

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

Self-Assessment Report

M.E (Biomedical Engineering)

**Department of Biomedical Engineering, MUET
2021**

TITLE OF REPORT

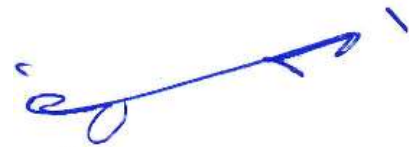
SELF ASSESSMENT REPORT OF M.E. (BIOMEDICAL ENGINEERING) PROGRAM

PROGRAM TEAM (PT) DEPARTMENT OF BIOMEDICAL ENGINEERING

- | | |
|-----------------------------------|---------------------|
| 1. Prof. Dr. Ahsan A. Ursani | Convener |
| 2. Dr. Abdul Qadir Ansari | Focal Person |
| 3. Dr. Syed Amjad Ali | Member |
| 4. Engr. Narinder Persad Chowdhry | Member |

DATE OF FINALIZATION OF REPORT

April 21, 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 supports 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.

Program Mission Statement

To produce biomedical professionals with mastery, high intellect and broad vision who can meet current needs and foresee future needs of the healthcare sector, medical diagnosis and treatment, through research and professional practice.

Program Objectives

The following objectives are formulated for the program to achieve the outcomes set:

1. Design a system/process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
2. To help students identify, formulate, and solve engineering problems.
3. To provide broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
4. Help recognize of the need for, and an ability to engage in lifelong learning.
5. Exhibit knowledge of contemporary issues and use the techniques, skills and modern engineering tools necessary for 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.

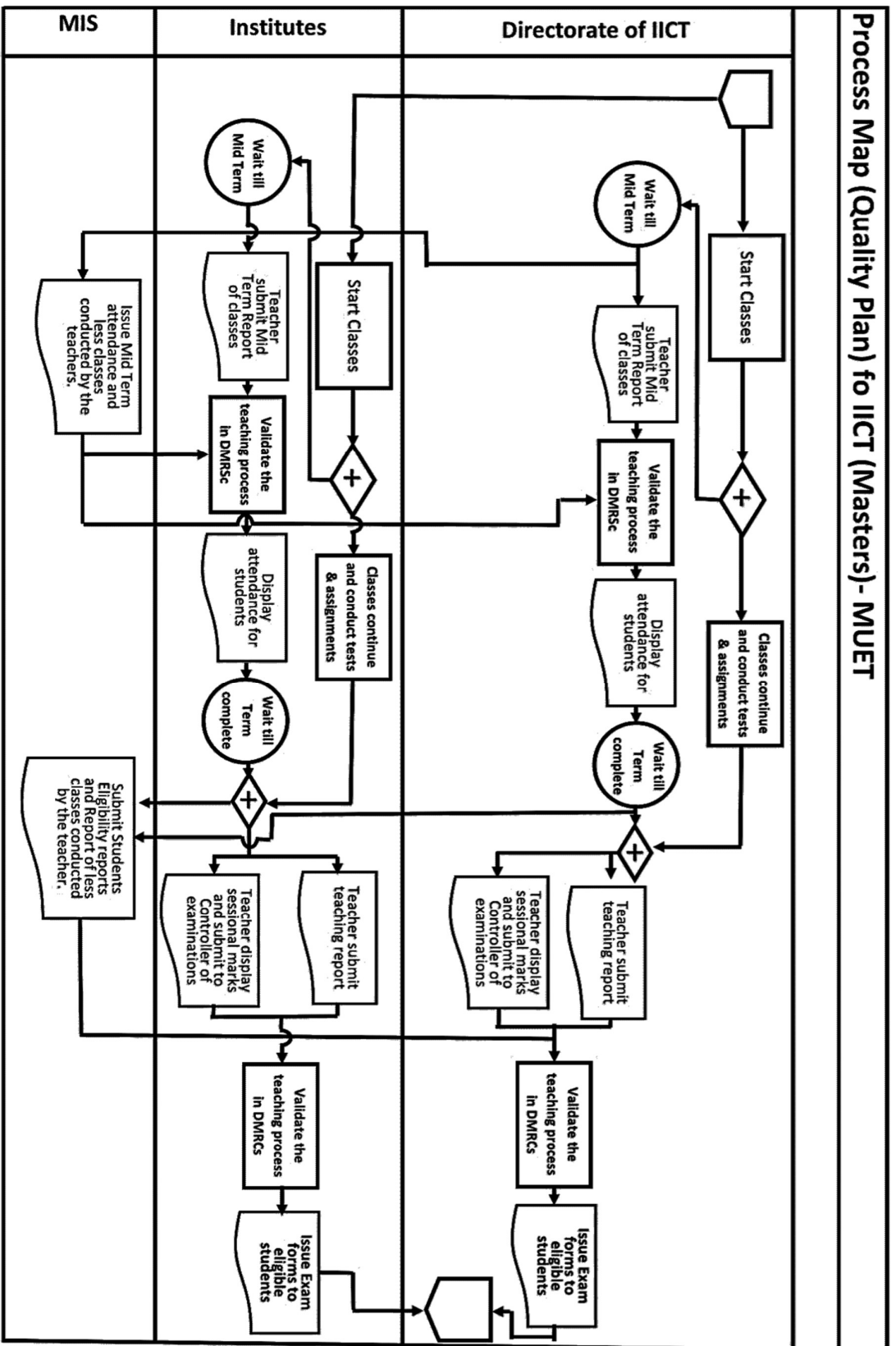
Step-3: Engaging competent teaching / non-teaching and research staff for the program

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) fo IICT (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
1. Design a system /process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	Employer Survey	April, 2020	Strong coordination among the stakeholders (Academia, Industry and Government) is required	Initiated
2. To help students identify, formulate, and solve engineering problems.	Employer Survey	April, 2020	More latest books arranged, related literature and seminars to be arranged.	Initiated
3. To provide broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	Alumnae Survey	April, 2020	Related field visits of various organizations are required.	Initiated
4. Help recognize of the need for, and an ability to engage in lifelong learning.	Alumnae Survey	April, 2020	Trainings by experts in field are required	Initiated
5. Exhibit knowledge of contemporary issues and use the techniques, skills and modern engineering tools necessary for engineering practice.	Alumnae Survey	April, 2020	Trainings by professionals 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 Masters of Engineering degree program that is:

1. To provide advanced training in rapidly evolving field of biomedical engineering
2. To train students to excel in field of telemedicine and e-health- the opportunity.
3. To train our student advanced modeling and simulation tools for Analysis and Design of healthcare solutions
4. To get them familiar with deep learning concepts and signal/image processing
5. To produce experts in the field of medical instrumentation, automation, control, testing and process management as applied in medical practice.
6. To enhance research and analytical abilities of the students and giving research orientation sessions.

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

Sr. No	Program Objective	Program Outcomes					
		1	2	3	4	5	6
1.	Design a system /process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	○	·	·	·	○	○
2.	To help students identify, formulate, and solve engineering problems.	·	·	⊙	⊙	·	·
3.	To provide broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	·	⊙		·	·	·
4.	Help recognize of the need for, and an ability to engage in lifelong learning.	·	·	·	·	·	⊙
5.	Exhibit knowledge of contemporary issues and use the techniques, skills and modern engineering tools necessary for 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.

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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. Based on periodic assessment necessary action will be taken for improvement.

