

**MEHRAN UNIVERSITY OF ENGINEERING
& TECHNOLOGY, JAMSHORO**

Self-Assessment Report

Ph. D (Biomedical Engineering)

**Department of Biomedical Engineering
2021**

TITLE OF REPORT

SELF ASSESSMENT REPORT OF Ph. D (BIOMEDICAL ENGINEERING) PROGRAM

PROGRAM TEAM (PT) DEPARTMENT OF BIOMEDICAL ENGINEERING

1. Prof. Dr. Ahsan A. Ursani
2. Dr. Abdul Qadir Ansari
3. Dr. Syed Amjad Ali

Convener
Focal Person
Member

DATE OF FINALIZATION OF REPORT
October 08, 2021



CHAIRMAN
Prof. Dr. Ahsan A. Ursani
Department of Biomedical Engineering

Table of Contents

Criterion 1: PROGRAM MISSION, OBJECTIVES & OUTCOME

- Standard 1-1: The program must have documented measurable objectives that support Faculty / College and institution mission statements.
- Standard 1-2: The program must have documented outcomes for graduating students. It must be demonstrated that the outcomes support the program objectives and that graduating students are capable of performing these outcomes.
- Standard 1-3: The results of program's assessment and the extent to which they are used to improve the program must be documented.
- Standard 1-4: The department must assess its overall performance periodically using quantifiable measures.

Criterion 2: CURRICULUM DESIGN AND ORGANIZATION

- Standard 2-1: The curriculum must be consistent and support the program's documented objectives.
- Standard 2-2: Theoretical background, problems analysis and solution design must be stressed within the program's core material.
- Standard 2-3: The curriculum must satisfy the core requirements for the program, as specified by the respective accreditation body.
- Standard 2-4: The curriculum must satisfy the major requirements for the program as specified by HEC, the respective accreditation body / councils.
- 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 / council.

Criterion 3: LABORATORIES AND COMPUTING FACILITIES

- Standard 3-1: Laboratory manuals/documentation/instructions for experiments must be available and readily accessible to faculty and students.
- Standard 3-2: There must be adequate support personnel for instruction and maintaining the laboratories.
- Standard 3-3: The University computing infrastructure and facilities must be adequate to support program's objectives.

Criterion 4: STUDENT SUPPORT AND ADVISING

- Standard 4-1: Courses must be offered with sufficient frequency and number for students to complete the program in a timely manner.
- Standard 4-2: Courses in the major area of study must be structured to ensure effective interaction between students, faculty and teaching assistants.
- Standard 4-3: Guidance on how to complete the program must be available to all students and access to academic advising must be available to make course decisions and career choices.

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.
- 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.

- 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.
- 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.
- 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.

Criterion 6: FACULTY

- Standard 6-1: There must be enough full-time faculty 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.
- 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.
- Standard 6-3: All faculty members should be motivated and have job satisfaction to excel in their profession.

Criterion 7: INSTITUTIONAL FACILITIES

- Standard 7-1: The institution must have the infrastructure to support new trends in learning such as 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.
- Standard 7-3: Class-rooms must be adequately equipped and offices must be adequate to enable faculty to carry out their responsibilities.

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.
- Standard 8-2: There must be an adequate number of high quality graduate students, research assistants and Ph.D. students.
- Standard 8-3: Financial resources must be provided to acquire and maintain Library holdings, laboratories and computing facilities.

Appendix I: List of Research Publications

Appendix II: Curriculum

Appendix III: Supporting Documents

CRITERION 1: PROGRAM MISSION, OBJECTIVES & OUTCOME

Mission Statement of the University

Mehran University of Engineering and Technology aims to promote technological change and sustainable development through higher education, research and outreach. Towards this end, it will provide a rewarding and challenging environment for faculty, staff and students.

Mission Statement of the Department

The mission of the Department of Biomedical Engineering is to teach, discover and broadly disseminate fundamental knowledge concerning to the field of Biomedical Engineering through educational innovation and use of interconnected human and technological systems followed by comprehensive evaluation process.

Standard 1-1: The program must have documented measurable objectives that support Faculty / College and institution mission statements.

The doctor of philosophy degree in Biomedical Engineering is a research degree. It is awarded in recognition of demonstrated mastery of subject matter in a chosen field of study and demonstrated competence in the conduct of an individual research investigation that represents a significant contribution to the cumulative knowledge of the field. The program of study and research is planned and supervised by an advisory committee. Each candidate's course work and research topic is approved by the advisory committee as meeting the standards generally associated with the doctoral degree.

Program Mission Statement

To produce biomedical scientists who carry out scientific research to improve human health.

Program Objectives

The objectives of the program include

1. Enabling researchers to identify a problem space, formulate a problem, and follow a conclusive research process.
2. Broaden the horizons of the biomedical engineering researchers by addressing cross disciplinary challenges.
3. Producing research-oriented professionals who can understand, communicate, and interpret quantitative information and mathematical ideas in the age of big data.
4. Consider the contemporary issues and apply modern scientific tools necessary in professional engineering practice.

Strategic plan to achieve program mission and objectives

Strategy:

The following are the main steps of the strategic plan to achieve the program mission and objectives:

Step-1: Carefully mapping the course objectives to the program outcomes and program outcomes to program objectives.

Step-2: Reviewing and updating the courses and their content regularly.

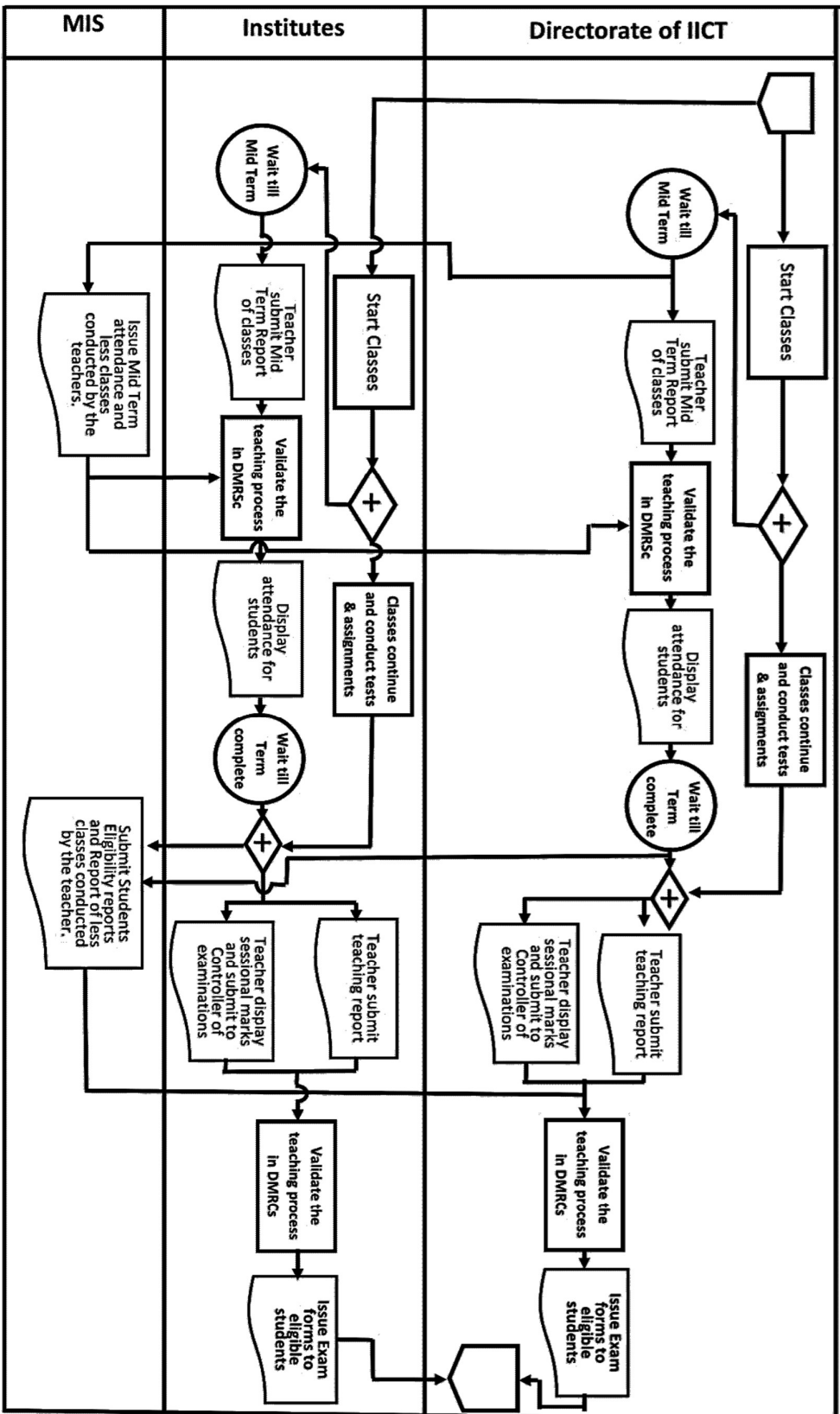
Step-3: Engaging competent teaching / non-teaching and research staff for the program

Step-4: Taking measures for continual improvement of the staff's qualifications

And through continual improvement in working efficiency through self-evaluation

Process Map – Postgraduate Studies

Process Map (Quality Plan) for ICT (Masters) - MUET



Reference:
Process Map - Postgraduate Studies

Measurement of objectives

The following table (Table 1.1) summarizes the process of measurement of objectives

Table 1.1: Measurement of Objectives and Improvements Made

Objectives	How measured	When measured	Improvement identified	Improvement made
Enabling researchers to identify a problem space, formulate a problem, and follow a conclusive research process.	Employer Survey	March, 2021	More latest books arranged, related literature and seminars to be arranged.	Initiated
Broaden the horizons of the biomedical engineering researchers by addressing cross disciplinary challenges.	Employer Survey	March, 2021	Strong coordination among the stakeholders (Academia, Industry and Government) is required	Initiated
Producing research-oriented professionals who can understand, communicate, and interpret quantitative information and mathematical ideas in the age of big data.	Alumnae Survey	March, 2021	Related field visits of various organizations are required.	Initiated
Consider the contemporary issues and apply modern scientific tools necessary in professional engineering practice.	Alumnae Survey	March, 2021	Trainings by experts in field are required	Initiated

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

Program Outcomes

The department of Biomedical Engineering offers the Ph. D (Biomedical Engineering) degree program that has learning outcomes for its students such as:

1. Apply knowledge of mathematics, science and engineering to the solution of complex engineering problem
2. Design and conduct experiments, analyze, interpret data and synthesize valid conclusions.
3. Design a system, component, or process, and synthesize solutions to achieve desired needs.
4. Identify, formulate, research through relevant literature review, and solve engineering problems reaching substantiated conclusions.
5. Use the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for public health and safety, cultural, societal, and environmental constraints.

The following table and the figure show how the program outcomes support the program objectives.

Table 1.2: The Relationship between Program Objectives and Program Outcomes

S. No	Program Objective	Program Outcomes				
		1	2	3	4	5
1.	Enabling researchers to identify a problem space, formulate a problem, and follow a conclusive research process.	⊙	.	⊙	.	○
2.	Broaden the horizons of the biomedical engineering researchers by addressing cross disciplinary challenges.	.	.	⊙	⊙	.
3.	Producing research-oriented professionals who can understand, communicate, and interpret quantitative information and mathematical ideas in the age of big data.	.	⊙	.	○	○
4.	Consider the contemporary issues and apply modern scientific tools necessary in professional engineering practice.	.	.	○	.	⊙

- ⊙ Substantial Contribution
- Moderate Contribution
- No Contribution

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 results of program’s assessment and the extent to which they are used to improve the program must be documented.

Actions taken based on the results of periodic assessments.

It is first Self-Assessment. On the basis of periodic assessment necessary action will be taken for improvement.

Major future program improvements plans based on recent assessments.

Department intend to increase the laboratory in various courses and to realize we intend to make MoUs with different research institutes in Pakistan and on the top of it we are in process to formulate a scholar internship opportunity for students at ICCBS, HEJ Institute at KU. Also we are in process to formulate training opportunities at PCSIR and KIRAN Karachi for scholars of PhD (Biomedical Engineering)

List strengths and weaknesses of the program

Department regularly asses the syllabus keeping in the view to bring the improvements in the quality desired by the industry.

