MUHAMMAD AMMAR AKRAM

Lecturer Mechanical Engineering Department,
HITEC University Taxila, Pakistan (Sept 2019-Present)
(MS Mechanical Engineering, Thermal Systems)
CAT 2 Trained Vibration Analyst from Mobius Institute
(Ph.D. in progress from NUST, Thermal Energy Engineering)
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Career OBJECTIVE

- Seeking the internee position in a leading organization to contribute improve my technical skills with a team of dedicated and experienced engineers by working and groom professionally.
- To obtain practical knowledge & experience of mechanical systems and instruments through appropriate training & participation.

PERSONAL DATA

Father Name	Muhammad Akram
Date of Birth	March 06, 1994
CNIC	38201-6424609-1
Religion	Islam
Province	Punjab
Nationality	Pakistani

Postal / Permanent Address: Main Road, House # 12/B, Near Atta Chakki Mehar Ghaiba Khan, Mohallah Sikandarabad, City & District Khushab.
Current/ Temporary Address: Gulistan Colony, Wah Cantt, Taxila District Rawalpindi.

ACADEMIC QUALIFICATION

Degree	University / Board	Session	GPA / %	Status
Ph.D. in progress (Thermal Energy Engineering)	USPCASE, NUST	Sept 2021-Present (Course work Completed/Thesis in progress)	3.67	In progress
MS Mechanical Engineering (Thermal System Engineering)	UET Taxila	2017-2019	3.16/4	Completed
BS Mechanical Engineering	HITEC University Taxila Cantt.	2013-2017	(3.09/4) 81.5 %	Completed

F. Sc	B.I.S.E Sargodha	2011-2013	(899/1100) 81.72 %	Completed
Metric	B.I.S.E Sargodha	2009-2011	(941/1050) 89.71%	Completed

ENGINEERING INTERNSHIPS

- KOT ADDU POWER COMPANY LIMITED (Internee, One Month)
- PIONEER CEMENT LIMITED (Internee, One Month)
- PAKISTAN ORDINANCE FACTORIES WAH CANTT. (Internee, One Month)
- SUMICO TECHNOLOGIES PVT LTD (Trainee, One Month)
- CENTRE FOR VIBRATION ANALYSIS AND CONDITION MONITORING (CVCM) (Training, 6 Days)

WORK EXPERIENCE

- **Lecturer Mechanical Engineering Department**, HITEC University Taxila, Pakistan (September 2019-Present).
- **Assistant Director Research Projects ORIC**, HITEC University Taxila, Pakistan (November 2024-Present).
- **Deputy Superintendent Exam**, Mechanical Engineering Department, HITEC University Taxila (December 2024-Present).
- **PhD Full Time Research Scholar** (Thermal Energy Engineering) (September 2021-Present).
- **MS Full Time Scholar**/ Research Assistant UET Taxila (Sept 2017- Aug 2019).
- **NAVTTC & PSDF** (Instructor Automotive Mechatronics (February 2024-August 2024).
- **PAE Solutions** (Plant Asset Efficiency Solutions) in collaboration with ORIC. (February 2024-Present)
- **CEO VIBRANT GREEN ENERGY TRADING SOLUTIONS** (March 2024-Present)
- **Power Plant Predictive and Proactive Maintenance.** (February 2024-Present)

Memorandum of Understanding (MoU) during my services as ADRP HITEC University Taxila

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- PAE Solutions/ Engineering Professionals.
- MRT Academy/ Engineering Professionals.
- HVACR Society/ Engineering Professionals.
- Idea Trainings/ Engineering Professionals.