Major future program improvements plan 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. Furthermore, we are in process to formulate training opportunities at PCSIR and KIRAN Karachi for master's students enrolled for M.E (Biomedical Engineering)

List strengths and weaknesses of the program

Department regularly assesses 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 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 ME (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.	17 ME(BME)	12
2.	18ME(BME)	6
3.	19ME(BME)	10
Total		28

List of Faculty Members pursuing PhD Abroad

S. No.	Name of Faculty Member	Name of Scholarship	Country
1	Salman Afridi	China Govt.	China

List of ME Faculty Members

S. No.	Name of Faculty Member	Designation	Degree
1	Dr. Ahsan Ahmed Ursani	Professor	PhD
	Dr. Syed Amjad Ali	Associate Professor	PhD
2	Dr. Abdul Qadir Ansari	Associate Professor	PhD
3	Engr. N. P. Chowdhry	Assist. Professor	MSc
4	Dr. Muhammad Amir Panhwar	Lecturer	PhD
5	Dr. Abdul Raheem Ansari	Lab Instructor	PhD
6	Engr. Rabia Chandio	Assist. Professor	ME

- 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	Electro4192	Ph.D	2008	INSA Rennes, France	Signal and Image Processing	24
			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 Professor 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	Engr. Narinder Parshad Chowdhry Assistant Professor 17-08-1996	Electro4028	MS	2004	Brunel Univ., West London, UK	Telemedicine and E-Health Systems	24
			B.E	1994	Electronics, MUET		
05	Engr. Rabia Chandio Assistant Professor 28-01-2008	BM/ 298	Ph.D.	-	Enrolled	Telemedicine and E-Health Systems	12
			M.E	2015	MUET		
			B.E	2007	MUET		
06	Dr. Maheen Mawish Surahio Assistant Professor 15-01-2019	-	PhD	2017	Hefei Uni Tech	Biotechnology	04
			MS	2011	UoS		
			BS	2008	UoS		
07	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		
08	Engr. Kandeel Khuwaja Lecturer 12-12-2019	BM/ 928				Image Processing	04
			M.E	2018	MUET		
			B.E	2014	MUET		
09	Dr Abdul Rahim Ansari Lab Instructor 08-02-2013	BM/ 727	Ph.D	2019	Hanyang University, South Korea	Telemedicine	06 months (07)
			B.E	2013	MUET	EMG Analysis	
10	Engr. Sarah Khuwaja Research Associate 21-09-2020	BM/ 1717	M.S	2020	Queen Mary University of London, England	Control Systems	2
			B.E	2018	MUET		

List of Ph.D. / M.E 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 Dowoodpota	Professor	Ph.D.

STUDENTS-TEACHERS

No of Students:	28
Dedicated Faculty:	10
Sharing Faculty:	02
Total Faculty	10+2=12
Student - Faculty Ratio	1:3

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:

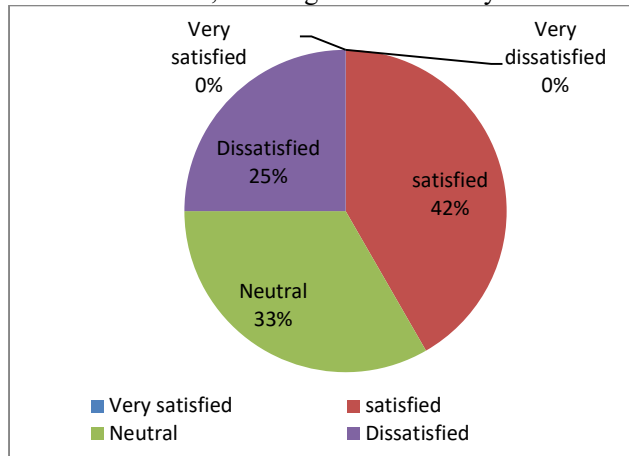
Table 1.4: Details of the Workshops / Seminars organized

S. No.	Title of the Workshop/Conference	Place	Date
1	Turnitin Orientation Workshop: Awareness Session	Dept. of BM Engineering	19-Jan-15
2	Bioinformatics: Computer Applications in Healthcare and Biomedicine	Dept. of BM Engineering	27-Feb-15
3	Inter-Departmental Hardware / Software based project competition	Dept. of BM Engineering	16-Apr-15
4	2-day workshop on "Arduino Microcontroller	Dept. of BM Engineering	19-Aug-15
6	One-day interactive session in the field of biomedical engineering with field expert Career Counseling and Opportunities for Engineers in Canada	M.D Makhdoom Hall, MUET Video Conferencing Hall, IIT	19-Oct-15 31st March 2016
7	Workshop on LabVIEW Certification Preparation	Dept. of BM Engineering	10th February 2017
8	SMART ideas in BME – STUDENT PROJECTS	Dept. of BM Engineering	10th March 2017
9	2-Day Evening Workshop on Programming A System on Chip with Bluetooth Low Energy.	Dept. of BM Engineering	20-21 Feb 2018
10	Futuristic Solutions in Biomedical Engineering	Dept. of BM Engineering	4/2/2018
11	Poster & Project Competition 2019	Dept. of BM Engineering	2/4/2019
12	Mechatronics with Arduino	Dept. of BM Engineering	23-25 April 2019
13	Basics of Arduino	Dept. of BM Engineering	1/1/2020

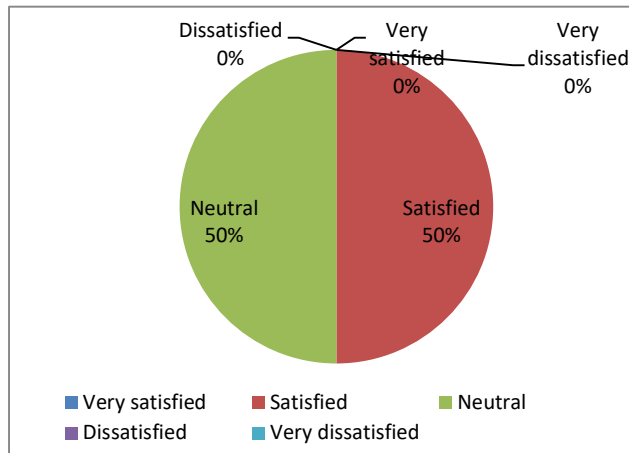
D. Faculty Satisfaction

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

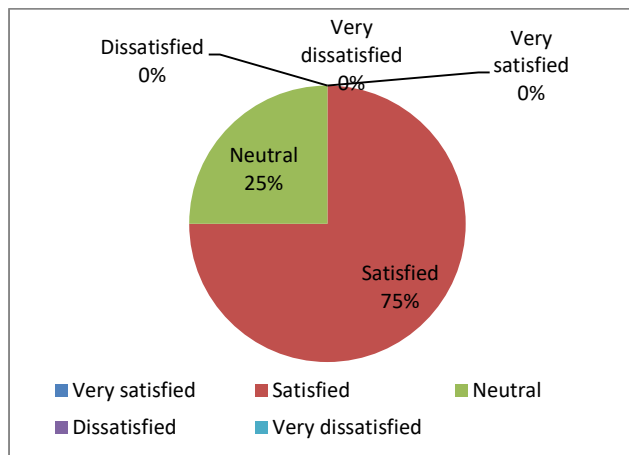
1. Your mix of research, teaching and community service



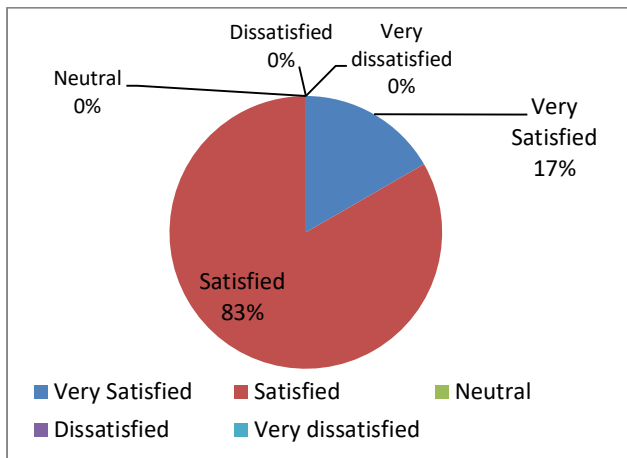
2. The intellectual stimulation of your work