List significant future development plans for the program

Department intend to increase the number of equipment for laboratory and Reference Library of the department under ISULL by HEC.

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

A. Students

1. Present student enrollment in the post-graduate program of PhD (Biomedical Engineering) in the last three batches is as follows:

Table 1.3: Student Enrollment in last four batches

S. No.	Batch (Postgraduate)	Enrolled Students
1.	18 PhD(BME)	2
2.	19PhD (BME)	1

List of PhD faculty members

S. No.	Name of Faculty Member	Designation	Degree
1	Dr. Ahsan Ahmed Ursani	Professor	PhD
2	Dr. Syed Amjad Ali	Associate Professor	PhD
3	Dr. Abdul Qadir Ansari	Associate Professor	PhD
4	Dr. Maheen Surahio	Assist. Professor	PhD
5	Dr. Muhammad Amir Panhwar	Assist. Professor	PhD
6	Dr. Abdul Raheem Ansari	Lab Engineer	PhD

- List of Dedicated Full time Faculty Members:

S. No.	Name, Designation and Joining Date	PEC #	Details of Qualifications			Specialization	Experience Teaching (Total years)
			Degree	Year	Institution		
01	Dr. Ahsan A. Ursani Professor 19-10-1996	Electro / 4192	Ph.D	2008	INSA Rennes, France	Signal and Image Processing	25
			M.E	2003	MUET		
			B.E	1995	MUET		
02	Dr. Syed Amjad Ali Assoc. Professor 14-09-2004	BM / 24	Ph. D	2014	Beijing Inst. Tech, China	Bionics Technology	16 (18)
			M.E	2006	MUET		
			B.E	2000	SSUET		
03	Dr. Abdul Qadir Ansari Associate Prof 01-01-2016	Comp /1546	Ph.D.	2012	MUET	Quality of Service/ BB Wireless Networks	04 (15)
			M.E	2004	MUET		
			B.E	2001	MUET		
04	Dr. Maheen M Surahio Assistant Prof 15-01-2019	-	PhD	2017	Hefei Uni Tech	Biotechnology	04
			MS	2011	UoS		
			BS	2008	UoS		
05	Dr. M. Aamir Panhwar Lecturer 13-02-2008	BM / 291	Ph.D	2020	China	Electronic Science and Technology	12
			M.E	2014	MUET		
			B.E	2007	MUET		

06	Dr Abdul Rahim Ansari Lab Engineer 08-02-2013	BM / 727	Ph.D	2019	Hanyang University, South Korea	Telemedicine	6 years
			B.E	2013	MUET	EMG Analysis	

List of Ph.D. Faculty (SHARED)

S. No.	NAME OF FACULTY MEMBER	DESIGNATION	DEGREE
01	Prof. Dr. Bhawani Shankar Chowdhry	Professor	Ph.D.
02	Prof. Dr. Mukhtiar Ali Unar	Professor	Ph.D.
03	Dr. Jawaid Daudpoto	Professor	Ph.D.

STUDENTS-TEACHERS

No of Students: 3
Dedicated Faculty: 6
Sharing Faculty: 3
Total Faculty 7
Student - Faculty Ratio 1:2

B. Publications

The list of publications for each faculty member is given in Appendix I.

C. Workshops and Seminars Organized

The following workshops were organized by the Department of Biomedical Engineering in the last four years:

Table 1.4: Details of the Workshops / Seminars organized

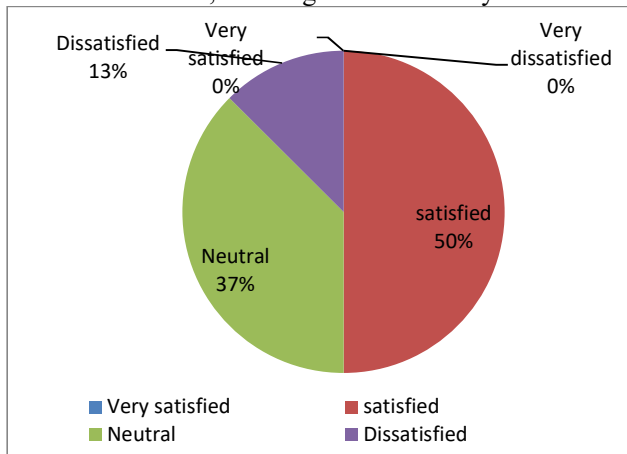
S. No.	Title of the Workshop/Conference	Place	Date
1	Turnitin Orientation Workshop: Awareness Session	Dept. of BM Engineering	January 19, 2015
2	Bioinformatics: Computer Applications in Healthcare and Biomedicine	Dept. of BM Engineering	February 27, 2015
3	Inter-Departmental Hardware / Software based project competition	Dept. of BM Engineering	April 16, 2015
4	2-day workshop on "Mechatronics with Arduino"	Dept. of BM Engineering	August 19, 2015
5	One-day interactive session in the field of biomedical engineering with field expert	M.D Makhdoom Hall, MUET	October 19, 2015
6	Career Counseling and Opportunities for Engineers in Canada	Video Conferencing Hall, IIT	March 31, 2016
7	Workshop on LabVIEW Certification Preparation	Dept. of BM Engineering	February 10, 2017
8	SMART ideas in BME – STUDENT PROJECTS	Dept. of BM Engineering	March 10, 2017
9	2-Day Evening Workshop on Programming A System on Chip with Bluetooth Low Energy.	Dept. of BM Engineering	Feb 20-21, 2018
10	Futuristic Solutions in Biomedical Engineering	Dept. of BM Engineering	February 2, 2018

11	Poster & Project Competition 2019	Dept. of BM Engineering	April 2, 2019
12	Mechatronics with Arduino	Dept. of BM Engineering	April 23-25, 2019
13	Basics of Arduino	Dept. of BM Engineering	January 1, 2020
14	Electrospinning- Making of Nanofibers	Dept. of BM Engineering- Online	August 13, 2021

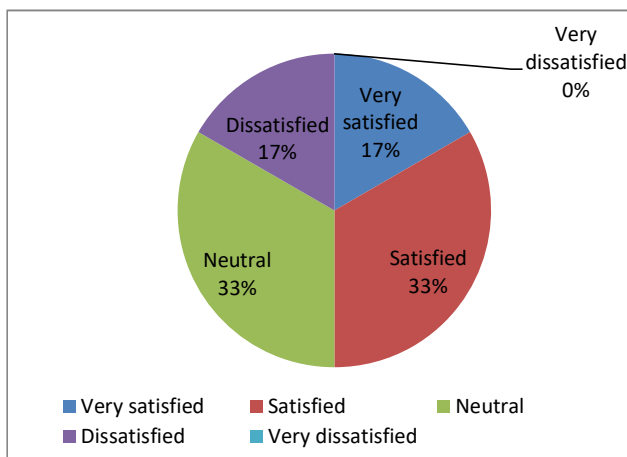
D. Faculty Satisfaction

The survey on the prescribed opinionnaire was conducted. The following pie charts illustrate the results.

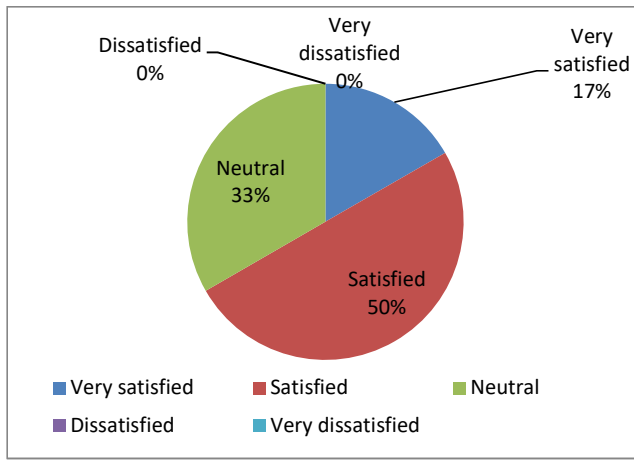
1. Your mix of research, teaching and community service



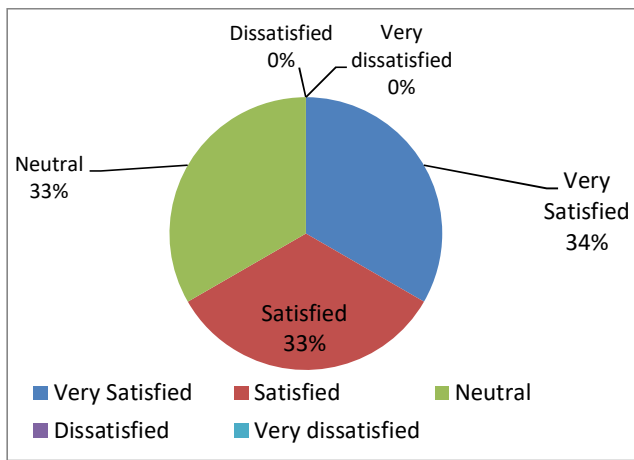
2. The intellectual stimulation of your work



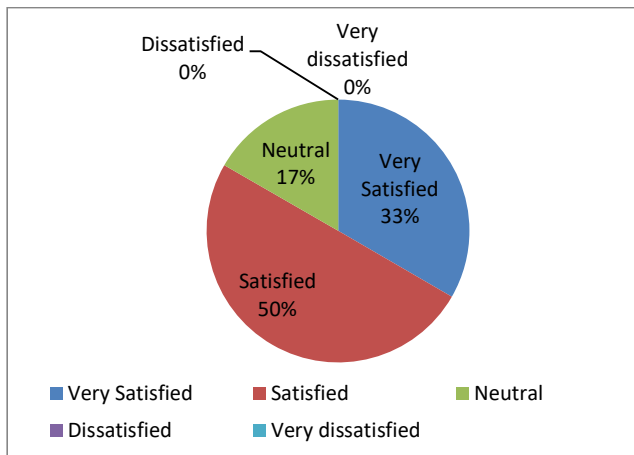
3. Type of teaching/research you currently do



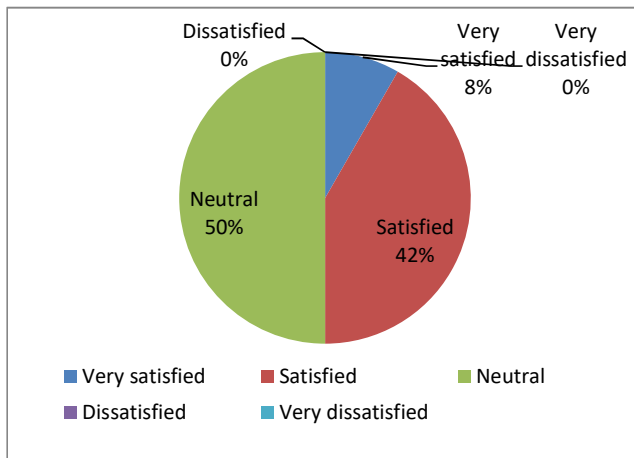
4. Your interaction with students



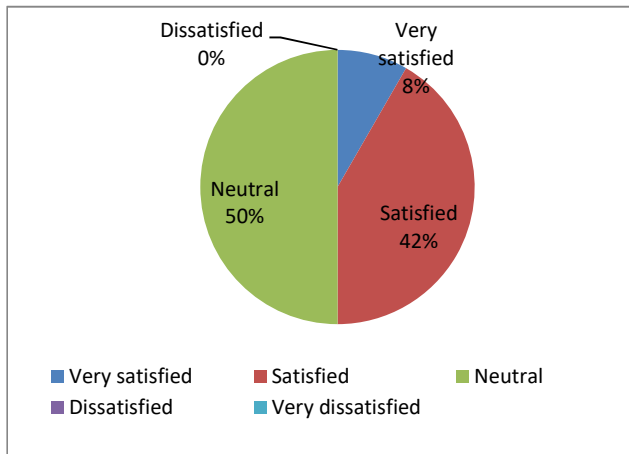
5. Cooperation you receive from colleague