COURSE INSTRUCTOR

- **Labs**
  - Heat and Mass Transfer Lab
  - HVAC Lab
  - Instrumentation Lab
  - Computer Aided Manufacturing Lab
  - Design of Machine Elements Lab
- **Theory Courses**
  - Material Science
  - Mechanical Vibration
  - Thermodynamics-1
  - Engineering Mechanics
  - Design of Machine Elements
  - Theory of Machines
  - Renewable Energy
  - Mechanics of Material

PROJECT GRANTS

- IGNITE Project funds of **70k** from **Higher Education Commission, Pakistan.**
  (Supervised project in 2021 entitled Design of Embedded System for Machine Fault Diagnosis using Vibration Analysis and Condition Monitoring)
- IGNITE Project funds of **90k** from **Higher Education Commission, Pakistan.**

  (Supervised project in 2024 entitled To Investigate the Effect of Vibration and Magnetic Field for Heat Transfer Performance of Heat Exchanger for Space Heating).
- IGNITE Project funds of **90k** from **Higher Education Commission, Pakistan.**

  (Supervised project in 2024 entitled Efficient Embedded System Design for the Experimental Investigation of Heat Transfer Enhancement of Heat Exchanger for Domestic Water Heating).

Departmental Administrative Duties

- Vice President HITEC Alumni Association.
- Assistant Director Resarch Projects ORIC, HITEC University Taxila.
- Deputy Superintendent Exam, Mechanical Engineering Department.
- University Focal Person **Pakistan HVACR Society**.
- Faculty Head **Pakistan HVACR Society HITEC University Chapter.**
- Focal Person **PAE Solutions**.
- Lab In charge and Departmental maintenance head for Mechanical Engineering Labs.
- Departmental Timetable and Exam Schedule Committee Member.

Attended CPD Workshops and Trainings

- **CAT-2 Machine Condition Monitoring** Training from Mobius Institute Australia.
- **'Hands-on Workshop on Patent Writing/Drafting and Submission'** organized by PHEC.
- **'Future Prospects in Renewable Energy and Waste Heat Recover Systems'** organized by University of Kolkata **(5 Days).**
- **Machine Condition Monitoring and Fault Diagnosis** for Predictive and Proactive Maintenance of Powerplants (University nearby powerplants e.g. Bestway Cement Hattar, Bestway Cement Farooqia, Steel and Paper Mills).
- Attended CPD Workshops organized by universities **(04)**.
- CPD workshops Organized **(06)**.
    - ✓ **Operation Deflection Shape Analysis/ ODA Analysis.**
    - ✓ **Machine Lubrication Analysis.**
    - ✓ **Resonance and its Control.**
    - ✓ **Optimization using MATLAB.**
    - ✓ **Industrial Instrumentation and Automation.**
    - ✓ **Standard Calibration Procedures (SCP) of an Industrial Instruments.**

BS and MS MECHNICAL ENGINEERING MAJOR SUBJECTS

Workshop Technology, Engineering Statics, Engineering Dynamics, Complex Variable and Transforms, Materials Science and Engineering, Fluid Mechanics (1,2) ,Thermodynamics (1,2),Mechanics of Materials(1,2),Analogue and Digital Systems, Numerical Analysis, Design of Machine Elements (1,2),Heat and Mass Transfer, Internal Combustion Engines, Refrigeration and Air Conditioning, Theory of Machines, Technical Report Writing, Instrumentation , Control Systems, Probability and Statistics, Mechanical Vibrations, Computer Aided Design and Manufacturing, Advanced Stress Analysis, Power Plant, Engineering Economics, Engineering Management, Engineering Ethics, Analytical and Numerical Techniques in Heat Transfer, Computational Fluid Dynamics, Flow Induced Vibration, Advanced Thermodynamics, Advanced Mathematics, Research Methodology.