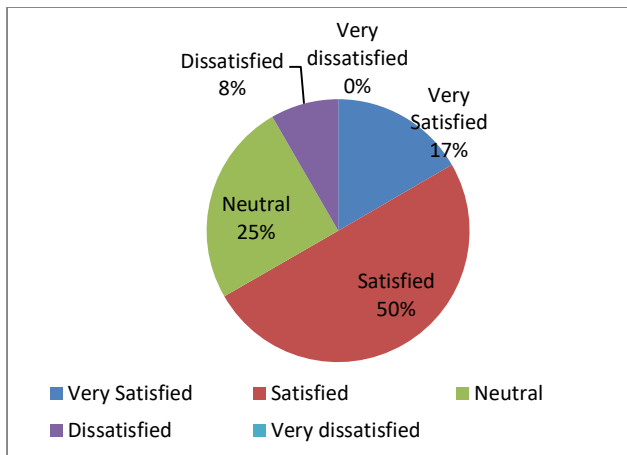
3. Type of teaching/research you currently do



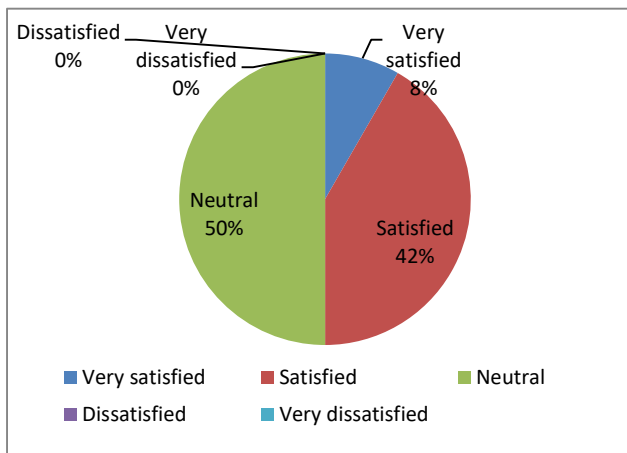
4. Your interaction with students



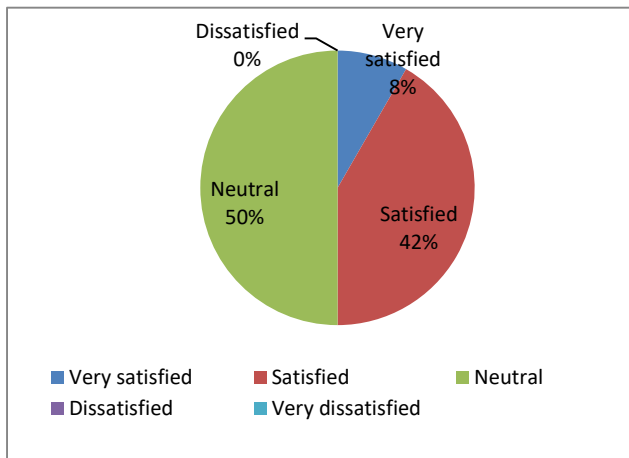
5. Cooperation you receive from colleague



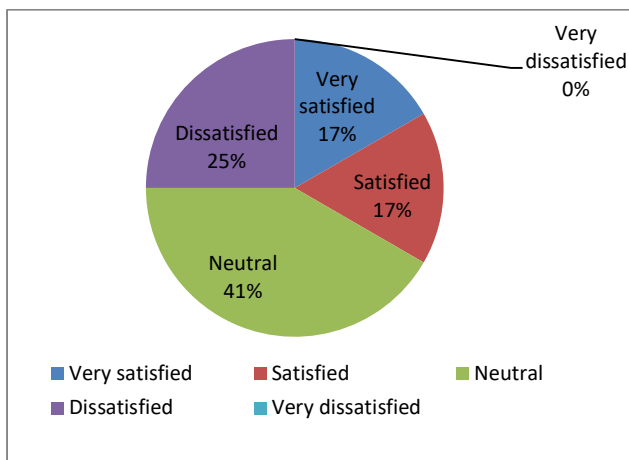
6. The mentoring available to you



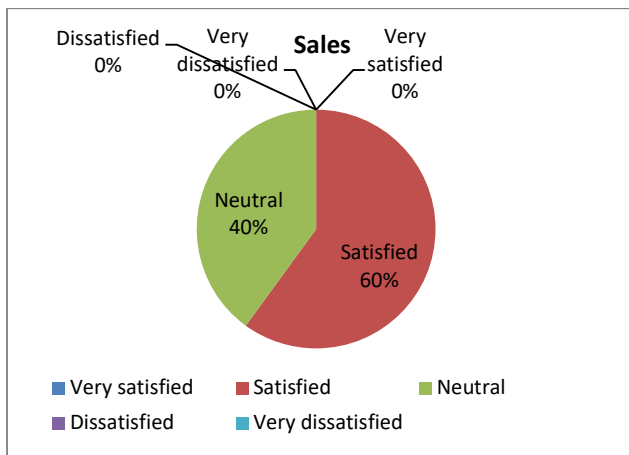
7. Administrative support from the department



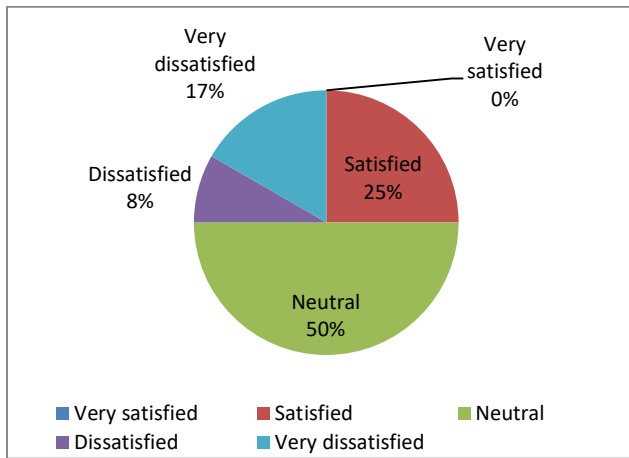
8. providing clarity about the faculty promotion process



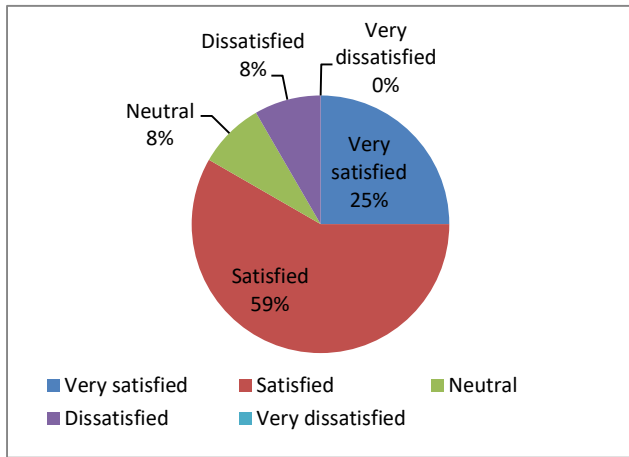
9. Your prospects for advancement and progress through ranks