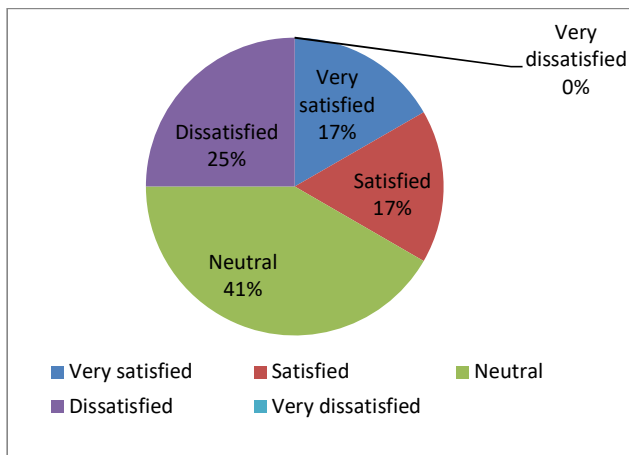
6. The mentoring available to you



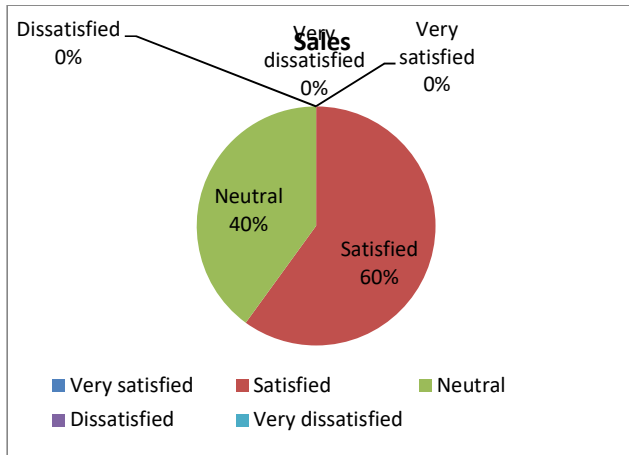
7. Administrative support from the department



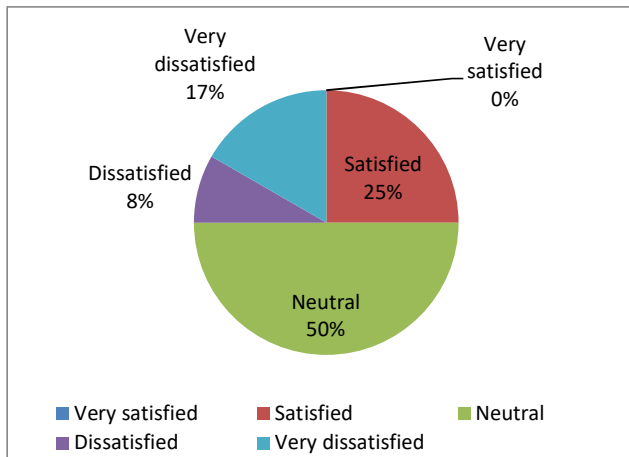
8. providing clarity about the faculty promotion process



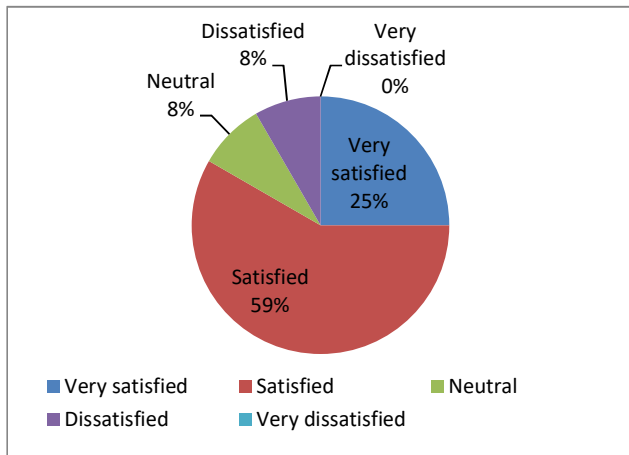
9. Your prospects for advancement and progress through ranks



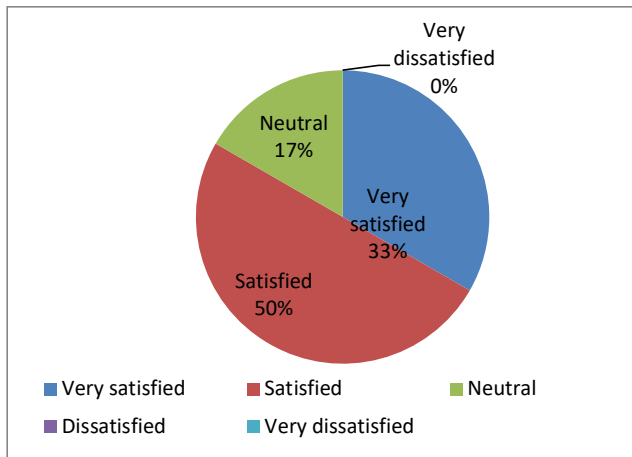
10. Salary and compensation package



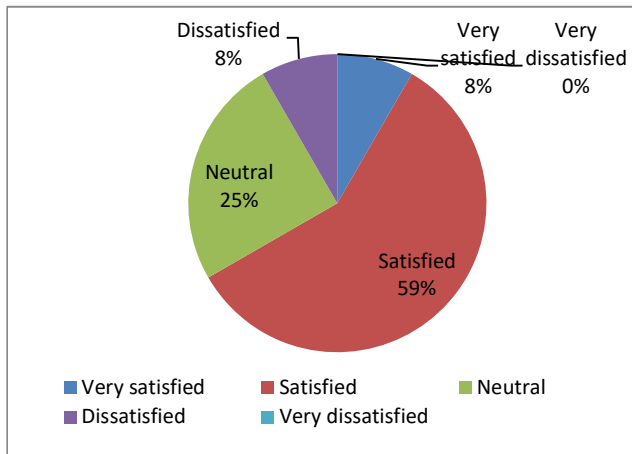
11. Job security and stability at the department



12. Amount of time for yourself and family



13. The overall climate at the department



E: Graduates Satisfaction

Since there are no graduates under this program are awarded degree, the subject survey is not possible.

CRITERION 2: CURRICULUM DESIGN AND ORGANIZATION

A. Title of the Program

PhD (Biomedical Engineering)

B. Definition of Credit Hour

Theory: 1 hour of classroom teaching in a week

Laboratory: 3 hour of laboratory teaching in a week

3 credit hour course is taught for 42 hours, minimum, in a semester

2 credit hour course is taught for 28 hours, minimum, in a semester

C. Degree Plan

All the offered courses are compulsory, electives are not offered yet.

D: Prologue

Biomedical industry is under constant requirement to find new ways of diagnostics to reduce healthcare costs, patient's suffering and improve accuracy. As a result, companies continue to implement technologies, such as robotics, process control, computers, and non-invasive testing in order to enhance productivity. Similarly, modern healthcare procedures including diagnostics and surgical procedures harness the technologies including robotics, computers, and non-invasive instrumentation. The theoretical foundations and the applications of engineering expertise in the field of medicine and industrial automation have several aspects in common. Examples include transducers and sensors used for medical as well as industrial instrumentation, ultrasonography used for non-invasive medical diagnosis and non-destructive material inspection, robots used in surgery and manufacturing, and radiation / radiography used for medical diagnosis as well as fatigue characterization. The techniques of modeling and simulating physiological and industrial systems also share several similarities and common tools. Taking advantage of these common theoretical foundations with different applications, the PhD program titled "Biomedical Engineering" aims at producing experts in instrumentation, automation, control, testing, and management as applied to Medical practice.

This program aims to provide advanced training in the rapidly expanding field of medical Engineering. The PhD program in biomedical Engineering is specialization in engineering discipline more focused on medical imaging, diagnosis, therapy, instrumentation, measurement and equipment design.

The program provides students with a broad coverage of this rapidly expanding field whilst particular emphasis is placed on inter-professional training and the multidisciplinary nature of the discipline, enabling the student to successfully complete complex tasks at the increasingly important interface between engineering and the life sciences.

Academic Profile

The researchers enrolled in the PhD program can plan, construct and optimize diagnostic equipment and telemedicine systems. They are also experts in medical instrumentation and imaging systems. Further they can explore their future in the area of Nano drug carrier design and food engineering. These competences require understanding and mastery of state-of-the-art technologies such as image processing, simulation tools, and instrumentation.

The program shall attract graduates with the background of Biomedical, Electronic, Telecommunication, Electrical, Computer Systems, as well as Software engineering.

Educational goals

The PhD Degree Course work (electives) has the purpose of educating graduates who are able to work and plan in the different contexts of medical and automation engineering especially in the industrial context, including production systems and their aspects of automation and control, mechanical technologies and measuring, also with reference to quality systems, with special reference to the manufacturing and processing sector and installations.

Employment opportunities

Graduates of this program are expected to play the professional role of a designer, a chief executive of a technical or production enterprise with an overall interdisciplinary vision of the complexities involved, and the capacity to realize this vision towards designing activities which can be intricate, both for installation, maintenance and providing trainings in a great variety of manufacturing and process companies as well as biomedical engineering departments of healthcare service providers.

CRITERION 3: LABORATORIES AND COMPUTING FACILITIES

Suitable laboratories and computing facilities are available and accessible to all faculty members and students to support teaching and research activities.

Standard 3-1: Laboratory manuals/documentation/instructions for experiments must be available and readily accessible to faculty and students.

All the manuals of the laboratory equipment are placed in the premises of the concerned laboratory in the custody of the lab in charge and the lab supervisor. The lab in charge is responsible for maintaining the record of the laboratory equipment along with accessories and manuals, and providing the students and the teachers with the same on demand. For the purpose, each laboratory has an office with almirah and a store to keep the accessories and the manuals in the safe custody.

The title of existing Labs in mentioned below in table 3.1

Table 3.1 : Laboratory Titles

Laboratory-I	Biomedical Instrumentation Laboratory
Laboratory-II	Biomedical Sciences Laboratory
Laboratory-III	Biomedical Engineering Laboratory
Laboratory-IV	Telemedicine & Research Laboratory
Laboratory-V	Biomedical Computing Laboratory
Laboratory-VI	Nanomedicine Research Laboratory

Standard 3-2: There must be adequate support personnel for instruction and maintaining the laboratories.

Each laboratory is supervised by senior faculty member with support of Lab Technicians / I.T Assistant and in some Labs no supporting staff is provided yet by competent authorities.

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

Each Department of the University has its own independent computing facilities. The Department of BM Engineering has its own computing lab housing 40 PCs. There's a qualified IT assistant that looks after the lab. In addition, a Lecture is in charge of the lab. Apart from this, all other labs have PCs supporting different pieces of equipment that need PC interfacing. There's yet another lab named "Telemedicine and Research Lab" that has 8 computers to support final year projects. Usually, each group working on the final year project and is assigned a separate PC in the Telemedicine and Research Lab.

CRITERION 4: STUDENT SUPPORT AND ADVISING

Introduction

Directorate of Students Affairs gives an active support and advice to the students in academic and non-academic matter and indicates the advocacy of other facilities desired by the students. Besides the Director Students Affairs there is an Advisory committee also to make coordination with students and the management to resolve students' matters. At department level class advisers are also appointed to keep in touch with student and help them in academic matter like class attendance, Course materials, arranging field visits etc.

Support Facilities for Students and other Components:

Many facilities have been developed and established in the University to provide assistance to the students in their studies as well as other related activities and leisure. These facilities and establishment are briefly described below:

Residential Accommodation

Ten hostels including two for female students and one for Post-graduate students, are available student's accommodation. The hostels can accommodate a total of 1300 students. The preference is given to the neediest students who belong to farther areas of the province. All the students who are interested in hostel accommodation can apply through a prescribed form which is available in the Provost office. All the residents have to follow strictly the hostel rules and regulations. The hostels are managed by the Provost, Deputy Provost and Wardens.

Medical Assistance

A part-time dispensary has been established in one of the hostels for the resident students, which is manned by a qualified doctor and a dispenser. Adequate quantity of essential medicines is also available in the dispensary for the minor ailments. Major sickness problems are referred to Liaquat University Hospital, which is quite nearby. An ambulance is also available for the sick students to take them to the hospital in any emergency.