FINAL YEAR PROJECT, BS MECHANICAL ENGINEERING

Fault Location Detection and Analysis of Rotory Machine Through Vibration Analysis

- This project is being made because of the increasing need of maintenance practices in industry known as the predictive and proactive maintenances. As no industry wants to stop their production due to failure of machinery, and if they become aware of the cause of that failure at initial stage, they can take a decision to overcome it before it happens.
- Hence this project's basic purpose is to find the location of fault in the running machinery and to provide certain measures to overcome it. In this project four major faults in machinery namely the broken gear teeth, misalignment, looseness, bearing faults, belt/pulley faults are studied and analyzed.
- These faults are located with the help of a branch of condition monitoring called Vibration Analysis. In which following analysis were performed on the obtained signals, PSD (power

spectral density), Time waveform analysis and Amplitude analysis. Generated results will help to improve design guidelines for rotary machine fault diagnosis.

MS MECHNICAL ENGINEERING (THERMAL SYSTEM ENGINEERING) MAJOR SUBJECTS

Conduction Heat Transfer, Advanced Thermodynamics, Engineering Analysis and Statistics, Dynamics of Machinery, Research Methodologies and Design of Experiment, Flow Induced Vibration, Convection Heat Transfer, Computational Fluid Dynamics

MS RESEARCH THESIS

Modelling of Flow Induced Vibration of Tubes in Oscillating Flows

- Flow-induced structural vibration is one of the most important and destructive (when reached at its limits) phenomenon experienced in numerous fields, including the aerospace industry, power industry, civil engineering and undersea technology.
- In process industries and nuclear power plants, heat exchangers are mainly used. Flow-induced vibrations in heat exchangers cause tube-to-support interaction with unsteady flows. This may lead to the shutdown of heat exchanger and whole process demanding expansive damage repair.
- The aim of the research is to investigate the Influence of the unsteady flow in cross flow heat exchangers because there is always some turbulence present in the shell side fluid before entering the tube bundle due to the presence of some flow control, pressure and some other measuring devices.

SUPERVISED FINAL YEAR PROJECTS (15+)

- Fault Location Detection of Rotary Machine Using Vibration Analysis; Case Study: Misalignment, Looseness, Bearing Faults, Belt/Pulley Faults (Completed)
- Experimental Study on the Early Diagnostic Capability of Vibration Characteristics of Multistage Spur and Helical Gear Mechanism Under Varying Speed Conditions and Fault Growth (Completed)
- Flow Induced Vibration in Heat Exchangers Subjected to Cross Flow (Completed)
- Effect of Upstream Turbulence on Fluid Elastic Instability behavior of Tube Bundle Subjected to Unsteady Flow (Completed)
- Heat Sink with Nano-particle enhanced Phase Change Materials for Passive Cooling (Completed).
- Design of Subsonic Water Tunnel for Particle Image Velocimeter with application for Fluid Structure Interaction.
- Design and Fabrication of Electric Bicycle.
- Design and Analysis of Thermal Energy Storage Tank with Solar Thermal Applications (In-Progress).
- Use of Phase Change Materials for the Thermal Management of Finned Solar Panels and Hybrid Cooling Techniques (In-Progress).
- To investigate the effect of Vibration and Magnetic Field for Heat Transfer Performance of Heat Exchanger. Designed for Application: Space Heating.

- Efficient Embedded System Design for the Experimental Investigation of Heat Transfer Enhancement of Heat Exchanger for Domestic Water Heating.

RESEARCH PUBLICATION

- **Experimental Analysis of Tooth Breakage Effect on the Vibration Characteristics of Spur Gears**

Technical Journal, UET Taxila (Published)

Various industrial applications have wider use of gears. Vibration analysis has been generally utilized as a part of condition monitoring of rotary machinery and engineering structures in order to prevent failure, increase reliability and decrease maintenance cost of the system. The aim of this study is to analyze the vibration produced due to the single as well as double tooth breakage of spur gear at five different RPMS. First, the test model was developed, and then specific fault was introduced in driven gear at 25, 50, 75 and 100% of single and double tooth breakage and data was acquired for individual fault using wireless tri-axial accelerometer. The recorded data was then analyzed using different statistical techniques and results have been plotted. The analysis shows that maximum vibration amplitude is produced at 75% of tooth breakage and tends to reduce at 100% of tooth breakage due to increase in the Transmission Error (TE). The Power Spectral Density (PSD) analysis suggests that amplitude of Gear Mesh Frequency (GMF) first rises up to 75% of tooth breakage and then suddenly falls down due to complete tooth removal but sidebands of Gear Mesh Frequency (GMF) tends to rise as tooth breakage increases. Also the other Statistical parameters Root Mean Square (RMS), Crest Factor (CF), Kurtosis and Skewness are analyzed and are very important for complete understanding of the phenomenon.