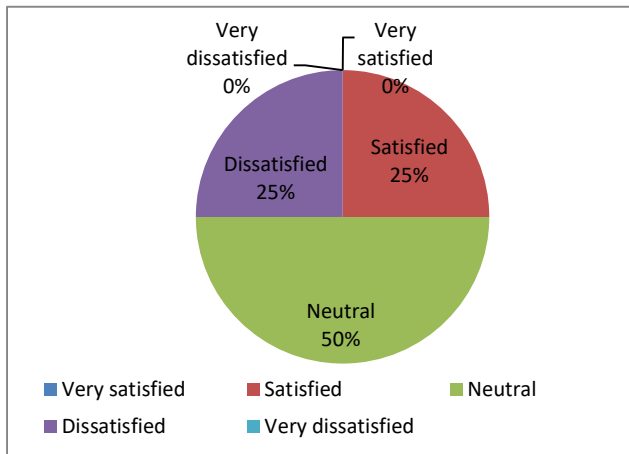
10. Salary and compensation package



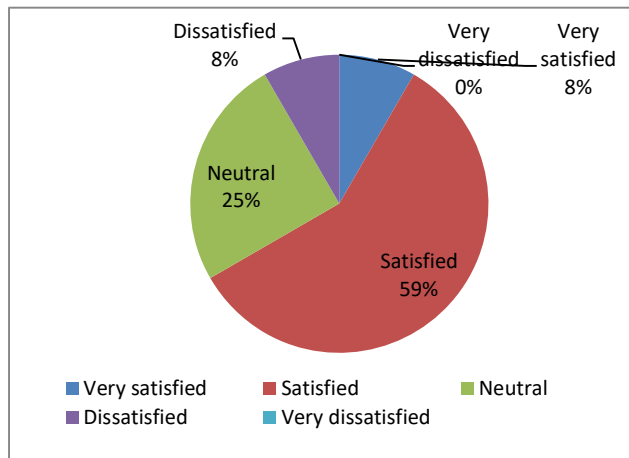
11. Job security and stability at the department



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

ME (Biomedical Engineering)

B. Definition of Credit Hour

Theory: 1 hour of classroom teaching in a week

Laboratory: 1 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 ME 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 ME 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

Graduates of this Master's course can plan, construct and optimize diagnostic equipment and telemedicine systems. They are also experts in medical instrumentation and imaging systems. These competences require understanding and mastery of state-of-the-art technologies such as image processing, simulation tools, and instrumentation. Graduates are prepared for top management positions in the fields of Quality Assurance, Management, Research, Development and all related areas requiring inter-disciplinary skills.

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

Educational goals

The Master Degree Course 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.

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

Program Outline (detail course content is given at Appendix –II)

Semester 1	(11+0 CH)
1. Advanced Telemedicine Systems	(2+0)
2. Medical Instrumentation	(2+0)
3. Statistics in Medicine	(2+0)
4. Digital Signal Processing for Measurement Systems	(3+0)
5. Ultrasonic Instrumentation and Imaging	(2+0)

Semester 2	(11+0 CH)
1. Medical Image Processing	(2+0)
2. Mechatronics in Medicine	(2+0)
3. Operations Management	(2+0)
4. Radiography and Computed Tomography	(3+0)
5. Laser and Spectroscopy	(2+0)

Semester 3	(5+1 CH)
1. Simulation of Dynamic Systems	(0+1)
2. Advanced Imaging Techniques	(2+0)
3. Research Methodology	(3+0)

Semester 4	
1. Thesis/Project	(0+6 CH)
<hr/>	
Total no. of credit hours	34

(0+6)

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

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 streamline 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 Master's 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 organized by the University. Candidates having secured less than 50 % marks in the Pre-admission Test shall not be eligible for consideration of their names for the purpose of admission in this University.

Eligibility

The eligible candidates should have:

Must have Bachelor'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 QCE 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 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 Master of Engineering (M.E.) 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 postgraduation 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
2	Engr. N. P. Chowdhry	Hyderabad, India	Conference	Oct. 2013
3	Engr. N. P. Chowdhry	Hyderabad, India	Conference	Sept. 2012
4	Engr. Rabia Chandio	Chitagong and Dhaka, B-desh	Student Exchange Program, HEC	June-July 2011
5	Engr. Salman Afridi	Zagreb, Croatia	Student Exchange Prog, Erasmusmundus	Sep 2010 – Aug 2011

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. The Department of BM Engineering as already worked out an uptodate-ness index as an indicator of the involvement of the faculty members in the activities of publications, project and thesis supervision or in receiving trainings. Table 6.3 shows parameters of the uptodateness index and the year-wise weightage given to each parameter.

Table 6.2: The Parameters along with their weightage to calculate the Uptodateness Index

	Period				
	2014-2013	2012-2011	2010-2009	2008-2007	2006-Older
Impact Factor Journal Publication	1	0.9	0.8	0.7	0.6
HEC Recognized Non-impact factor Research Journal	0.9	0.8	0.7	0.6	0.5
Books (Engg)	0.8	0.7	0.6	0.5	0.4
Proceedings / Book Chapter	0.7	0.6	0.5	0.4	0.3
PhD Thesis Supervision	0.7	0.6	0.5	0.4	0.3
ME Thesis Supervision	0.6	0.5	0.4	0.3	0.2
BE Thesis Supervision	0.5	0.4	0.3	0.2	0.1
Trainings /workshop attended	0.5	0.4	0.3	0.2	0.1
Magazine / Newspaper Articles/Book	0.4	0.3	0.2	0.1	0

The table 6.3 shows the uptodateness index of each faculty member calculated using the formula explained in table 6.2.

Table 6.3: The uptodateness index of the faculty members

S. N	Faculty Member	Impact Factor Journal Publictin	HEC Rec. Non-IF Journal	Engg Books	Proc. Book Chapter	PhD Thesis Sup	ME Thesis Sup	BE Thesis Sup	Traings w/shop attende d	Mgzine N.paper Articles /Book	Conf. Tech. Com.	Total
1	Dr. Ahsan A. Ursani	3.6	7.4	1.5	1.8	0	1.2	3.6	3.2	7.6	1.9	31.8
2	Engr. N. P. Chowdhry	0	0	1.0	7.5	0	1.5	8.9	4.6	0.6	0	24.1
3	Dr. Muhammad Arif	1.8	0.9	0	3.6	0	0	0.9	2.4	1.0	0	10.6
4	Dr. Najma Baloch	0	0	0	0	0	0	1.2	1.6	0	0	2.8
5	Engr. Faisal Ali	0	0	0	0	0	0	0.0	2.2	0	0	2.2
6	Engr. Rabia Chandio	0	0	0	0	0	0	1.4	2.0	0	0	3.4
7	Engr. Salman Afridi	0	0	0.6	0	0	0.6	2.7	2.7	0	0	7.2
8	Engr. M. A. Panhwar	0	0	0	0	0	0	2.0	1.3	0	0	3.3

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 12 students currently enrolled in new ME 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://muetdigitallibrary.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	2014-15	Rs. 346,747/-	Rs.343,921
2	2015-16	Rs. 450,350/-	Rs. 357,730
3	2016-17	Rs. 374,089/-	Rs. 353,340
4	2017-18	Rs. 345,340/-	Rs. 347,340
5	2018-19	Rs. 348,976/-	Rs. 356,976
6	2019-20	Rs. 351,906/-	Rs. 359,904

Subscription of Journals 2016

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)
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 <i>Lachnum</i> . <i>Carbohydrate Polymers</i> , 117 , 788-796. (SCI, IF 4.81)

S. No.	Publication
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. Wireless personal communications. 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. International Journal of Computer Networks & Communications (IJCNC) 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. Engineering Science and Technology International Research Journal (ESTIRJ), 3(4), pp.58-62.
17	Rajper, S., Ursani, A. and Moorat, S. (2019). Automatic Diagnosis of Diabetic Retinopathy Using Morphological Operations. International Journal of Sciences: Basic and Applied Research (IJSBAR), 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" Sindh Univ. Res. Jour. (Sci. Ser.) 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" Sindh Univ. Res. Jour. (Sci. Ser.) 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" , Mehran University Research Journal of Engineering & Technology , 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" , Mehran University Research Journal of Engineering & Technology , 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" Sindh Univ. Res. Jour. (Sci. Ser.) 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" Sindh Univ. Res. Jour. (Sci. Ser.) Vol.47 (2 JUNE) 247- 250 (2015)
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</i>

S. No.	Publication
	<i>Annual International Conference on CYBER Technology in Automation, Control, and Intelligent Systems (CYBER)</i> , pp. 276-281. IEEE, 2018.
27	Junaid Rajput ¹ , 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(ijacs)</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)
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 <i>International Symposium on Advances in Metallurgy & Materials</i> (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", <i>Journal of Ultrasound in Medicine and Biology</i> , Vol-43, Issue-08, pp. 1690-1702, August, 2017.