Transport Facilities

The University has deployed buses for the use of students on various routes between the Campus and Hyderabad/Qasimabad/Latifabad/Kotri. Students have to pay nominal transport charges on yearly basis for the use of this facility.

Sports Facilities

The Directorate of Sports is responsible to entertain the students of this University by arranging Indoor and Outdoor sports events i.e. Inter Hostel for hostler students and Inter Department for department competitions. The university has the state of the art gymnasium and cricket ground for students (male and female) and teachers. The University also organizes and participate Interuniversity Sports Events in a large number. Previously lot of the University students has remained Gold, Silver and Bronze Medalist. The

University sports teams not only participate in Sindh Universities Sports Gala event but this University has also organized the same event at a high level.

Financial Aid:

As per directives of Higher Education Commission, Mehran University of Engineering and Technology, Jamshoro has taken initiative to stream line the Scholarship/Financial Aid of our students, in this regard we have established "Student Financial Aid Office" (SFAO) of Mehran University of Engineering and Technology, Jamshoro. Now all Scholarships/financial Aid Cases are routed through Student Financial Aid Office (SFAO). A centralized record of all students getting any Financial Aid will be kept in the Student Financial Aid Office (SFAO).

Other Scholarships

All the post graduate programs are fully funded on Prime Minister's scheme. The tuition fee has been reimbursed to the registered candidate after verifying their eligibility record through Prime minister's office.

Standard 4-1:

Courses must be offered with sufficient frequency and number for students to complete the program in a timely manner. The department offers courses in light of requirements of Pakistan Engineering Council (PEC) and Higher Education Commission (HEC) and completed in due course of time by following yearly academic calendar.

Courses offered

All courses offered for M. E. program are compulsory. No any choice given to students to elect any courses of his/her choice. The courses taught outside the department are managed and monitored through a clearly defined policy.

Standard 4-2:

Courses in the major area of study must be structured to ensure effective interaction between students, faculty and teaching assistants. Close coordination is observed among student, faculty and teaching assistants during the courses through the steps taken as under. Students are required to attend their classes regularly well in time. Class Adviser are appointed for each batch for making close coordination with students and help them solving academic problems Approved Teaching Plan are required to given to each student before start of course Teachers gives assignments to each student and guide them to give presentations on various topics Delivery of course material to the student is also ensured by the class representative and class adviser Teachers entertain students in his/her office to solve queries related to the course.

Standard 4-3:

Guidance on how to complete the program must be available to all students and access to academic advising must be available to make course decisions and career choices.

Information about program requirements

Students are informed about the program requirements through newspaper, notice board and MUET website.

Advising system

The Directorate of Students Affairs advises students in academic affairs, rules & regulations; adapt university life and studies; explore their interests and goals; work toward meeting departmental mission. The advisor also meets with prospective students and their parents or guardians and. the advisors and staff welcomes all questions and queries.

Professional counseling and interaction with practitioners

A Directorate of Industrial Liaison has been established in the University to provide professional counseling and provide platform to interact with practitioners. The Directorate is also facilitating the organization of industrial/field training for the students of the University. In addition to arranging the practical training for the undergraduate students, the Directorate of Industrial Liaison also performs the following functions.

To collaborate with the industries for identifying their problems and attempting to solve them through efforts of experienced and qualified professors of the University. To arrange exchange of technical staff between the University and industry for the mutual; benefit of the both. To guide and recommend students for internships in the industrial/commercial sector. Effectiveness may be observed from raising standard of university at national and international level, affiliation with foreign institutions and recruitment of MUET students within from the campus at the time of program completion.

CRITERION 5: PROCESS CONTROL

The processes by which major functions are delivered are in place, controlled, periodically reviewed, evaluated and continuously improved.

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.

Criteria for Admissions

Admissions to the all postgraduate courses are made according to the policies and rules, framed by the authorities of the university from time to time. The candidates who apply for their admission on the basis of fake certificates/documents (detected before or after their admission) shall be prosecuted under criminal law and their admission shall be cancelled. Additionally, they may also be debarred for a period of three years for future admissions.

Admission Process

A notice for admission in first year is published in daily newspapers for inviting applications. The schedule of issue and submission of application form is given in the advertisement and on MUET website. The Prospectus and Application Forms are sold through branches of an authorized bank. The relevant policy, rules and procedure for admission, information about pre-admission test is published in the prospectus. The University provides information regarding services to the customers through: Advertisement Prospectus Notice Boards MUET Website.

Submission of Admission Forms

The candidates are required to obtain application forms from designated Banks in various cities and towns on payment of prescribed fees and are asked to deposit them with the same banks within the announced due date. These application forms are then sent to the Mehran University where they are scrutinized. After this scrutiny, all the eligible candidates are sent admission slips for entry to the Pre-Admission Test.

Pre-admission Test

In accordance with the policies adopted by the Federal as well as Provincial Government of Sindh all the eligible candidates applying under any category are now required to appear in the pre-admission test conducted by Institute of Information and Communication Technologies of the University. Candidates having cleared the pre-admission test shall not be eligible for consideration for admission in the PhD program of the University.

Eligibility

The eligible candidates should have:

Must have master's degree in relevant fields. Appeared and passed in Pre-admission Test.

Evaluate and Improve Admission Criteria

The admission criterion is evaluated every year by Policy Framing Committee. The recommendations of that committee are further reviewed and recommended further by the Academic Council of the University to the Syndicate for approval.

Standard 5-2:

The process by which students are registered in the program and monitoring of student 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.

Students' Registration

When a candidate is provisionally selected for admission in a particular discipline, he/she will be given a letter containing terms & conditions as per rules and advise to report personally to the Chairman of the

department concerned by the due date to get Roll Number after filling the challan and depositing fees if said terms & condition accepted. Similarly, the tuition fees. Each student is required to enroll himself/herself in the University and obtain Enrolment Card accordingly. In case of failure, he/she will not be allowed to appear in the examination.

Every student shall observe all rules & regulations including the Mehran University of Engineering & Technology Students Conduct and Discipline Regulations, 1978 as amended up to 6.7.2006.

Monitoring the Academic Progress

The Chairman / Director of the concerned Department / Institute / Directorate reviews the performance of their teachers in the Departmental Management Review Meetings in accordance with the Teaching Plan, which provides a chance to take preventive measures against any potential Non-Conformity. The subject teachers are also required to submit the class attendance sheets of the students along with the topic covered in the class to the Directorate of Management Information System (MIS), through the Chairman / Director of the concerned Department / Institute / Directorate. The Chairman / Director or his nominee from within the Departmental Management Review Committee verifies the class attendance sheets, before sending to the Directorate of MIS.

A copy of the class attendance sheet duly stamped and signed by the Administrator in MIS is returned to the teacher through the concerned Chairman / Director. Any discrepancy observed in attendance sheet is communicated by the Director MIS to the teacher through the concerned Chairman / Director. The Dean of the faculty concerned is authorized to settle the matter in consultation with the Director MIS and the concerned Chairman / Director if need arises.

At the mid and final, every subject teacher compiles a report in prescribed form of the syllabus completed with the help of the copies of class attendance sheets and submits it to the concerned Chairman / Director. The Chairman / Director then reviews the report submitted by every subject teacher in Departmental Management Review to ensure the completion of prescribed syllabi in the semester. A copy of Teaching Plan is also provided to the students at the beginning of every semester to prevent non-conformity.

Review Non-conformity

The concerned Chairman / Director reviews all the identified Non-Conformities occurred during the term and investigate the root-cause of the Non-Conformity and reports it to the concern Dean, who reviews the nature of Non-Conformity and sends it to the Vice-Chancellor. The Vice-Chancellor also reviews the nature of Non-Conformity and sends it to the Registrar to make it a part of the agenda for the up-coming meeting of the Academic Council. The Academic Council is fully authorized and responsible to deal with Non-Conformity as per the nature. The Academic Council can take any action as per statutes, to eliminate the detected Non- Conformity acceptance of the services under concessions preclude the services as per Regulations. The Academic Council is also fully authorized to take action even if the Non-Conformity is detected after the completion of the delivery of the services.

Verification of the corrective actions taken on a Non-Conformity

As per decisions of the Academic Council, Chairman / Director of the concern Department / Institute / Directorate takes the corrective measures against the Non-Conformity and reviews its status in the next Departmental Management Review to re-verify the status and to demonstrate the conformity to the requirement.

Evaluation of registration and monitoring Process

The admission and monitoring process is evaluated by Policy Framing Committee when required. The recommendations of that committee are further reviewed and recommended further by the Academic Council of the University to the Syndicate for approval.

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. Process used to ensure that highly qualified faculty is recruited to the program

The University assigns responsibilities defined in the quality management system to personnel ensuring that they are competent on the basis of applicable education, training, skills and experience. Their qualification and experience data are maintained for record purposes.

Faculty Appointment

The faculty is appointed purely on the basis of Approved Rules, Regulations and Statutes fulfilling requirements of PEC and HEC. Following the appointment process the vacant seats are announced through local & national newspapers and MUET website. After receiving scrutinize the applications and call for appearing before selection board. The selection board conducts interviews and gives recommendations to the syndicate for approval. After approval offer letters are given to the selected candidates. For the sake promotion the faculty members can apply for next higher post. They can be appointed for next higher post through the same process of selection board.

Faculty Evaluation

Faculty members' performance is evaluated annually through Annual Confidential Reports prepared by the Chairman and countersigned by the Dean Concerned.

Teacher evaluation through Customer Feedback System

Customer/Student feedback is obtained regularly to monitor the level of satisfaction and to identify the needs and expectations of the students. The Vice Chancellor or his nominee is responsible for obtaining student feedback. Student feedback is obtained through Student Feedback Form. Student feedback is obtained at the end of each Academic Term. The student feedback is compiled in the Computer Centre and statistically analyzed. The results of the analysis are submitted to the Vice Chancellor who would forward to the Dean

QEC to place it in the Management Review Committee. Based on the statistical analysis actions are initiated for improvements towards quality of services. The relevant departments of the University are responsible for handling customer queries. The Chairman / Director /Head of Section is responsible for handling customer complaints related to his department / Institute / Section, in the cases mentioned below and others.

- Improper services or inadequate services
- Non co-operation of personnel
- Issues related to customer feedback

The customer complaint, through written application is received by Chairman / Director / Head of section who enters the complaint in the Customer Complaint Log. The Chairman / Director / Head of Section reviews the complaint, discusses with the customer and takes remedial measures. Any delay in taking remedial measure is the responsibility of concerned chairman / Director / Head of Section. On the basis of complaints, the concerned Departmental Head fills in the Corrective / Preventive Action Request (CPAR). The CPAR contains a description of the unsatisfactory condition, root cause analysis, the proposed corrective action, person responsible to carry out the corrective action and proposed completion date.

The CPAR is sent to the Dean QEC, who reviews the proposed corrective action with the concerned Departmental Head. After the approval of both the Dean QEC and the concerned Head of the Department, Dean QEC logs in the CPAR in CPAR Log, allots number to the CPAR and returns the CPAR to the concerned Head of the Department to initiate the corrective action. The Vice-Chancellor is the final authority in case of more than one corrective actions suggested. QEC will maintain the Corrective/Preventive Action Log. Customer complaint data is statistically compiled and analyzed after every 3 months by the Quality Coordinator and brought in the upcoming meeting of Departmental Management Review Committee. On the basis of the decision taken in the meeting of DMRC the Chairman / Director / Head of Section will take appropriate action for improvement.

Training, Awareness and Competency

The University has established and maintains a procedure to:

- Identify competency needs for personnel performing activities affecting quality;
- Provide training or take other actions to address identified needs;

- Evaluate effectiveness of the training provided

Ensure that employees are aware of the relevance and importance of their activities and how they contribute to the achievement of the quality objectives. Maintain appropriate records of education, experience, training and qualification.

Methods used to retain excellent faculty members

In order to retain excellent faculty members who is on contact, the University extends his/her contact or he/she may apply for regular post and go through the selection procedure as per rules.

Indicate how evaluation and promotion processes are in line with institution mission statement.