- **A Review of Failure Modes of Nuclear Fuel Cladding**

Journal of Engineering, Science and Technology (Published)

In this research, an effort has been made to systematically establish the research studies managed on an assortment of nuclear fuel cladding materials since the initial reactors, revealing some of the main failure modes and briefly reflecting the challenges facing the progress of fuel cladding materials and clad tube failure for the future generation of reactors. An introduction to various clad materials has been added, in which, the result of alloying elements on the material properties have been presented. Each subsection of the review has been provided with some tables and figures. The small part on determining a good fuel clad has also been encompassed. The last section of the review has been devoted to accidents occur related to fuel clad. About 101 published studies (1965-2017) are examined in this review. It is noticeable from the review of articles that increase in corrosion and creep rate during Loss of Coolant Accident (LOCA) are significant. During corrosion, oxide layers formed on the clad surface are brittle, which would endanger the structural integrity. Creep deformation cause cladding tube ballooning.

- **Thermal Applications of Hybrid Phase Change Materials-A Critical Review**

Journal Thermal Science (Published)

Phase Change Materials (PCMs) with their high latent heat capacity have a great ability to store energy during their phase change process. PCMs are renowned for their applications in solar and thermal energy storage systems for the purpose of heating and cooling. However, one of the major drawbacks of PCMs is their low thermal conductivity due to which their charging and discharging time reduces along with the reduction in energy storage capacity. This reduction in the energy storage capacity of PCMs can be improved by producing organic-inorganic hybrid form-stable PCMs, with the combination of two or more PCMs together to increase their energy storage capacity. Nanoparticles that possess high thermal conductivity are also doped with these HPCMs to improve the effectiveness of thermal conductivity. This paper presents a short review on the

applications of HPCM in energy storage and building application. Apart from this a short section of applications of composite PCMs (CPCM) is also reviewed with discussions made at the end of each section. Results from the past literature depicted that the application of these HPCMs and CPCM enhanced the energy storage capacity and thermal conductivity of the base PCM and selection of a proper hybrid material plays an essential role in their stability. It is presumed that this study will provide a sagacity, to the readers, to investigate their thermo-physical properties and other essential applications.

- **Vibration Based Gear Fault Diagnosis Under Empirical Mode Decomposition and Power Spectrum Density Analysis**

Advances in Science and Technology Research Journal (Published)

Rotating machinery plays a significant role in industrial applications and covers a wide range of mechanical equipment. A vibration analysis using signal processing techniques is generally conducted for condition monitoring of rotary machinery and engineering structures in order to prevent failure, reduce maintenance cost and to enhance the reliability of the system. Empirical mode decomposition (EMD) is amongst the most substantial non-linear and non-stationary signal processing techniques and it has been widely utilized for fault detection in rotary machinery. This paper presents the EMD, time waveform and power spectrum density (PSD) analysis for localized spur gear fault detection. Initially, the test model was developed for the vibration analysis of single tooth breakage of spur gear at different RPMs and then specific fault was introduced in driven gear under different damage conditions. The data, recorded by means of a wireless tri-axial accelerometer, was then analyzed using EMD and PSD techniques and the results were plotted. The results depicted that EMD algorithms are found to be more functional than the ordinarily used PSD and time waveform techniques.