S. No.	Publication
39	S. Kalhoro, A. Baqai, and M. Arif , "Design of a Low Cost Health Status Indication Device using Skin Conductance Technique", <i>Sindh University Research Journal (Science Series)</i> , 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", <i>Mehran University Research Journal of Engineering & Technology</i> , 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", <i>IET Communications</i> , 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", <i>Sindh University Research Journal (Science Series)</i> , 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.
48	Sultan, Mueed, Muhammad Mujtaba Shaikh, and Narinder Parshad Chowdhry . "Comparative Analysis of Knee Joint Replacement and Stem Cells Therapy Treatment for Knee Osteoarthritis Using Statistical Techniques." <i>Research in Medical and Engineering Sciences</i> 8.4 (2020): 887-897

Appendix -II

Curriculum

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

Title of Subject:	Advanced Telemedicine Systems [BM600]		
Discipline:	ME (Biomedical Engineering)		
Semester:	1 st		
Effective:	15BM Batch and onwards		
Assessment:	Sessional Work: 10%	Mid-Semester: 30%	Final Exam: 60%
Marks:	Theory: 50	Practical: 0	
Credit Hours:	2	0	
Min. Contact Hours:	28	00	

Aims: The students will learn about development, deployment, evaluation and outcome of advanced information systems usage in health care along with RFID in healthcare including transmission of medical information over wireless communication networks and patient data security and privacy.

Contents

Fundamentals of Healthcare informatics¹

Information technology & healthcare, providing healthcare to the patients, Healthcare informatics development, Overview on telemedicine, information flooding in e-health

Technology of telemedicine systems²

Types of telemedicine information, tele-consultation system components, communication network & services, RFID in telemedicine

Wireless Technology in Patient Monitoring¹

Body area networks, emergency rescue, remote recovery, at the hospital, wearable patient monitoring applications, Planning & deployment considerations, scalability to support future growth, integration with existing IT infrastructure, evaluating IT service and solution provider, quality management, evaluation of e-health & telehealth services

Technology for safeguarding Medical Data and Privacy¹

Information security overview, cryptography, safeguarding patient medical history, anonymous data collection and processing, biometric security and identification

Recommended Books

1. Bernard Fong, A.C. M. Fong & C.K. Li "Telemedicine Technologies", 2011 John Wiley & Sons Ltd, ISBN: 978-0-470-74569-4
 2. A. C Norris, "Essential of Telemedicine and Telecare, 2002 John Wiley & Sons Ltd, ISBN:0-471-53151-0
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Approval:

Board of Studies

Advanced studies & Research board

Academic Council

Res. No. 6.2

Res. No.

Res. No.

Dated: 21-02-2014

Dated:

Dated:

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

Title of Subject:	Medical Instrumentation [BM610]		
Discipline:	ME (Biomedical Engineering)		
Semester:	First		
Effective:	15BM Batch and onwards		
Assessment:	Sessional Work: 10%	Mid-Semester: 30%	Final Exam: 60%
Marks:	Theory: 50	Practical: 0	
Credit Hours:	2	0	
Min. Contact Hours:	28	00	

Aims: This course aims to make the students familiar with the design and development of instrumentation for clinical measurement and biomedical research. The subject introduces the theory and practice of common sensor systems used in clinical medicine.

Contents

Basic concepts and principles of measurement¹

Principles of signal acquisition, Instrument types and performance characteristics, errors in the measurement, calibration, noise and signal processing, variable conversion elements, Display, recording and presentation of data, measurement reliability and safety systems

Sensor Technologies¹

Resistive, Capacitive, Inductive sensors, optical sensors, ultrasonic sensors, piezoelectric, piezoresistive, magnetic sensors, Hall-effect sensors, nuclear sensors, microsensors

Transducers^{1,2}

Displacement and Proximity, Temperature, Pressure, Flow, Level, Mass, Force and Torque, Translational and Rotational Motion,

Physiological Transducers^{2,3}

Origin of biopotentials, Biopotential electrodes, Physiological sensors and transducers

Biomedical Instrumentation System^{4,5}

Components of medical instrumentation systems, General design criteria & process of instruments, Commercial medical instrumentation development process, Electrical safety of equipment

Recommended Books

1. Measurement and Instrumentation Principles, 3rd Edition, 2001, Alan S Morris, ISBN 0-7506-5081-8
 2. Biomedical Instrumentation & Measures, Cromwell, ISBN: 9780130764485
 3. Bioinstrumentation, John G. Webster (Editor), 2007, ISBN: 9788126513697
 4. Medical Instrumentation: Application and Design, John G. Webster (Editor), 2009, ISBN: 9780471676003
 5. Introduction to Biomedical Equipment Technology, Joseph J. Carr, 2001, ISBN: 9788177588835
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Board of Studies

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Dated:

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INSTITUTE OF INFORMATION AND COMMUNICATION TECHNOLOGIES
DEPARTMENT OF BIOMEDICAL ENGINEERING

Title of Subject:	Statistics in Medicine [BM620]		
Discipline:	ME (Biomedical Engineering)		
Semester:	First		
Effective:	15BM Batch onwards		
Assessment:	Sessional Work: 10%	Mid-Semester: 30%	Final Exam: 60%
Marks:	Theory: 50	Practical: 0	
Credit Hours:	2	0	
Min. Contact Hours:	28	00	

Aims: This course is a reasonably thorough treatment of the theory of probability and statistics. The course aims to give concepts of statistics as applied in medicine.

Contents

Statistics and Estimation^{1,2,3}

Descriptive Statistics, Introduction to Probability, Confidence interval, Discrete Probability Distributions, Continuous Probability Distributions, Central limit theorem, Conditional Probability, Joint Probability, Bayes' theorem, Bayesian Inference, Relative Risk, Chi-Squared values, P-values, Relationship between Population and Sample, Estimation of the Mean of a Distribution, Estimation of the Variance of a Distribution, Maximum Likelihood

Medical Statistics^{4,5}

Contingency matrix, pre-test probability, post-test probability, sensitivity, specificity, Expected value decision making, Receiver Operating Characteristic curve, Life expectancy, treatment threshold probability, Quality adjusted life years, Disease incidence rate, disease prevalence rate, mortality and morbidity rates, Kappa Statistics

Regression and Correlation⁴

General Concepts, Fitting Regression Lines, the Correlation Coefficient, Statistical Inference for Correlation Coefficients, Multiple Regressions

Recommended Books

1. Fundamentals of Biostatistics, Bernard Rosner, 7th Edition, 2010, ISBN-13: 978-0538733496
 2. Biostatistics: A Foundation for Analysis in the Health Sciences, 10th Edition, Wayne W. Daniel, 2013, ISBN-13: 978-1118302798
 3. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole, 9th Edition, 2011, ISBN-13: 978-0321629111
 4. Medical Statistics, 4th Edition, David Machin, Michael J Campbell, Stephen J Walters, ISBN: 978-0-470-02519-2
 5. Medical Informatics, 2nd Edition, Edward H. Shortliffe, Leslie E. Perrault, 2001, ISBN: 0-387-98472-0
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Approval:

Board of Studies

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Dated: 21-02-2014

Board of FEEC Engineering

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Dated:

Academic Council

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Dated:

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

Title of Subject:	Digital Signal Processing for Measurement Systems [BM630]		
Discipline:	ME (Biomedical Engineering)		
Semester:	1 st		
Effective:	15BM-Batch and onwards		
Assessment:	Sessional Work: 10%	Mid-Semester: 30%	Final Exam: 60%
Marks:	Theory: 100	Practical: 0	
Credit Hours:	3	0	
Min. Contact Hours:	42	00	

Aims: The course aims to give students the fundamentals of digital signals. It will then investigate a number of advanced signal processing tools and the mathematical concepts they are based on. Finally, the performances of DSP based measurement systems are learned.