Evaluation and promotion processes are as per rules & regulations of the University. Each faculty member is evaluated annually on his performance in teaching, research and other university services. These evaluations are based on the teaching performances through Annual Confidence Reports, self-evaluation, and the chairman's evaluation countersigned by the Dean Concerned. The teaching evaluation is based on the students' input and is conducted during the last few weeks of every semester for all the courses offered in the department. The chairman appoints research/graduate assistants to carry out this activity. At the end of the second semester, faculty members are requested to fill out their self-evaluation forms. Once the teaching evaluations and self-evaluations are reviewed by the Chairman, he forwards them along with his input to the Dean of College of Computer Science and Engineering, which are then forwarded to the Dean of Faculty and Personnel Affairs. Following this, the Faculty Affairs Committee, a standing committee of the university appointed each year and chaired by the Dean of Faculty and Personnel Affairs, reviews and finalizes the faculty evaluations. The annual performance evaluation of each faculty member is sent directly to him every academic year. The University realizes that maintaining high standards and continuous improvement of quality of teaching, research, and other services is directly associated with the benefits, incentives, and awards granted to the faculty with their development and achievements. The result of this policy is clearly reflected by the progress observed in teaching and level of the program graduates, increased rate of publications in reputed journals and conferences, in addition to the professional satisfaction level among faculty members. The policy has resulted in a stable educational environment and ensured the continued teaching competence and professional growth of the faculty.

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. In order to achieve excellence in teaching and students' learning the sound process is implemented and regularly evaluated. Moreover, the department puts a strong emphasis on utilizing the current modern technologies such as multimedia, audio-visual facilities, computer animations, and models by teachers in order to enhance the quality of course material delivery. Processes and procedures used to ensure that teaching and delivery of course material are effective and focus on student learning are conducted through implementing the following process.

The Academic Calendar is issued every year for postgraduate programs with the approval of the authorities. It is given wide publicity and also issued in the Prospectus each year. Subject allocated by the Chairman purely on the basis of expertise of the teachers. Time table is prepared by the time table committee. The teaching plan for every teaching subject has to be prepared by the concerned teacher and is to be submitted to the Chairman / Director for approval by the Departmental Management Review Committee. The concerned Chairman / Director is responsible to ensure the completion of syllabi within prescribed number of lectures during the semester.

There is a requirement of Academic Council to complete the syllabus within specific time frame, and with a limit of minimum number of lectures to be delivered. The subject teachers are required to develop a tentative Teaching Plan for the semester and that includes the syllabus to be completed in minimum number of lectures prescribed by the Academic Council. The Departmental Management Review Committee of the concerned Department approves the Teaching Plan for each subject of the semester.

If the prescribed syllabus is not covered in the specific time frame, then it is considered as a non-conforming service.

The Chairman / Director of the concerned Department / Institute / Directorate reviews the performance of their teachers in the Departmental Management Review Meetings in accordance with the Teaching Plan, which provides a chance to take preventive measures against any potential Non-Conformity. The subject teachers are also required to submit the class attendance sheets of the students along with the topic covered in the class to the Directorate of Management Information System (MIS), through the Chairman / Director of the concerned Department / Institute / Directorate. The Chairman / Director or his nominee from within the

Departmental Management Review Committee verifies the class attendance sheets, before sending to the Directorate of MIS. A copy of the class attendance sheet duly stamped and signed by the Administrator in MIS is returned to the teacher through the concerned Chairman / Director. Any discrepancy observed in attendance sheet is communicated by the Director MIS to the teacher through the concerned Chairman / Director. The Dean of the faculty concerned is authorized to settle the matter in consultation with the Director MIS and the concerned Chairman / Director if need arises. At the mid and end of the term every subject teacher compiles a report in prescribed form of the syllabus completed with the help of the copies of class attendance sheets and submits it to the concerned Chairman / Director. The Chairman / Director then reviews the report submitted by every subject teacher in Departmental Management Review to ensure the completion of prescribed syllabi in the term.

A copy of Teaching Plan is also provided to the students at the beginning of every semester to prevent non-conformity. Class Advisers are appointed for each batch to keep in touch with students and perform following tasks:

- to make counseling with students to help them in solving their difficulties related
- to the academics;
- to inform the students about the availabilities of scholarships and guide them;
- to provide awareness to the students about the conduct and discipline regulations;
- to guide students in organizing their study tours, field trips and internship arrangements;

- to monitor the students' activities other than academics and report to the
- Chairman/Director;
- to monitor the class attendance of the students and advise them accordingly;
- to report the class room condition to the Chairman/Director for necessary
- improvement;
- to keep in liaison with the University Management through the Chairman/Director/Dean Concerned to solve students' problems

Standard 5-5:

The process that ensures that students 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. The effective and clearly documented procedure is available to ensure that graduates have completed the program requirements. This process is also periodically evaluated to ensure that it is meeting its objectives.

A student shall be awarded degree of PhD (Doctor of Philosophy) only after he/she has passed the examinations and cleared all the Heads of all the terms and defending the final thesis project within the prescribed time. The Chairman reviews the student records and ensures that all requirements for doctoral degree have been met, then recommend the degree application forms. The Controller of examinations office makes a final check and issue degree certificate with signatures of Controller Examinations, Registrar and the Vice Chancellor.

CRITERION 6: FACULTY

Faculty members must be current and active in their discipline and have the necessary technical depth and breadth to support the program. There must be enough faculty members to provide continuity and stability, to cover the curriculum adequately and effectively and to allow for scholarly activities.

Standard 6-1: There must be enough full time faculty 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.

-For detail of dedicated faculty members of biomedical engineering (Annexure-A is attached)

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.

Update Faculty Members

The faculty members of Biomedical Department are familiar with current advancement of their fields through internet, research journals, e-journal, and latest books. The faculty has been provided many opportunities for professional development such as funds for participating in regional, national and international conferences to present scholarly and creative work. Table 6.2 enlists the faculty members who travelled abroad to present their research work / under exchange program:

Table 6.1: Participation of the faculty members in the courses and conferences abroad

S. No.	Name of the Teacher	Place where travelled	Purpose	Dates
1	Prof. Dr. A. A. Ursani	Limerick, Ireland	Post-Doctoral Studies	31 st Dec-2016

Apart from this, our faculty members keep publishing in the conferences and newspapers and magazines for public awareness on issues of society and technology alike.

CRITERION 7: INSTITUTIONAL FACILITIES

Institutional facilities, including library, classrooms and offices must be adequate to support the objective of the program. To satisfy this criterion a number of standards must be met.

Standard 7-1: The institution must have the infrastructure to support new trends in learning such as e-learning.

- Describe infrastructure and facilities that support new trends in learning.
- Indicate how adequate the facilities are

Infrastructure and facilities available that support new trends in learning

In the new area of 21st century the traditional learning and teaching methods are dramatically changing towards e-learning to bring new teaching and research opportunities in the field of engineering, sciences and technology. All the teachers of the Department maintain and use their official webpages and emails addresses. Our faculty of biomedical engineering uploads their e-lectures on their home pages, MUET blogs, and social network like Facebook etc. The Department also has Internet connectivity through Wi-Fi as well, which is accessible to the faculty, staff and the students of the dept. Noteworthy is the video channel of Professor Dr. Ahsan Ahmad Ursani on the Dailymotion on the URL: <http://www.dailymotion.com/aurسانی>. Dr. Ursani's video channel comprises several lectures on Signal Processing and Mathematics in Sindhi.

Each staff member and student has a User ID and E-mail ID under MUET domain to have the following facilities.

- Digital Library Services through PERN
- HEC online journals access through PERN
- Multimedia development services for Faculty and Students
- Online Courseware / Material and Presentations
- Hardware and Software resources sharing
- OTS 2004 (Online testing System of MUET)
- Computerized Attendance System for Students
- Video Conferencing System (Lectures and Presentations sharing between all Universities of Pakistan through PERN)
- E-Discussion Forums for Faculty and Students

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.

Library Facilities

Books

The Mehran UET Jamshoro has one of the most high-tech libraries in the country, with a huge collection of books that is enhanced every year.

The library book collection comprises of approximately 123,000 and the around 20,000 are available in the book bank, which are lent to students for one term on nominal rent. The book titles cataloged electronically for easy searching and browsing. The collection of books is updated continuously and new textbooks as well as reference material are acquired on the recommendations of experienced faculty members.

Journals

The online digital library of the University contains more than 80,000 books related to Engineering Science and Technology. Access to 15,000+ electronic journals is available on-line within the university campus under Digital Library Program; a Project of Higher Education Commission, most of these resources give access to full text of the research publications.

Other Services

To provide access to online information resources, students and faculty members alike are provided with Internet facility in the Library. Students are encouraged to use computer for their project work in the Internet section of the library with a PCs, internet connectivity, network printer and a photocopier.

Seminar Library

More than 703 books are shelved in the seminar library of the department. The library also maintains a record of previous/current project/thesis scripts to be referred by the final year students.

Standard 7-3: Classrooms must be adequately equipped and offices must be adequate to enable faculty to carry out their responsibilities.

Our classrooms are furnished with the seating capacity of more than 60. All the classrooms are equipped with digital multimedia and computer to facilitate teaching staff to deliver their animated lectures. The teacher's offices are fully furnished with high quality furniture, computer and internet facility. Teachers can also access internet via Wi-Fi using their Laptops, Palmtops, tablets and smartphones.

Adequacy of the classrooms

There are four classrooms in the premises of the department, i.e. one for each class/batch. The classrooms are properly ventilated and are equipped with multimedia projector and a Computer.

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.

- The faculty members are offered and paid the salary packages as decided by the govt. pay scales. In addition, the University teachers are offered various allowances including medical allowance, conveyance allowance, orderly allowance, and senior post allowance. Apart from this, University also offers reimbursement of hospital bills and vaccination charges. Furthermore, University allots a residential plot, measuring 600 yards in its housing society, to each faculty member.

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

There are **3 students currently enrolled in PhD program of Biomedical Engineering**, the year-wise details of the postgraduate enrollment are given in table 1.3.

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

The following are the details of the budget earmarked by the University for Library, laboratory consumables, and purchase of laboratory equipment.

The Mehran University of Engineering & Technology Library & Online Information Center contains more than 154000 books related to Engineering Science and Technology. Access to 29 E-databases for electronics journals and e-books are available on-line within the university campus and outside the campus under Digital Library Program; a Project of Higher Education Commission, most of these resources are available full text.

There are more than 22000 text books in the Book Bank which are loaned to students for one term on nominal rent. The collection of books is updated continuously and new books are acquired on the recommendations of experienced faculty members, which makes collection most suited and beneficial to graduate and under-graduate students. In addition, latest reference and other books are also acquired every year to keep the users of the library abreast with the latest information on Science & Technology specially engineering and its allied subjects.

In addition to providing the readers with in-house collection, services are also provided for inter-library loan and photocopying of literature including technical information centers within and outside Pakistan. This service is further enhanced by cooperation among Muslim Countries under COMSTECH.

The Mehran University of Engineering & Technology Library & Online Information Center also offers following services:

- In MUET Library & Online Information Center students and faculty members are also provided internet facility for their research project, assignments and online lecturers work for which PCs are installed in the Online Information Center of the library for access of students.
- MUET Library provides the facility of Multimedia & Research Development Center, which include softcopy of books, CD/DVD Writing, Scanning and printing to students, faculty members and researchers. Multimedia & Research Center also provide space for researcher with I-7 Computer (Wireless Headphones; Hi Fi Audio system) connected with Wi-Fi Networks. Full access of HEC Digital Library provided possible assist to create bibliography of work electronically (zotero, Endnote). In Multimedia & Research development Center research articles and e-books are provided to the faculty members and students on their demands.
- The MUET library offer the trainings program regarding awareness of HEC digital library resources e-brary, science direct and IEEE to the students of all faculties of University.