- **Effect of Grid Generated Turbulence on the Flow Induced Vibration Response of Parallel Triangular Tube Bundle in Cross Flow**

(Annals of Nuclear Energy, Published)

This paper is concerned with the analysis of the grid generated turbulence on flow induced vibration response of the parallel triangular tube bundle with pitch ratio of 1.54. Turbulence characteristics of the upstream flow can highly influence the stability behavior of a single flexible as well as multiple flexible tubes in early rows of tube bundle. Experimentation have been performed in the wind tunnel with the free stream velocity ranging from 0 to 8.9 m/s. Distinct amplitude behavior for the monitored tube has been observed for each row in both streamwise and the transverse direction. With the increase in the upstream turbulence, the stability threshold of the monitored tube tends to be delayed for single flexible case, however for the multiple flexible case the stability threshold tends to move towards early values. This indicates the importance of stiffness mechanism in generating instability in the monitored tube, which is enhanced by upstream turbulence. Surprisingly, upstream turbulence is strongly affecting frequency response of the tube bundle. Spectral analysis depicts that translational mode dominates rocking mode for single flexible tube bundle for all cases even for highest turbulence intensities. However, for multiple flexible tube case the rocking mode tends to dominant for the fourth row subjected to highest turbulence intensity of 16.5%. This may be due to the uneven distribution of forces on the tube length due to upstream turbulence and turbulence generated by first three rows which intern to excites the rocking mode. This indicates that multiple flexible tube bundle dominates rocking mode frequency amplitude because of fluid forces generated by tube to tube coupling, the rocking mode become significant which reflects the importance of stiffness mechanism for generating instability in the monitored tube. Stability diagram delineates that for higher upstream turbulence intensities, the data points lies on the upper side of stability boundary in unstable region for multiple flexible tube case and under the stability boundary for single flexible tube case. This indicates that the previous theoretical stability models either underestimate or overestimates the stability behavior of tube bundle and hence requires modification in the model to predict the stability boundaries for higher upstream turbulence intensities.

- **Applications of Nanoparticles Enhanced Phase Change Materials (NePCM) -A Critical Review**

(Applied Thermal Engineering, Published)

Phase change materials (PCMs) are great energy storage materials due to their phase change properties. The energy absorbed and released by PCMs over a specific temperature range can be used in many applications such as thermal, solar, electronic and battery thermal management, textiles, heat pipes, food packaging and so on. Besides of having high latent heat storage capacity, PCMs possess low thermal conductivity due to which they call for the incorporation of nanoparticles. Addition of nanoparticles, having high surface to volume ratio, enhance the thermal conductivity of PCMs. This paper presents the comprehensive review on the preparation techniques and applications of nanoparticles enhanced PCMs (NePCMs) in various fields. This paper is classified into different sections depending upon the application of NePCM and discussions have been made on various sections. Results from the previous study revealed that the addition of nanoparticles in the base PCM increased its thermal conductivity.

- Experimental investigation on graphene-based nanoparticles enhanced phase change materials (GbNePCMs) for thermal management of electronic equipment

(Journal of Thermal Energy Storage, Published)

The present study focuses on the thermal management of electronic components using nanoparticles enhanced phase change materials (NePCMs) based heat sinks for the reduction in the baseline temperature, to heighten the operational time and ensure the enhanced functionality and reliability of the working system. RT-44HC and RT-64HC are used as the base PCMs along with the incorporation of GNPs (0.002wt%, 0.005wt% and 0.008wt%) for different heating loads i.e. 0.86 KW/m2, 1.44 KW/m2 and 2.40 KW/m2. Results revealed that after 90 min of charging phase, RT-44HC/GNPs (0.008wt%) has depicted best performance with the maximum reduction of 25% in the baseline temperature for 0.86 KW/m2. Subsequently, at 1.44 KW/m2 RT-44HC/GNPs (0.005wt%) and RT-64HC/GNPs (0.008wt%) have shown maximum reduction of 13.6% and 11.8% respectively. For higher heating load i.e. 2.40 KW/m2 RT-64HC/GNPs has revealed best performance with maximum reduction of 16.37% in the temperature. Hence, for low heating loads, RT-44HC composites are best recommended whereas, RT-64HC composites are suitable for higher power levels and high heating loads.