Contents

Review of Signals^{1,2,3}

Signals, some important signals, Continuous-time signals, Discrete-time signals, basic time operations, even signals, odd signals, signals in frequency domain, Fourier transform, Sampling of continuous-time signals, Sampling theorem, Quantization, encoding, A system, Linear Time-Invariant systems, unit pulse response, difference equation, Signal energy, Signal power, Convolution sum, Cross correlation, Auto-correlation

Transforms of the discrete domain³

The discrete Fourier transform, System frequency response, The Z transform, Pulse transfer function (PTF), Obtaining PTF from a difference equation

Digital filter design^{3,4}

Fundamental concepts of filters, filter approximations, Ideal filters, Concepts of FIR and IIR systems, Design of FIR filters using Window method, Methods of IIR filter Design, Spectral Estimation

Advanced Signal Processing^{3,4}

Basic Wiener filter theory, Adaptive Signal Processing, Least Squares Method, Recursive LSM, Multi-rate signal processing, DSP processors, Performance of DSP based measurement systems

Recommended Books

1. Signals and Linear Systems Analysis, Gordon E. Carlson, 2nd Edition, 1998, ISBN: 978-0471124658
2. Digital Signal Processing for Measurement Systems: Theory and Applications, Gabriele D'Antona, 2006, ISBN: 9780387249667
3. Digital Signal Processing: Principles, Algorithms, and Applications, John G. Proakis, 4th Edition, 2007, ISBN: 9788131710005
4. Digital Signal Processing: A Practical Approach, Emmanuel C. Ifeachor, 2nd Edition, 2002, ISBN: 9788131708248

Approval:

Board of Studies	Res. No. 6.2	Dated: 21-02-2014
Advanced Studies and Research Board	Res. No.	Dated:
Academic Council	Res. No.	Dated:

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

Title of Subject:	Ultrasonic Instrumentation and Imaging [BM640]		
Discipline:	ME (Biomedical Engineering)		
Semester:	1 st		
Effective:	15ME-BME and onwards		
Assessment:	Sessional Work: 10%	Mid-Semester: 30%	Final Exam: 60%
Marks:	Theory: 50	Practical: 0	
Credit Hours:	2	0	
Min. Contact Hours:	28	00	

Aims: This course provides the basic principles of ultrasound physics and technology, ultrasound imaging modes, transducer, imaging techniques, and ultrasound applications in medical imaging and instrumentation.

Contents

Physics of ultrasound¹

Fundamentals of Ultrasound, Echoes, Wave Equation, Impedance, Power and Reflection, Scattering, Attenuation, transducers, Single-element and array transducers

Ultrasound Fields¹

Continuous wave, Pulsed Pressure, Pulse Echo fields, Axial and Lateral Resolution, Focal Spot Size, Ultrasound nonlinearity

Principles of ultrasound imaging and instrumentation²

A-Mode, B-Mode, M-Mode, C-Mode, Doppler, Harmonic imaging, Elasticity imaging, Acoustic Microscope

Applications^{3,4}

Ultrasound tissue characterization, Micro-bubble contrast agents, Blood flow measurement, ultrasound in drug delivery, high intensity focused ultrasound (HIFU) for therapy.

Recommended Books

1. Diagnostic Ultrasound Imaging: Inside Out, Thomas L. Szabo, 2nd Edition, 2013, ISBN-9780123964878
 2. Biomedical Technology and Devices: Handbook, Ed: James Moore, George Zouridakis, 2004, ISBN: 0-8493-1140-3
 3. Biomedical Signal and Image Processing, Kayvan Najarian, Robert Splinter, 2nd Edition, 2012, ISBN: 978-1-4398-7033-4
 4. Richard S. C. Cobbold "Foundations of Biomedical Ultrasound", 2006, ISBN: 13978-0-19-516831-0
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MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO
INSTITUTE OF INFORMATION AND COMMUNICATION TECHNOLOGIES
DEPARTMENT OF BIOMEDICAL ENGINEERING

Title of Subject:	Medical Image Processing [BM650]		
Discipline:	Biomedical Engineering		
Semester:	Second		
Effective:	15BM Batch and onwards		
Assessment:	Sessional Work: 10%	Mid-Semester: 30%	Final Exam: 60%
Marks:	Theory: 50	Practical: 0	
Credit Hours:	2	0	
Min. Contact Hours:	28	00	

Aims: This course focuses on processing of medical images, including enhancement, denoising, visualization and analysis for feature extraction and classification.

Contents

Fundamental Concepts of Image Processing¹

Fundamentals of digital image processing, the gray-level histogram, histogram transformations and look-up tables

Image Enhancement in the Spatial Domain¹

Algebraic operations, Logical (Boolean) operations, Geometric operations, Convolution-based operations

Image Enhancement in the Frequency Domain²

The Fourier domain, The Fourier transform, Properties of the Fourier transform, Sampling, Cross-correlation and autocorrelation, Imaging systems – point spread function and optical transfer function, Frequency domain filters, Tomographic reconstruction

Image Restoration

Image degradation, noise, noise-reduction filters, de-blurring, modeling image degradation, Geometric degradations, morphological image processing, mathematical morphology, morphological operators, and extension to gray-scale images

Image Segmentation

Introduction, thresholding, region-based methods, boundary-based methods

Image Classification

Object recognition and classification, connected components labeling, Features, Object recognition and classification, statistical classification, structural/syntactic classification, applications in medical image analysis

Three-Dimensional Visualization

Image visualization, Surface rendering, Volume rendering, Virtual reality

Recommended Books

1. Digital Image Processing for Medical Applications, Geoff Dougherty, © Cambridge University Press, Cambridge University Press, ISBN: 978-0-521-86085
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INSTITUTE OF INFORMATION AND COMMUNICATION TECHNOLOGIES
DEPARTMENT OF BIOMEDICAL ENGINEERING

Title of Subject:	Mechatronics in Medicine [BM660]	
Discipline:	Biomedical Engineering	
Semester:	2 nd	
Effective:	15BM batch and onwards	
Assessment:	Sessional Work: 10% Mid-Semester: 30% Final Exam: 60%	
Marks:	Theory: 50	Practical: 0
Credit Hours:	2	0
Min Contact Hours:	28	00

Aims: This subject is aimed at giving concepts in Mechatronics as a multidisciplinary field, with applications in prosthetics and rehabilitation. The subject shall cover the biomedical implants also.

Contents

Mechatronic Systems^{1,2}

Machine elements, electronic elements, computing elements, Sensing elements, actuation elements, data acquisition

Biomechatronic Systems³

Introduction, Sensors for Biomechatronics, Actuators for Biomechatronics, Biomechatronic Systems, Hearing Aids, Heart Aids, Respiratory Aids, Prosthetic Limbs

Robotic Systems⁴

Types of robot, Robotic arm terminology, robotic arm configuration, basic robotic systems, Robot manipulators, Robotic manipulator kinematics, robotic arm positioning concepts, robotic arm path planning, actuators, Robot accessories, Robotic Sensors, End effectors, Robotic Grippers, Robot drives, Robot controllers

System Models⁵

Elements of mechanical systems, spring-mass damper system, an unconventional approach of modeling, arrangement of mechanical elements, Rack and Pinion arrangement, elements of an electrical system, unconventional solution to RLC circuit, application to DC servomotor, Hydraulic system modeling, modeling of actuators, modeling of control valves, thermal systems, modeling of thermal systems

Applications⁶

Medical applications of robot, surgical robots, nanorobots, Robotjet, robots for material handling, robots for disaster management, Grand Challenges for Robotics, Vision guided robotics

Recommended Books

1. Introduction to Mechatronics and Measurement Systems, David G. Alciatore, Michael B. Hstand, 4th Edition, 2011, ISBN: 9780073380230
 2. Introduction to Mechatronics Appuu Kuttan, 1st Edition, 2007, ISBN: 9780195687811
 3. Mechatronics: Principles and Applications, Godfrey Onwubolu, 2005, ISBN: 9780080492902
 4. Mechatronics, G. Hegde, 2010, 9781449668150
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Approval:

Board of Studies	Res. No. 6.2	Dated: 21-02-2014
Advanced Studies and Research Board	Res. No.	Dated:
Academic Council	Res. No.	Dated:

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

Title of Subject:	Operations Management [BM670]		
Discipline:	Biomedical Engineering		
Semester:	2 nd		
Effective:	15BM batch onwards		
Assessment:	Sessional Work: 10%	Mid-Semester: 30%	Final Exam: 60%
Marks:	Theory: 100	Practical: 0	
Credit Hours:	2	0	
Min. Contact Hours:	28	00	

Aims: This course introduces the management of operations, products, services, quality and projects.