- There are also a blogs <http://muetfacultycoordination.blogspot.com> to give the access of books recommended in teaching plan. Another blog <http://www.muetoic.blogspot.com> to give the awareness trainings regarding HEC Digital Library, <http://muetdigitalibrary.blogspot.com> access of E-books, Journals, Tutorials and Thesis's Guidance, video lectures, dictionaries and encyclopedias etc.
- The Catalog of books is computerized and accessible the library of Congress gateway <http://www.loc.gov/z39.50> serving one point access interface for books catalog, full text electronic journals and e-books on web.
- The MUET Library & Online Information Center also offered Wi-Fi service in whole Library inside/outside Building.

The library is heavily used by the students, faculty members and researchers and is open from 8:00 am to 12:00 Mid-night and also on Saturday and Sunday Professional staff available at service points to meet the needs of the readers. Besides this under library system program the seminar libraries have been established in various institutes/departments.

S. No.	Allocation Year	Allocation	
		BME	IICT
1	2018-19	Rs. 348,976/-	Rs. 356,976
2	2019-20	Rs. 351,906/-	Rs. 359,904

Subscription of Journals

1. INTERNATIONAL JOURNAL OF BIO MEDICAL ENGINEERING AND TECHNOLOGY

Appendix-I

List of Publications

S. No.	Publication
1	Hou, G., M. M. Surhio , H. Ye, X. Gao, Z. Ye, J. Li and M. Ye (2019). "Protective effects of a <i>Lachnum</i> polysaccharide against liver and kidney injury induced by lead exposure in mice." <i>International journal of biological macromolecules</i> 124 : 716-723. (SCI, IF 3.67)
2	Surhio, M. M. , Li, J., & Ye, M. (2019). Health-promoting potential of derivatized fungal polysaccharides: a review. In progress (SCI journal).
3	Wang, Y., Hou, G., Li, J., Surhio, M. M. , & Ye, M. (2018). Structural characterization, modification through carboxymethylation and sulfation, and in vitro antioxidant and hypoglycemic activities of a polysaccharide from <i>Lachnum sp.</i> <i>Process Biochemistry</i> , 72 , 177-187 (SCI, IF 2.49)
4	Surhio, M. M. , Wang, Y., Xu, P., Shah, F., Li, J., & Ye, M. (2017). Antihyperlipidemic and hepatoprotective properties of selenium modified polysaccharide from <i>Lachnum sp.</i> <i>International Journal of Biological Macromolecules</i> , 99 , 88-95. (SCI, IF 3.67)
5	Surhio, M. M. , Wang, Y., Fang, S., Li, J., & Ye, M. (2017). Anti-fatigue activity of a <i>Lachnum</i> polysaccharide and its carboxymethylated derivative in mice. <i>Bioorganic & Medicinal Chemistry Letters</i> . 27 (2017), 4777-4780. (SCI, IF 2.45).
6	Jing, L., Zong, S., Li, J., Ye, M., Surahio, M. , & Yang, L. (2017). Potential mechanism of protection effect of exopolysaccharide from <i>Lachnum</i> YM406 and its derivatives on carbon tetrachloride-induced acute liver injury in mice. <i>Journal of Functional Foods</i> , 36 , 203-214. (SCI, IF 3.14)
7	Zong, S., Wu, Y.n., Yang, L., M Surhio, M. , & Ye, M. (2016). Ferrous Ion Chelating Modification and Treatment of Iron-Deficiency Anemia of Exopolysaccharide from <i>Lachnum sp.</i> <i>Current Chemical Biology</i> , 10 (2), 109-116. (SCI, IF 0.67)
8	Jing, L., Zong, S., Li, J., Surhio, M. M. , & Ye, M. (2016). Purification, structural features and inhibition activity on α -glucosidase of a novel polysaccharide from <i>Lachnum</i> YM406. <i>Process Biochemistry</i> , 51 (10), 1706-1713. (SCI, IF 2.49)
9	Du, Z., Zong, S., Surhio, M. M. , Xu, P., Yang, L., & Ye, M. (2016). Structural characterization and anti-hypoxia activity of an exopolysaccharide isolated from fermentation broth of <i>Lachnum sp.</i> <i>Process Biochemistry</i> , 51 (9), 1290-1298. (SCI, IF 2.49)
10	Du, Z., Shi, F., Liu, D., Ye, H., Surhio, M. M. , Li, J., & Ye, M. (2016). Anticoagulant activity of a sulfated <i>Lachnum</i> polysaccharide in mice with a state of hypercoagulability. <i>Bioorganic & Medicinal Chemistry Letters</i> , 26 (22), 5550-5556. (SCI, IF 2.45)
11	Chen, T., Wang, Y., Li, J., Su, N., Surhio, M. M. , Yang, L., & Ye, M. (2016). Phthaloyl modification of a polysaccharide from <i>Lachnum</i> YM262 and immunomodulatory activity. <i>Process Biochemistry</i> , 51 (10), 1599-1609. (SCI, IF 2.49)
12	Chen, T., Zhang, M., Li, J., Surhio, M. M. , Li, B., & Ye, M. (2016). Structural characterization and hypoglycemic activity of Trichosanthes peel polysaccharide. <i>LWT-Food Science and Technology</i> , 70 , 55-62. (SCI, IF 2.32)

S. No.	Publication
13	He, Y., Ye, M., Jing, L., Du, Z., Surahio, M., Xu, H., & Li, J. (2015). Preparation, characterization and bioactivities of derivatives of an exopolysaccharide from Lachnum. <i>Carbohydrate Polymers</i> , 117, 788-796. (SCI, IF 4.81)
14	Ullah MG, Chowdhary BS, Rajput AQ, Baloch AK, Ursani AA , Latif S. Wireless body area sensor network authentication using voronoi diagram of retinal vascular pattern. <i>Wireless personal communications</i> . 2014 Jun 1;76(3):579-89.
15	Ursani, Z., Ursani, A. A. , & Corne, D. W. (2015). A Mass Balancing Theorem for the Economical Network Flow Maximisation. <i>International Journal of Computer Networks & Communications (IJCNC)</i> Vol, 7. No.6, November 2015, DOI: 10.5121/ijcnc.2015.7602.
16	Memon, I., Ursani, A. , Bohyo, M. and Chandio, R. (2019). Automated Diagnosis of Glaucoma using Deep Learning Architecture. <i>Engineering Science and Technology International Research Journal (ESTIRJ)</i> , 3(4), pp.58-62.
17	Rajper, S., Ursani, A. and Moorat, S. (2019). Automatic Diagnosis of Diabetic Retinopathy Using Morphological Operations. <i>International Journal of Sciences: Basic and Applied Research (IJSBAR)</i> , 48(3), pp.213-223.
18	Syed Amjad Ali , Amir Mahmood Soomro, Arbab Nighat Khizer , Syed Zain U Abydin, Awais Yasin "Position-Position Difference Based Haptic Force Feed-back Robotic Control System" <i>Sindh Univ. Res. Jour. (Sci. Ser.)</i> Vol.47 (4 DEC) 717-722 (2015)
19	Syed Amjad Ali , Amir Mahmood Soomro, Arbab Nighat Khizer , Syed Zain U Abydin "Six Degree of Freedom (6-DOF) Force Sensor Based Haptic Force Feedback Robotic System" <i>Sindh Univ. Res. Jour. (Sci. Ser.)</i> Vol.47 (3 SEPT) 425- 430 (2015)
20	Syed Amjad Ali , Amir Mahmood Soomro, Arbab Nighat Khizer "Design, Implementation and Testing of Master Slave Robotic Surgical System" , <i>Mehran University Research Journal of Engineering & Technology</i> , vol 34, No 1 (JAN) ,82-91 2015
21	Arbab Nighat Khizer, Amir Mahmood Soomro, Syed Amjad Ali "A Hybrid Flight Control for a Simulated Raptor-30 V2 Helicopter" , <i>Mehran University Research Journal of Engineering & Technology</i> , Vol 34, No 2 (APRIL) , 178-182 ,2015.
22	Soomro Amir Mahmood, Amjad Ali Syed , Shahnawaz Farhan Khahro, Xiaozhong Liao, and Farhan Manzoor. "A Stable Control Strategy for Input-Series Output-Series Connected Boost half Bridge DC-DC Converter." <i>TELKOMNIKA Indonesian Journal of Electrical Engineering</i> 12, no. 1 (2014): 72-79.(Accession number: 14156055)
23	Soomro, Amir Mahmood, Amjad Ali Syed , Khizer Arbab Nighat "An Isolated Boost-Three Level Bi-directional DC-DC Converter with Phase Shift PWM" <i>Sindh Univ. Res. Jour. (Sci. Ser.)</i> Vol.47 (2 JUNE) 195-198 (2015)
24	Soomro, Amir Mahmood, Khizer Arbab Nighat, Amjad Ali Syed "Multiphase Boost-Half-Bridge DC-DC converter and its Working Mode Analysis" <i>Sindh Univ. Res. Jour. (Sci. Ser.)</i> Vol.47 (2 JUNE) 247- 250 (2015)

S. No.	Publication
25	Soomro, Amir Mahmood, Amjad Ali Syed , Khizer Arbab Nighat “FPGA Based Control Strategy for Three phase DC-DC converter” Sindh Univ. Res. Jour. (Sci. Ser.) Vol.47 (3 SEPT) 595- 598 (2015)
26	Kong, Xiangzhan, Xingguang Duan, Amjad Ali Syed , Yonggui Wang, and Ping Li. "Needle Intervention Robot-Assisted Driving System with Augmented Haptic Force Feedback Facility." In <i>2018 IEEE 8th Annual International Conference on CYBER Technology in Automation, Control, and Intelligent Systems (CYBER)</i> , pp. 276-281. IEEE, 2018.
27	Junaid Rajput1, Abdul Rahim Ansari , Syed Amjad Ali , Designing Prototype of Electronic Sudometer for Qualitative Analysis of Hyperhidrosis, International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429 Volume 8 Issue III Mar 2020 .
28	Ali, F., Shaikh, F.K., Ansari, A.Q. , Mahoto, N.A. and Felemban, E., 2015. Comparative analysis of VANET routing protocols: On road side unit placement strategies. <i>Wireless Personal Communications</i> , 85(2), pp.393-406.(I.F:2.0)
29	Bohra, N., Kalwar, S., Ansari, A.Q. and Kotwal, S., 2016. Analyzing the QoS Parameters in Manet for Proactive, Reactive and Hybrid Routing Protocol Using NS-2. <i>Bahria University Journal of Information & Communication Technology</i> , 9, p.24.
30	Ansari, A.Q. , Memon, A.L. and Shaikh, F.K., 2016. Application Specific Scheduling in WiMAX: Ensuring QoS in Application Mix Environment. <i>Bahria University Journal of Information & Communication Technologies</i> , 9(S), pp.35-40.
31	Ansari, A.Q. , Memon, A.L. and Qureshi, I.A., 2016. Optimizing WiMAX: Mitigating Co-Channel Interference for Maximum Spectral Efficiency. <i>Mehran University Research Journal of Engineering and Technology</i> , 35(4), pp.645-656.
32	Hussain, A., Memon, A.L. and Ansari, A.Q. , 2017. A Symmetric RZ-DPSK Based Colorless NG-PON using Optical Carrier Suppression Scheme. <i>Mehran University Research Journal of Engineering and Technology</i> , 36(1), pp.129-138.
33	Rind, M.M., Qureshi, I.A. and Ansari, A.Q. , 2017. Measuring the role of trust in m-commerce acceptance: An empirical analysis in context of Pakistan. <i>Mehran University Research Journal of Engineering and Technology</i> , 36(2), pp.321-332.
34	Salman ul Mouzam Abbasi, Muhammad Daud, Salman Ali and Abdul Qadir Ansari , “Design of Android-Based Remote Patient Monitoring System” <i>International Journal of Advanced Computer Science and Applications(ijacsa)</i> , 9(6), 2018.
35	Jabeen, S., Qadir, A. , Tufail, B. and Ahmed, S., 2018, Diagnostic Accuracy of A/A ratio and A/G ratio for noninvasive prediction of Esophageal Varices in patinets of Cirrhosis with Hepatitis B and C, <i>JSZMC</i> ,9(3),pp.1476-1479.
36	Ansari AQ , Ansari SJ, Khan MQ, Khan MF, Qureshi UA, Khatri Z, Ahmed F, Kim IS. Electrospun Zein nanofibers as drug carriers for controlled delivery of Levodopa in Parkinson syndrome. <i>Materials Research Express</i> . 2019 Apr 17;6(7):075405.(I.F:1.9)