- System Design for Early Fault Diagnosis of Machines Using Vibration Features

5th International Conference on Power Generation Systems and Renewable Energy Technologies Istanbul Technical University ***(published)***

- **Experimental Analysis of Fluid Elastic Instability Impact of Flow Induced Vibration upon Wavy and Grooved Tubes within Heat Exchanger Tube Bundle (IJRES, published*).***

The present study is concerned with the experimental analysis of fluid-elastic instability phenomenon of flow induced vibration of wavy and grooved tube in the heat exchanger tube bundle, considering the steady flow in the upstream of the tube array. Results are plotted and validated with the performed experimental results of tube bundle in parallel triangular arrangement with pitch to diameter ratio (1.54). The reduced gap velocity of tube bundle subjected to water tunnel ranges from $1.15 \leq Ur \leq 5.76$ and Reynolds number ranges from $7.31 \times 10^4 \leq Re \leq 1.83 \times 10^5$.

The monitored tube response in both stream wise and transverse direction seems to be highly dependent on its location in a specific row. The first two rows of all tube's arrangement are found to be stable. Moreover, for wavy

tube the third row is critical as it triggers early instability in the monitored tube particularly in the transverse direction.

- **Robust Path Tracking of Autonomous Vehicle in Presence of Model Uncertainties via Model Based Linear Quadratic Gaussian (LQG) Control with Adaptive Q-Matrix.**

From few decades, the engineers are facing troubles and challenges in achieving the robust behavior of autonomous vehicles. The main task here is to achieve autonomous vehicles stability, smooth tracking of path and fast response. To accomplish the mentioned task, we work on Linear Quadratic Gaussian (LQG). We implement the LQG with adaptive Q-Matrix in MATLAB and Simulink and see that it exhibits smooth tracking, minimizes the overshoot and settling time. The LQG also rejects noise or disturbance and tracks path smoothly even with the uncertainties. The performance of LQG, PID, Fuzzy, MPC and LQR controllers are compared with the results of LQG, and it is concluded that the LQG performs better in case of tracking and rejecting the disturbance. ***(Journal of Xi'an Shiyou University, HEC X Category, Published)***

COMPUTER SKILLS / SOFTWARES

Solidworks
MATLAB
ANSYS 21
Microsoft Office
C++
Pro Engineer
LAB VIEW
SIGVIEW
Origin PRO

PROFESSIONAL NETWORK DETAILS

Google Scholar: https://scholar.google.com/citations?user=24HnBusAAAAJ&hl=en
LinkedIn: https://www.linkedin.com/in/ammar-akram-1039a78b/

INTERESTS

- Vice President **HITEC Alumni Association**.
- University Focal Person **Pakistan HVACR Society**.
- Faculty Head **Pakistan HVACR Society HITEC University Chapter.**
- Focal Person **PAE Solutions**.
- Reviewer Team Member of **National and Internation Research Journals**.
- Attended **Express Education & Career Expo** at **Pak China Friendship Center, 2013 for** project exhibition from university**.**
- Participated in Science Society Project **Exhibition** in **HITEC University Taxila Cantt 2015**.
- Member in Indoor games i.e. Basketball and badminton in **HITEC Olympiad 2011.** Team member in organizing **Concert** in **HITEC 2011.**

- Participated in '**Bridge Stick Structure'** competition held by **NAYS** in **HITEC University Taxila.**

REFRENCES

Prof. Dr. Shahab Khushnood (Ex Dean MED, UET Taxila)
Dr Hafiz Muhammad Ali (Associate Professor MED, UET Taxila)
Luqman Ahamd Nizam (Assistant Professor, HITEC University Taxila)
Engr. Shafique Memon (Ex Deputy PEC Registrar)