Contents

Introduction to Operations Management

Introduction, Current issues in operations management, Introduction, Strategy, Strategic role of operations and operations, Managers, Strategy in context of manufacturing and service

Policy

Developing new products and Services, Innovation, Introduction to NPD, Importance of NPD, Process of NPD, Best practice in NPD, Operations Processes, Introduction, Factors affecting process design, Types of generic process, Physical layout, Trends in process design, Manufacturing, Managing Supply, Capacity, Throughput and Quality, Introduction, Understanding supply, Evolution from purchasing to supply, management, sourcing strategies

Practice

Introduction, understanding capacity, Determinants of demand, Strategies for matching supply and demand, Managing throughput, Improving material, Customer and information flows, Managing operations, Flows, Inventory, Improving operations flows, Project management, Designing the project process, Project planning, Work breakdown structure and stage-gate planning

Performance Improvement

Quality, Historical perspective on Quality, Quality management, Quality standards and certification, Service quality, Quality awards programs, Design quality, Total quality Management, Performance measurement, Continuous improvement, Radical performance improvement, World-Class Operations, Lean Production, Importance of human resources, Quality and innovation in WCO, Reconfiguration of firms, Mergers and alliances, Ethics In WCOs, Analyzing manufacturing operations, Quantitative, Methods, Statistical approaches, Forecasting techniques, Index numbers, Operational research techniques, analyzing service operations, Service delivery, Queuing and shift scheduling, Designing and analyzing service systems, Mathematical tools and techniques for analyzing services

Recommended Books

1. Operations Management: Policy, Practice and Performance Improvement, Steve Brown, Kate Blackmon, Paul Cousins, Harvey Maylor, 2001, ISBN: 978-0750649957, ISBN: 0 7506 4995 X
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Board of Studies

Res. No. 6.2

Dated: 21-02-2014

Advanced Studies and Research Board

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

Title of Subject:	Radiography and Computed Tomography [BM680]		
Discipline:	ME (Biomedical Engineering)		
Semester:	2 nd		
Effective:	15BM batch onwards		
Assessment:	Sessional Work: 10%	Mid-Semester: 30%	Final Exam: 60%
Marks:	Theory: 100	Practical: 0	
Credit Hours:	3	0	
Min. Contact Hours:	42	00	

Aims: This subject is aimed at giving basic and advanced concepts of X-ray imaging. The subject shall cover medical applications of X-ray imaging. The subject shall also span the techniques of image reconstruction methods in Computed Tomography and image processing for image enhancement.

Contents

X-ray Radiography^{1,2}

Physics of X-ray and Gamma rays, Properties of X-rays and Gamma rays, X-ray Generation, Bremsstrahlung, Hard X-rays, Soft X-rays, Interaction of X-rays and Gamma rays with matter, characteristic radiation, Imaging with X-rays, Attenuation Based X-ray Imaging, X-ray Detection, Image formation physics, Modeling film characteristics, Florescence, CCD sensors, Scintillation counter, Radiation Dose, Biological effects of X-rays, KERMA, X-ray Image Quality, the imaging geometry, scattering effects

Computed Tomography^{1,2}

Attenuation tomography, Time of flight tomography, Reflection tomography, Diffraction tomography, CT scanners, Scanning configurations, Spiral reconstruction, formulation of attenuation CT, CT image artifacts, Fourier Slice theorem

Radiography for Medical Applications

Volumetric measurement of tumors, bone fracture detection, Coronary obstruction visualization, mammography, pneumonia

Image Visualization, Reconstruction and Enhancement¹

Image as 2D spatial function, Image resolution, Image Histogram, image contrast, histogram normalization, histogram equalization, Color spaces, spherical transform, enhancing a color image, image segmentation, spatial domain filtering, 2D DFT, frequency domain filtering

Recommended Books

1. Biomedical Signal and Image Processing, Kayvan Najarian, Robert Splinter, 2nd Ed., 2012, ISBN: 978-1-4398-7033-4
 2. Introductory Medical Imaging, A. A. Bharath, 2009, ISBN: 9781598296112
 3. Biomedical Imaging, Karen M. Murdy, Robert Plonsey, Joseph D Bronzino, 2003, ISBN:0-8493-1810-6
 4. Non-Destructive Test and Evaluation of Materials, Jaymangal Prasad, C. G. Krishnadas Nair, 2008, 978-0-07-062084-1
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Approval:

Board of Studies

Res. No. 6.2

Dated: 21-02-2014

Advanced Studies and Research Board

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

Title of Subject:	Laser and Spectroscopy [BM690]		
Discipline:	ME (Biomedical Engineering)		
Semester:	2 nd		
Effective:	15BM batch onwards		
Assessment:	Sessional Work: 10%	Mid-Semester: 30%	Final Exam: 60%
Marks:	Theory: 50	Practical: 0	
Credit Hours:	2	0	
Min. Contact Hours:	28	00	

Aims: This subject is aimed at giving fundamental concepts of photonics, lasers and spectroscopy. The subject shall also cover medical applications of lasers and spectroscopy.

Contents

Fundamentals of Photonics and Lasers¹

Photon Detectors, Noise in Photon Detectors, Photodiode Detectors, Lasers and Coherent Light, Optical Resonators, Gaussian Beam Optics, Stimulated Emission and Optical Gain, Optical Amplifiers, Laser Oscillation, CW Laser Characteristics, Pulsed Lasers, Optically Pumped Lasers, Electrically Pumped Lasers

Spectroscopy^{2,3}

Fundamental principles of spectroscopy, prism spectrometer, grating spectrometer, interferometers, wavelength measurements, lasers as spectroscopic light sources, Ultraviolet spectroscopy, Infrared spectroscopy, Raman spectroscopy, Flame photometry, Emission spectroscopy, Fluorometry and phosphorimetry, photoacoustic spectroscopy, mass spectroscopy

Applications of Laser and Spectroscopy^{4,5}

Laser instrumentation and measurement, principles used in measurement, Distance measurement, Laser spectroscopy for medical diagnosis

Recommended Books

1. Photonics and Lasers: An Introduction, Richard S. Quimby, 2006, ISBN: 978-0-471-71974-8
 2. Spectroscopy, 12th Edition, 2007, B. K. Sharma, ISBN: 81-8283-018-4
 3. Laser Spectroscopy: Basic Concepts and Instrumentation, 4th Edition, Wolfgang Demtroder, ISBN: 3-540-65225-6
 4. Pavia Lampman, Kriz, Vyvyan, Introduction to Spectroscopy, 4th Edition, ISBN: 978-0-495-11478-9
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Approval:

Board of Studies

Res. No. 6.2

Dated: 21-02-2014

Advanced Studies and Research Board

Res. No.

Dated:

Academic Council

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

Title of Subject:	Simulation of Dynamic Systems [BM700]		
Discipline:	ME (Biomedical Engineering)		
Semester:	3 rd		
Effective:	15BM batch and onwards		
Assessment:	Sessional Work: 40%	Final Exam: 60%	
Marks:	Theory: 00	Practical: 100	
Credit Hours:	0	1	
Minimum Contact Hours:	00	42	

Aims: This subject is aimed at giving concepts and hands on experience of simulation of physiological and biomechanical systems for optimizing processes and products.

Course Objectives:

- Mathematical description of physical systems.
- Techniques of modeling and analysis of dynamic systems.
- Identification and parameterization of models from experimental data.
- Knowledge of simulation tools of dynamic systems and their use.

Contents

Introduction, history, models as approximations of real-world events Characteristics and descriptors of models and simulation

categories of Models and simulation

Life-time of simulation, many facets of simulation, experimentation and experience aspect of simulation

Discrete event simulation^{1,2}

Queing system model components, simulation methodology, DES examples, Hand simulation, Arena simulation, sequential simulation, Simpack queuing implementation, parallel simulation

Modeling continuous systems^{1,2}

System class, M&S strategy, Modeling approach, Model examples, Simulation implementation

Monte Carlo simulation^{1,2}

Sensitivity analysis, applications of Monte Carlo simulation

System Modeling^{1,2}

Types of system models, Examples of modeling in biomechanics and physiology Operations Research methods

Recommended Books

1. Modeling and Simulation Fundamentals: Theoretical Underpinnings and Practical Domains, John A. Sokolowski, 2010, ISBN: 978-0-470-48674-0
 2. Principles of Modeling and Simulation: A Multidisciplinary Approach, John A. Sokolowski, 2011, ISBN: 9781118210949
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Approval:

Board of Studies

Res. No. 6.2

Dated: 21-02-2014

Advanced Studies and Research Board

Res. No.

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Academic Council

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

Title of Subject:	Advanced Imaging Techniques [BM710]		
Discipline:	ME (Biomedical Engineering)		
Semester:	3 rd		
Effective:	15ME-BME and onwards		
Assessment:	Sessional Work: 10%	Mid-Semester: 30%	Final Exam: 60%
Marks:	Theory: 50	Practical: 0	
Credit Hours:	2	0	
Min. Contact Hours:	28	00	

Aims: This subject is aimed at giving advanced concepts of imaging. The subject shall cover medical applications of imaging using Thermal, PET, and MR imaging modalities. The subject shall also span Functional MR Imaging.

Contents

Infrared Thermal Imaging¹

Introduction and fundamentals, Properties of IR imaging systems, Advanced methods in IR imaging, Basic concepts of heat transfer, Applications, Direct visualization of physical phenomena, IR imaging of buildings and infrastructure, Detection of gases, Microsystems, Thermal reflections, electrical applications, IR imaging in medicine, Pathophysiological-based Understanding of IR Imaging, IR imaging for breast cancer detection, New generation IR technologies

Positron Emission Tomography^{2,3}

Introduction, Physical and physiological principles of PET, PET signal acquisition, PET image formation, Significance of PET, Applications of PET, Comparison of CT, MRI and PET, Single Photon Emission Computed Tomography

Magnetic Resonance Imaging^{3,4}

Introduction, Nuclear magnetism, Resonance, Physical and physiological principles of MRI, Mathematical formulation, Functional MRI, Bold MRI, Applications, Comparison of MRI with other imaging modalities, Registration of MR images

Recommended Books

1. Infrared Thermal Imaging: Fundamentals, Research, and Applications, M. Vollmer, K. P. Mollman, 2010, ISBN: 978-3-527-40717-0
 2. Basics of PET Imaging, Gopal B Saha, 2nd Edition, 2010, ISBN: 978-1-4419-0804-9
 3. Biomedical Signal and Image Processing, Kayvan Najarian, Robert Splinter, 2nd Edition, 2012, ISBN: 978-1-4398-7033-4
 4. Biomedical Imaging, Karen M. Murdy, Robert Plonsey, Joseph D Bronzino, 2003, ISBN:0-8493-1810-6
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Approval:

Board of Studies	Res. No. 6.2	Dated: 18-11-2013
Advanced Studies and Research Board	Res. No.	Dated:
Academic Council	Res. No.	Dated:

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

Title of Subject:	Research Methodology [BM720]		
Discipline:	ME (Biomedical Engineering)		
Semester:	3 rd		
Effective:	15ME-BME and onwards		
Assessment:	Sessional Work: 10%	Mid-Semester: 30%	Final Exam: 60%
Marks:	Theory: 100		Practical: 0
Credit Hours:	3	0	
Min. Contact Hours:	42	00	

Aims: This course provides basic concepts of research and its methodologies. Students will learn how to identify appropriate research topics, select and define a research problem and parameters, collect and analyze data, write a project report, a thesis and a research proposal.

Objectives: At the end of this course, the students should be able to:

- understand some basic concepts of research and its methodologies
- identify appropriate research topics
- select and define appropriate research problem and parameters
- prepare a project proposal (to undertake a project)
- organize and conduct research (advanced project) in a more appropriate manner
- write a research report and thesis
- write a research proposal (grants)
- use software tools for data analysis
- manage literature review and bibliography using software tools

Contents

Introduction

Research and its characteristics, types of research, research process

Research problem

Study population, subject area, considerations in selecting a research problem, defining and formulating a research problem, methodology, preparing the research design, conducting the research, examples of research at the university

Literature review

Knowledge base, findings, contextualizing the findings, clarity and focus of research problem, finding and managing references

Formulation of objectives

Characteristics of objectives, concepts, indicators and variables, identifying variables, types of measurement scales, constructing hypotheses, functions of hypotheses

Collecting data

Ethical issues in data collection, collecting information, seeking consent, providing incentives, seeking sensitive information, possible harm to the participants, maintaining confidentiality

Processing and analyzing data

Editing data, classifying data, tabulating data, metadata, qualitative data analysis, quantitative data analysis, analysis of variance, hypothesis testing, Kruskal-Wallis test, manual data analysis, computer tools for data analysis

Report writing

Writing a research proposal, writing a project report, writing a thesis, writing a research paper, referencing, software for referencing

Recommended Books

1. Research Methodology, P. Sam Daniel, 2011, ISBN: 978-81-7835-900-7
 2. Practical Research Methods, Catherine Dawson, 2002, New Delhi, UBS Publishers' Distributors
 3. Research Methodology - Methods and Techniques, C. R. Kothari, 1985, New Delhi, Wiley Eastern Limited, ISBN:
 4. Research Methodology-A Step-by-Step Guide for beginners, 2nd Ed., Ranjit Kumar, 2005, Singapore, Pearson Education, ISBN:
 5. Fundamentals of Research Methodology and Statistics, Yogesh Kumar Singh, 2006, ISBN : 978-81-224-2418-8
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Approval:

Board of Studies

Res. No. 6.2

Dated: 21-02-2014

Board of FEEC Engineering

Res. No.

Dated:

Academic Council

Res. No.

Dated:

Appendix -III
Supporting Documents



Employer Feedback

We are very grateful to you for sparing some of your valuable time to complete this Feedback. Your feedback will help us to further improve our academic standards.

- Name of Employer: LUMHS
- Name of Organization: IBET
- Designation of Employer: Director IBET
- Contact Number: 022921339
- Email ID: ave.lums@shpt
- Number of MUET graduates working at your organization.

	BE	ME	PHD
Male	3	2	
Female		4	

- Number of graduates working on following the levels of responsibility:

- Entry Level 4
- Middle Level 5
- Senior Level _____

- Number of Graduates working as

- Technical Person / Maintenance Engineer _____
- Sales Manager / Promotion Manager _____
- Academic / Researcher _____
- Other (please specify) _____

- How satisfied are you with their / our graduates' overall performance?
(1: Least satisfied, 5: Highly satisfied)

5	4	3	2	1
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- Any other comments:

Dated: 11-03-21


Signature of **DIRECTOR**
Institute of Bio Medical Engineering
& Technology LUMHS, Jamshoro.