S. No.	Publication
37	Saleem, M., Saleem, U., Ansari, A.Q. , Ahmed, F., Khatri, Z. and Kim, I.S., 2019, September. Synthesis and Release of Ibuprofen Loaded Zein/Gelatin Nanofiber Scaffolds for Potential Application in Burn Wounds. In International Symposium on Advances in Metallurgy & Materials (p. 1). Pakistan Institute of Engineering and Applied Sciences.
38	M. Arif , M. A. Ali, M. M. Shaikh, and S. Freear, "Investigation of Nonlinear Chirp Coding for Improved Second Harmonic Pulse Compression", Journal of Ultrasound in Medicine and Biology, Vol-43, Issue-08, pp. 1690-1702, August, 2017.
39	S. Kalhoro, A. Baqai, and M. Arif , "Design of a Low Cost Health Status Indication Device using Skin Conductance Technique", Sindh University Research Journal (Science Series), Vol-49, Issue-02, pp. 309-316, June, 2017.
40	M. Arif , M. A. Samejo, and Farida Memon, "Use of Nonlinear Frequency Modulated Signals for the Enhancement of Subharmonic Response from Contrast Microbubbles", Mehran University Research Journal of Engineering & Technology, Vol-36, Issue-01, pp. 183-192, January, 2017.
41	M. A. Ali, M. Arif , and W. Kumar, "Joint CIR, CFO, DCO and FI/FS Rx IQ Imbalance Estimation", IET Communications, The Institution of Engineering and Technology, Vol-10, Issue-15, pp. 2025-2033, October, 2016.
42	F. Memon, F. Jameel, M. Arif , and F. A. Memon, "Model Based FPGA Design of Histogram Equalization", Sindh University Research Journal (Science Series), Vol-48, Issue-02, pp. 435-440, March 2016.
43	Ansari, Abdul Rahim , and Sunghyun Cho. "Efficient Power Allocation based on CHESS-PC for Energy-efficient Public Safety Networks." <i>IEIE Transactions on Smart Processing & Computing</i> 7, no. 6 (2018): 467-477.
44	Ansari, Abdul Rahim , and Sunghyun Cho. "CHESS-PC: Cluster-HEad selection scheme with power control for public safety networks." <i>IEEE Access</i> 6 (2018): 51640-51646.
45	Ansari, Abdul Rahim , Nasir Saeed, Mian Imtiaz Ul Haq, and Sunghyun Cho. "Accurate 3D localization method for public safety applications in vehicular ad-hoc networks." <i>IEEE Access</i> 6 (2018): 20756-20763.
46	Ansari , Muhammad Adil, Umair Saeed Solangi, Mohsin Shaikh, Kashif Hussain Memon, Shafiullah Soomro, and Abdul Rahim Ansari . "A Framework for Non-Contact Wafer Level Testing of Wireless NoC-based SoCs." <i>International Journal of Applied Engineering Research</i> 12, no. 20 (2017): 9459-9466.
47	Ansari, Muhammad Adil, Abdul Rahim Ansari , Jinuk Kim, and Sungju Park. "Enabling test/diagnosis of automotive semiconductor chips through FlexRay network." In <i>2017 International Conference on Electrical and Computing Technologies and Applications (ICECTA)</i> , pp. 1-5. IEEE, 2017.

Appendix -II

Curriculum

MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO
DEPARTMENT OF BIOMEDICAL ENGINEERING

Course Title	: Array Signal Processing	Course Code: BM800
Disciplines	: Biomedical Engineering	
Semester	: 1 st / 2 nd (Elective)	
Effective	: 18PhD IICT Batch onwards	
Credit Hours	: TH: 03 PR: 00	
Min. Contact Hours	: TH: 42 PR: 00	
Maximum Marks	: TH: 100 PR: 00	
Assessment	: Sessional: 10% Mid-Sem. Exam: 30% End-Sem. Exam: 60%	

AIMS

To impart the knowledge of working principles and performance analysis of smart actuators in Biomedical engineering.

Objectives

Upon successfully completing this course, students will be able to:

1. Formulate problems in electromagnetics, acoustics, and seismology as a task of Array Signal Processing.
2. Apply a suitable techniques of beamforming to a given application.

CONTENTS

Fixed Beamforming

Signal Model and Problem formulation, Linear Array Model, Performance Measures, Spatial Aliasing, Fixed beamformers, Delay and sum, Maximum DF, Superdirective, Null Steering, A signal subspace perspective, Joint Diagonalization, Tradeoff between WNG and DF

Adaptive Beamforming

Signal Model, Problem Formulation, and Array Model, performance measures, Adaptive beamformers, Wiener, MVDR, Tradeoff, Maximum Array Gain, LCVM,

Differential Beamforming

First-order Design, Second-order, Third order design, General Order, Minimum norm beamformers, Hypercardioid, Supercardioid

Beam Pattern Design

Nonrobust approach, Robust approach, Frequency invariant beam pattern design, Least-Squares method, Joint optimization

Recommended Books

1. Jacob Benesty, Israel Cohen, Jingdong Chen, Fundamentals of Signal Enhancement and Array Signal Processing, (Wiley - IEEE), Latest Edition
-

Approval:	Board of Studies	Res. No. 20.4	Dated: 14-02-2019
	Advanced Studies and Research Board	Res. No. 159.07	Dated: 11-06-2019
	Academic Council	Res. No.	Dated:

MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO
DEPARTMENT OF BIOMEDICAL ENGINEERING

Course Title	: Ultrasound and Biological Medium	Course Code: BM810
Disciplines	: PhD (Biomedical Engineering)	
Semester	: 1 st	
Effective	: 19 Batch onwards (Elective)	
Credit Hours	: TH: 03 PR: 00	
Min. Contact Hours	: TH: 42 PR: 00	
Maximum Marks	: TH: 100 PR: 00	
Assessment	: Sessional: 10% Mid-Sem. Exam: 30% End-Sem. Exam: 60%	

AIMS

To impart fundamental knowledge in acoustics, including wave equation, and propagation in a biological medium.

Objectives

Upon successfully completing this course, students will be able to:

3. Formulate the wave propagation of sound waves under different conditions and in different media.
4. Model the interaction of sound waves with a biological medium.

CONTENTS

Wave Equation

Wave Equation, Fundamental Equations for an Ideal Fluid, Small-Amplitude 1D Acoustic Wave Equation, 3D Wave Equation, Velocity Potential, Speed of Sound, Acoustic Impedance, Solution of Wave Equation, Spherical Waves, Cylindrical Waves, Wave in Solid

Sound Reflection, Refraction, and Transmission

Acoustic Energy and Intensity, Sound Pressure and Intensity Level, Boundary Conditions, Normal Incidence, Oblique Incidence, Middle Layer Transmission

Acoustic Field and Wave Radiation

Acoustic Interference, Acoustic Wave Radiation, Transducer Field, Array Transducer Field

Acoustical Properties of Biological Tissue

Cell and Tissue, Acoustic Attenuation, Wave Equation with Attenuation, Viscosity Relaxation, Attenuation Measurement

Recommended Books

1. Yufeng Zhou, Principles and Applications of Therapeutic Ultrasound in Healthcare, CRC Press, Latest Edition
2. Ayache Bouakaz, Therapeutic Ultrasound, edited by Jean-Michel Escoffre, Springer, Latest Edition

Approval:	Board of Studies	Res. No. 20.4	Dated: 14-02-2019
	Advanced Studies and Research Board	Res. No. 159.07	Dated: 11-06-2019
	Academic Council	Res. No.	Dated:

MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO
DEPARTMENT OF BIOMEDICAL ENGINEERING

Title of Subject	: Therapeutic Ultrasound	Course Code: BM820
Disciplines	: PhD (Biomedical Engineering)	
Semester	: 2 nd	
Effective	: 19 Batch onwards (Elective)	
Credit Hours	: TH: 03 PR: 00	
Min. Contact Hours	: TH: 42 PR: 00	
Maximum Marks	: TH: 100 PR: 00	
Assessment	: Sessional: 10% Mid-Sem. Exam: 30% End-Sem. Exam: 60%	

AIMS

To confer knowledge on the emerging technologies of ultrasound therapy, their clinical trials, the challenges in the therapeutic applications of ultrasound.

Objectives

Upon successfully completing this course, students will be able to:

1. Explain the role of ultrasound in physiotherapy, thermometry, lithotripsy, and drug delivery.

CONTENTS

Ultrasonic Physiotherapy

Introduction, System Structure and Treatment Protocol, Mechanisms and Bioeffects, Clinical Trials

Hyperthermia

Rationale of Hyperthermia, Effect of Thermal Conduction and Blood Perfusion, Ultrasound Hyperthermia Technology, Thermometry, Treatment Planning and Control, Ultrasound Hyperthermia-Induced Effects, Clinical Outcome, Combination with Radiation, Hyperthermia-Mediated Drug Release

Shock Wave Lithotripsy and Treatment

Kidney Stone Disease and SWL History, Development, Limitations in Renal Injury and Stone Fragmentation, Technology and Measurement, Mechanisms of SWL: Stone Fragmentation and Renal Injury, Technical Improvement, Shock Wave Therapy

High-Intensity Focused Ultrasound

Introduction, History of HIFU, Advantages of HIFU, System Structure and Operation, Mechanism of HIFU, HIFU Monitoring and Control, Clinical Applications, Clinical Experience, HIFU-Related Therapeutic Methods

Ultrasound-Mediated Drug Delivery/Gene Transfection

Introduction, Drug/Gene Delivery Approach, Acoustically Active Drug Vehicles, Sonoporation, Targeted Drug Delivery for Cancer, Gene Therapy, Sonophoresis, Sonothrombolysis, Drug Delivery across the Blood-Brain Barrier (BBB), Sonodynamic Therapy

Recommended Books

1. Yufeng Zhou, Principles and Applications of Therapeutic Ultrasound in Healthcare, CRC Press, Latest Edition
 2. Ayache Bouakaz, Therapeutic Ultrasound, edited by Jean-Michel Escoffre, Springer, Latest Edition
-

Approval:	Board of Studies	Res. No. 20.4	Dated: 14-02-2019
	Advanced Studies and Research Board	Res. No. 159.07	Dated: 11-06-2019
	Academic Council	Res. No.	Dated:

MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO
DEPARTMENT OF BIOMEDICAL ENGINEERING

Course Title	: Non-linear Acoustics and Ultrasound	Course Code: BM830
Disciplines	: PhD (Biomedical Engineering)	
Semester	: 2 nd	Effective: 19 Batch onwards (Elective)
Pre-Requisite	: Ultrasound and Biological Medium (BM810)	
Credit Hours	: TH: 03 PR: 00	
Min. Contact Hours	: TH: 42 PR: 00	
Maximum Marks	: TH: 100 PR: 00	
Assessment	: Sessional: 10% Mid-Sem. Exam: 30% End-Sem. Exam: 60%	

AIMS

To impart advanced knowledge in acoustics, including nonlinear wave equation, measurement of nonlinearity, cavitation, and transducer design for the applications in Biomedical Engineering.

