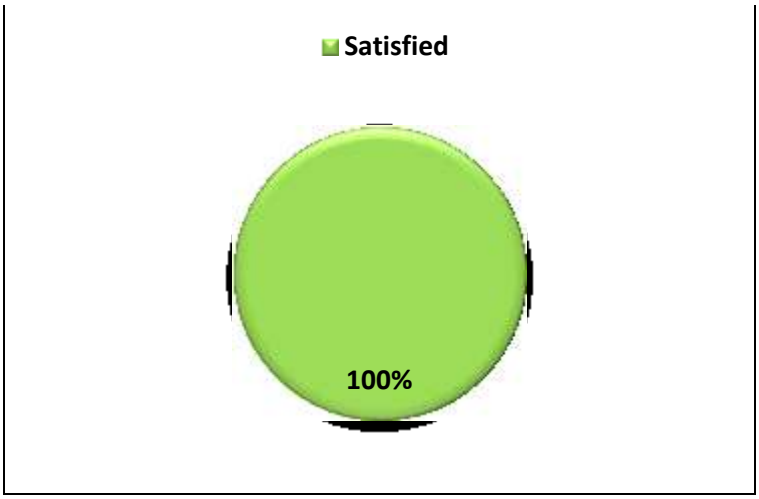
Q6. You are satisfied with the administrative support from the University



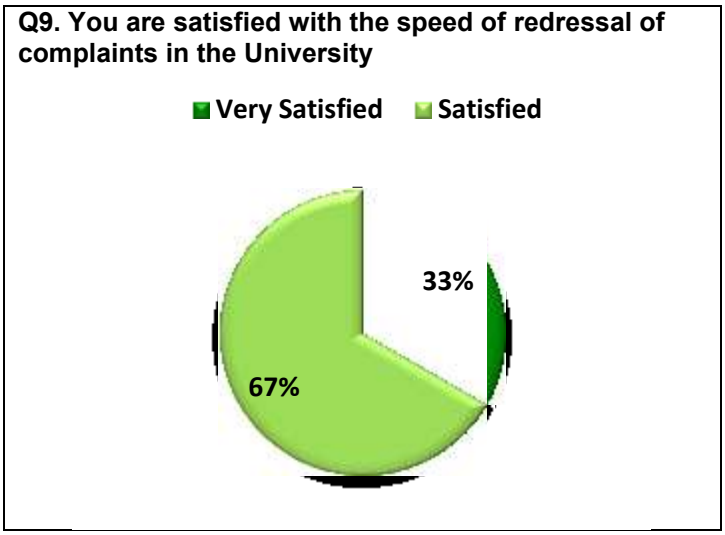
Q7. You are quite clear about the faculty promotion policies and processes

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

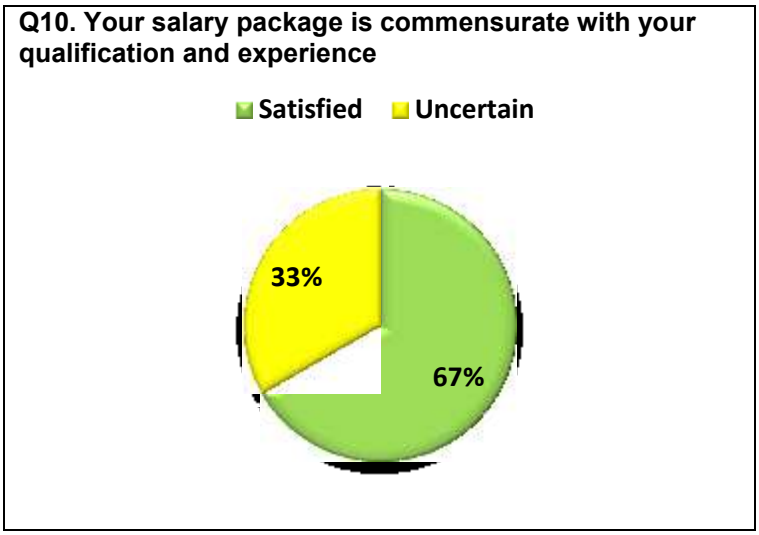




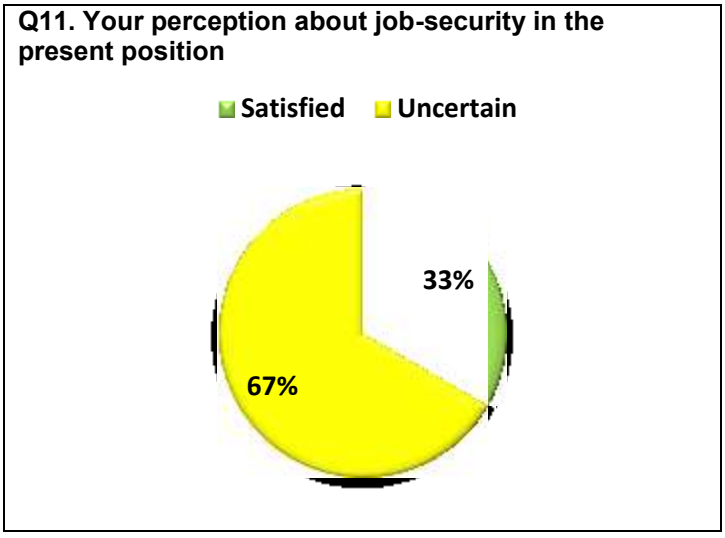
Q9. You are satisfied with the speed of redressal of complaints in the University



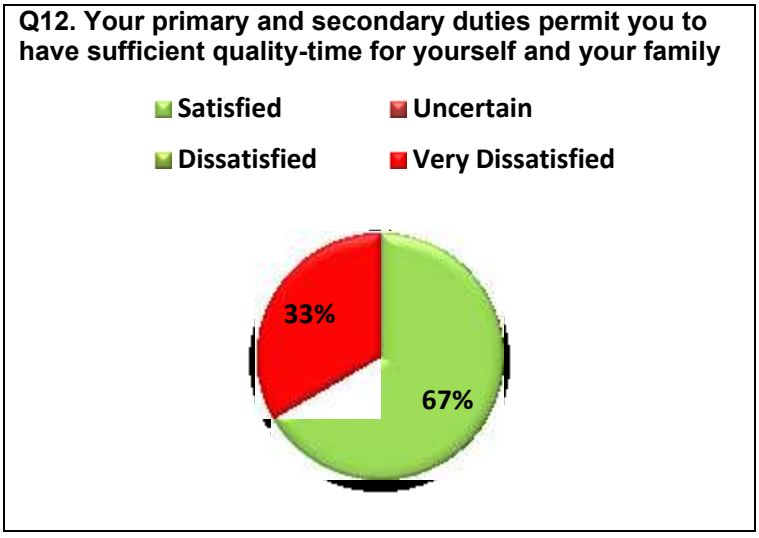
Q10. Your salary package is commensurate with your qualification and experience



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 28 core courses for the PhD 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.