Objectives

Upon successfully completing this course, students will be able to:

2. Formulate the nonlinear wave propagation and interaction of sound waves at different frequencies and amplitudes.
3. Explain cavitation, its measurement and its effects
4. Design and calibrate different kinds of transducers for various applications

CONTENTS

Nonlinear Acoustics

Nonlinear Dynamic Equation, Nonlinear Equation of State, Nonlinearity Parameters, Nonlinear Acoustic Wave Propagation, Interaction of Finite-Amplitude Sound Waves, Interaction of Sources at Different Frequencies, Propagation of Finite-Amplitude Wave in Viscous Medium, Measurement of Nonlinearity B/A

Cavitation

Nucleation, Cavitation Threshold, Rectified Diffusion, Bubble Dynamics, Cavitation Effects, Cavitation Measurement

Transducer

Piezoelectricity, Equivalent Circuit, Transducer Design, Capacitive Transducer, Transducer Array

Acoustic Field Calibration and Measurement

Acoustic Pressure Measurement, Radiation Force Balance, Calorimeter, Holography, Interferometric Measurement, Field Mapping Using Vibrometer, Schlieren Imaging, Light Diffraction Tomography, Light Scanning of Ultrasound Field, Time-Delay Spectrometry
Infrared Thermography

Recommended Books

3. Yufeng Zhou, Principles and Applications of Therapeutic Ultrasound in Healthcare, CRC Press, Latest Edition
 4. Ayache Bouakaz, Therapeutic Ultrasound, edited by Jean-Michel Escoffre, Springer, Latest Edition
-

Approval:	Board of Studies	Res. No. 20.4	Dated: 14-02-2019
	Advanced Studies and Research Board	Res. No. 159.07	Dated: 11-06-2019
	Academic Council	Res. No.	Dated:

MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO
DEPARTMENT OF BIOMEDICAL ENGINEERING

Title of Subject	: Medical Robotics	Course Code: BM840
Disciplines	: Ph.D. in Biomedical Engineering	
Semester:	: 1 st	
Effective	: 19 Batch onwards (Elective)	
Credit Hours	: TH: 03 PR: 00	
Min. Contact Hours	: TH: 42 PR: 00	
Maximum Marks	: TH: 100 PR: 00	
Assessment	: Sessional: 10% Mid-Sem. Exam: 30%	End-Sem. Exam: 60%

AIMS

To understand the importance and potential applications of robotics in the medical or paramedical fields, acquire the fundamental Knowledge, Characteristics, State of the art surgeries, interactive modeling/design and Force Feedback Control.

Objectives

Student will be able to solve mathematically the position and orientation of objects and the relationship between robot joint coordinates and tool position, Outline the current state, types, rolls of medical robots, advantages/disadvantages of various mechanisms, and difficulty in force sensing for them.

CONTENTS

Characteristics of Medical Robotics and State of the Art

Introduction, Characteristics of medical robotics, Potential advantages of using a robot in a medical procedure, State of the art in Surgery of the head and neck, Orthopedic surgery, Mini-invasive or laparoscopic surgery, Interventional radiology and percutaneous procedures, Remote ultrasound Radiotherapy and radiology

Design of Medical Robots

Introduction, From the characterization of gestures to the design of robots, Analysis of the gesture, Kinematic and dynamic specifications, Kinematic choices, Design methodologies, Concept selection, Optimization of design parameters, Technological choices, Actuators, Sensors, Material, Security and dependability, Risks reduction in medical robotics

Interaction Modeling and Force Control

Modeling interactions during medico-surgical procedures, Properties of tissues with small displacements, Non-viscoelastic models, Estimation of force models, Case study: needle-tissue interactions during a percutaneous intervention, Force control, Force control strategies, Implicit force control, Explicit force control, Stability, Choice of a control architecture, Application examples

Recommended Books

1. Medical Robotics, Jocelyne Troccaz, iSTE Ltd, John Wiley & sons Inc, Latest Edition
 2. Robotics, Vision and Control, Fundamental Algorithms in MATLAB, Peter Corke, Springer-Verlag Berlin, Latest Edition
 3. Medical Robotics: Minimally Invasive Surgery, Paula Gomes, Latest Edition
-

Approval:	Board of Studies	Res. No: 20.4	Date: 14-02-2019
	Advanced Studies and Research Board	Res. No. 159.07	Dated: 11-06-2019
	Academic Council		

MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO
DEPARTMENT OF BIOMEDICAL ENGINEERING

Title of Subject	: Functional Foods and Nutraceuticals	Course Code: BM850
Disciplines	: PhD (Biomedical Engineering)	
Semester	: 1 st	
Effective	: 19 Batch onwards (Elective)	
Credit Hours	: TH: 02 PR: 00	
Min. Contact Hours	: TH: 28 PR: 00	
Maximum Marks	: TH: 50 PR: 00	
Assessment	: Sessional: 10% Mid-Sem. Exam: 30% End-Sem. Exam: 60%	

CONTENTS

Phytonutrients and their classification, Sources of biomolecules: cereals, herbs/spices, fruits/vegetables, animal and dairy products, Functional role of active ingredients and their allied health benefits, Technologies and processing operations in the extraction of functional ingredients, Designer food formulations; antioxidants, dietary fiber, prebiotics & probiotics, mineral & vitamins, Diet based therapies against metabolic diseases, Efficacy of functional foods and nutraceutical products, Safety and regulatory issues, Consumer acceptance regarding nutrified foods, Microencapsulation and nanotechnology in nutraceuticals delivery system. Emerging trends and technologies

Recommended Readings

1. Pathak, Y.V., Handbook of nutraceuticals. volume ii: scale-up, processing and automation. CRC Press Inc, USA, Latest Edition
 2. Tiwari, B.K., Brunton, N.P. and Brennan, C.S., Handbook of plant food phytochemicals: sources, stability and extraction. John Wiley & Sons, UK, Latest Edition
 3. Ghosh, D., Das, S., Bagchi, D., Samarta, R.B., Innovation in healthy and functional foods. CRC Press, Boca Raton, FL, USA, Latest Edition
-

Approval:	Board of Studies	Res. No. 20.4	Dated: 14-02-2019
	Advanced Studies and Research Board	Res. No. 159.07	Dated: 11-06-2019
	Academic Council	Res. No. _____	Dated: _____

MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO
DEPARTMENT OF BIOMEDICAL ENGINEERING

Title of Subject	:	Recent Advances in Food Science and Technology		
Course Code	:	BM860		
Disciplines	:	PhD (Biomedical Engineering)		
Semester	:	2 nd		
Effective	:	19 Batch onwards (Elective)		
Credit Hours	:	TH: 02	PR: 00	
Min. Contact Hours	:	TH: 28	PR: 00	
Maximum Marks	:	TH: 50	PR: 00	
Assessment	:	Sessional: 10%	Mid-Sem. Exam: 30%	End-Sem. Exam: 60%

CONTENTS

Emerging technologies

Fats and oils, cereals, dairy, beverage, fruits and vegetables and meat industry, Emerging food safety issues, Supercritical fluid extraction, Biofortification, Nanotechnology: Concept and applications, Novel ideas in food packaging, the emerging coating techniques (Electrostatic coating of foods), High pressure processing, Ohmic heating, Membrane processing, Application of ultrasounds and microwaves in food processing, Extrusion technology

Genetically modified foods

Nutritional aspects, safety issues and legislation, Modern quality standards, Microscopic imaging for analysis of micro and nano-structures (colloidal assemblies, polymer interactions etc.) of foods, Recent news in food science and technology

Advances in Food Safety

Trends in food Safety, Principles of Prevention, Risk and Hazard Analysis of Foods, Foodborne Infectious and Microbial Agents, Foodborne Toxic and Physical Agents: physical and chemical contaminants in food and their health impact, Engineering Controls and Technology, Safety Management of the Food Supply, Laboratory Methods for Food Safety foodborne viruses: an emerging risk to health, Biosafety, bioterrorism, Biosolid recycling, mad cow disease. Food safety issues in developing world, Economic impact of food safety

Recommended Books

1. Buttriss, J. and Saltmarsh, S., Functional foods. Royal Society of Chemistry, Cambridge, UK, Latest Edition
 2. Knechtges, P.L., Food safety: theory & practice. Jones & Bartlett Learning, Burlington, M.A. USA., Latest Edition
 3. Food Science and Technology, edited by Geoffrey Campbell-Platt, Latest Edition
 4. Handbook of Food Science and Technology 2: Food Process ..., Volume 2, By Romain Jeantet, Thomas Croguennec, Pierre Schuck, Gérard Brule, Latest Edition
 5. Catherine Saxelby's Complete Food and Nutrition Companion: The Ultimate A-Z ..., By Catherine Saxelby, Latest Edition
-

Approval:	Board of Studies	Res. No. 20.4	Dated: 14-02-2019
	Advanced Studies and Research Board	Res. No. 159.07	Dated: 11-06-019
	Academic Council	Res. No. _____	Dated: _____

MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO
INSTITUTE OF INFORMATION AND COMMUNICATION TECHNOLOGIES

Title of Subject	: Smart Actuators	Course Code: BM870
Disciplines	: Ph.D. in Biomedical Engineering	
Semester	: 2 nd Effective :	19 Batch and onwards (Elective)
Credit Hours	: TH: 03 PR: 00	Min. Contact Hours : TH: 42 PR: 00
Maximum Marks	: TH: 100 PR: 00	
Assessment	: Sessional: 10%	Mid-Sem. Exam: 30% End-Sem. Exam: 60%

Aim: To impart the knowledge of working principles and performance analysis of smart actuators in Biomedical engineering.

Objectives After successfully completing this course, students will be able to:

1. Comprehend working principles of various smart actuators
2. Select appropriate actuators for a medical device/system.
3. Integrate micro-actuators in biomechatronic system

CONTENTS

Smart Actuator Fundamentals

Importance of actuator, smart actuator attributes, transducing materials, concomitant actuation and sensing

Electrostatic Actuators

Functional principles of electrostatic actuators, pull-in phenomenon, constant charge and voltage mode of electrostatic force, comb drive working principles, x- and z- direction motions of comb drive

Shape Memory Alloy (SMA) Actuators

Shape memory effect, pseudo-elasticity, design of SMA actuators, modelling and control of SMA actuators

Piezoelectric Actuators

Piezoelectricity, piezoelectric materials, constitutive modelling of piezoelectric materials, resonant and non-resonant piezoelectric actuators, control of piezoelectric actuators

Soft actuators

Importance of soft actuators in biomedical engineering, fluidic elastomer actuators, dielectric electro-activated polymers, shape morphing polymers

Micro-Actuators

Biological inspiration of micro-Actuators, micro-actuator applications in biomedical engineering, micro-actuators with different energy inputs

Recommended Books

1. Smart Actuator and Sensor Technologies: Design, Modeling, Fabrication, and Control for Mechatronic Systems by Kam K Leang, Kwang J Kim, Latest Edition
2. Soft Actuators: Materials, Modeling, Applications, and Future Perspectives edited by Kinji Asaka, Hidenori Okuzaki, Latest Edition
3. Emerging Actuator Technologies: A Micromechatronic Approach by By José L. Pons, Latest Edition

Approval:	Board of Studies	Res. No: 20.4	Dated: 14-02-2019
	Advanced Studies and Research Board	Res. No. 159.07	Dated: 11-06-2019
	Academic Council	Res. No. _____	Dated:

MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO
DEPARTMENT OF BIOMEDICAL ENGINEERING

Title of Subject : Advanced Machine Learning Course Code: BM880

Disciplines	: PhD (Biomedical Engineering)		
Semester	: 2 nd / 3 rd (Elective)		
Effective	: 19 Batch and onwards (Elective)		
Credit Hours	: TH: 03	PR: 00	
Min. Contact Hours	:	TH: 42	PR: 00
Maximum Marks	: TH: 100	PR: 00	
Assessment	: Sessional: 10%	Mid-Sem. Exam: 30%	End-Sem. Exam: 60%

Course Contents

Introduction

Probability theory, expectations and covariance, the Gaussian distribution, the curse of dimensionality, Decision theory, information theory

Probability Distributions

Binary variables, multinomial variables, the Gaussian distribution, the exponential family, nonparametric methods

Linear Models for Regression

Linear basis function models, the bias-variance decomposition, Bayesian linear regression, Bayesian model comparison, the evidence approximation, limitations of fixed basis functions

Linear Models for Classification

Discriminant functions, two classes, multiple classes, least squares for classification, Fisher's linear discriminant, relation to least squares, Fisher's discriminant for multiple classes, the perceptron algorithm, Fisher's discriminant for multiple classes

Mixture Models and EM

K-means clustering, mixtures of Gaussians, an alternative view of EM, the EM algorithm in general

Continuous Latent Variables

Principal Components Analysis, Probabilistic PCA, kernel PCA, nonlinear latent variables models

Book Recommended

Bishop, Christopher M. "Pattern recognition and Machine Learning"

Approval:	Board of Studies	Res. No. 20.4	Dated: 14-02-2019
	Advanced Studies and Research Board	Res. No. 159.07	Dated: 11-06-2019
	Academic Council	Res. No.	Dated: